Meta-Heuristic Approach to Supply Chain Optimization in an Integrated Hierarchical Production Planning System

A thesis submitted to the Department of Industrial and Production Engineering in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

by
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March, 2009

This thesis titled "Meta-Heuristic Approach to Supply Chain Optimization in an Integrated Hierarchical Production Planning System", submitted by Sultana Parveen, Roll No.: P04030801F, Session: April 2003, to the Department of Industrial and Production Engineering, Bangladesh University of Engineering and Technology, Dhaka 1000, Bangladesh, has been accepted as satisfactory in partial fulfillment of the requirements for the degree of Doctor of Philosophy on 07 March 2009.

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List of Abbreviations

AHP	Analytic Hierarchy Process
CLSP	Capacitated Lot-Sizing Problem
COP	Combinatorial Procedure
DLSP	Dynamic Lot-Sizing Problem
DRP	Distribution Requirement Planning
EDD	Earliest Due Date
EOQ	Economic Order Quantity
FGSP	Flexible Job-Shop Scheduling Problem
GA	Genetic Algorithm
GPPB	Generalized Part Period Balancing
GSA	Genetic Algorithm With Search Area
LTC	Least Total Cost
LUC	Least Unit Cost
MCDM	Multi Criteria Decision Making
MOEA	Multi Objective Evolutionary Algorithm
MOGA	Multi Objective Genetic Algorithm
MOP	Multi Objective Problem
MPCS	Material Planning and Control System
MPS	Master Production Scheduling
MRP	Material Requirements Planning
NPGA	Niched Pareto Genetic Algorithm
NPGA	Nondeterministic Polynomial
NSGA	Non Dominated Sorting Genetic Algorithm
POQ	Period Order Quantity
PPB	Part Period Balancing
ROR	Re-Order Point
SPT	Shortest Processing Time

Acknowledgments

First of all, the author would like to express her profound gratitude to Almighty Allah, the most gracious and the most merciful, for giving her adequate physical and mental strength for doing this research work.

The author is pleased to express her heart-felt and most sincere gratitude to Dr. M. Ahsan Akhtar Hasin, Professor, Department of Industrial and Production Engineering, for supervising the research work and subsequently for reading numerous inferior drafts and improving them, for his constructive criticism, valuable advice and continual encouragement.

The author would like to acknowledge gratefulness to the members of doctoral committee, Professor Dr. M. A. Rashid Sarkar, Professor Dr. Md. Kamal Uddin, Dr. A. S. M. Latiful Hoque, Dr. Nafis Ahmad and Dr. Md. Abdul Gafur for their rigorous monitoring the research progress and valuable suggestions. The author would like to express her utmost gratitude to the external member of the board of examiners, Dr. Mokbul Ahmed Khan for his valuable suggestions.

The author gratefully acknowledges to the authorities of the furniture company for providing data. The author is very much thankful to the authority of BUET for allowing study leave to complete her research work.

Special thanks go to Professor Dr. Md. Abul Kashem Mia, Department of Computer Science and Engineering, BUET and the beloved husband of the author, who has shared in much of her postgraduate life and provided continual emotional support and understanding.

Finally, the author acknowledges with sincere thanks the all out co-operation and services rendered by the faculty members and staffs of the department she belongs.

Abstract

The total supply chain of any enterprise is composed of three main sections: backward linkage, forward linkage and inside value-chain. The backward linkage is a function of inward supply management, with its inherent uncertainty. The internal value chain is basically a hybrid function of several materials management functions. The two most important of these functions are complex issues of uncertain inventory control and NP-hard type production scheduling problem. The forward side is composed of multi-variable interactive system, where variables interact with each other to control market demand. An internal material planning is one of the most complex tasks in an industry. Presence of a large number of variables, operating in uncertain environment, is the main reason behind such complexity. As a result, optimization in a materials planning system requires a great deal of simplification. A material planning is thus suggested in several levels, starting from long-range aggregate planning, going through disaggregated Master Production Scheduling, individual component planning and finally ending to shop floor scheduling. Each individual level has its own form of complexity. The first level of complexity starts in converting an aggregate production planning system into disaggregated master production scheduling. The master production scheduling is essentially the output of aggregate planning where master production scheduling process drives the material requirements planning (MRP) system. The determination of net requirements is the core of MRP processing. Lot-sizing is a major aspect of the MRP process. A lot-sizing problem involves decisions to determine the quantity and timing of production for N different items over a horizon of T periods. In the present work, it has been assumed that only one machine of each type is available with a fixed capacity in each period. The objective is to minimize the sum of set-up and inventory carrying costs for all items without incurring backlogs. In case of a single item production only an optimal solution algorithm exists. But for medium-size and multi-item problems, optimal solution algorithms are not available. It has been proved that even the two-item problem with constant capacity is NP-hard (Nondeterministic polynomial-hard). This has increased the importance of searching for good heuristic solutions. In the present research

work, heuristic methods have been developed and implemented to solve the multi-item, single level, limited capacity lot-sizing problem, bypassing parameters to the next step of planning.

Production scheduling is the most complex step in the hierarchical production planning system. That is why the production scheduling problems have received ample attention from both researchers and practitioners, because an efficient production schedule can achieve reduction of production cost and inventory cost, increase in profit and increase in 'on-time' delivery to customers. A Pareto-optimal algorithm is developed in this research work for a scheduling problem on a single machine with periodic maintenance and non-preemptive jobs. In literature, most of the scheduling problems address only one objective function; while in the real world, such problems are always associated with more than one objective. In this work, both multi-objective functions and multi-maintenance periods are considered for a single machine scheduling problem. On the other hand, periodic maintenance schedules are also considered in the model. The objective of the model addressed in this work is to minimize the weighted function of the total job flow time, the maximum tardiness, and the machine idle time in a single machine environment. The parametric analysis of the trade-offs of all solutions with all possible weighted combination of the criteria has been carried out. A neighborhood search heuristic has been developed also. The computational results have shown that the modified Pareto-optimal algorithm provides a better solution than the neighborhood search heuristic and this shows the efficiency of the modified Pareto-optimal algorithm.

For forward side optimization, distribution system parameters have been identified that affect subsequent marketing. The parameter of distribution for optimization has been selected with Multi Criteria Decision Making (MCDM) technique. Finally a distribution plan has been optimized using optimization-based "Transportation algorithm".

Chapter 1
Introduction

1.1 Background

The supply chain management is an integrated and coordinated process of planning, implementing and controlling efficient and cost effective flow and storage of goods, services and related information from the point of origin to the point of consumption with the ultimate objective of conforming to customer requirements. It begins with raw materials acquisition, continues through internal value-chain operations and ends with distribution of finished goods.

The total supply chain is composed of three main stages: the backward linkage, internal value-chain and the forward linkage. The backward linkage is a function of supply management, centered on multiplicity of basically operations research-based 'Transportation problem'. The internal materials management is a typical example of NP-hard (NP stands for Non-deterministic Polynomial, i.e. the problem cannot be solved optimally in polynomial time) type inventory control and production scheduling problem. The forward linkage is composed of multi-variable interactive system, where variables interact with each other to control market demand. In fact, the forward side again becomes an input to backward linkage, because the market demand again helps in creating aggregate demand. As such, it forms a loop of integrated "Production Planning System". However, this loop, as a 'system' has never been studied, although discrete studies on single elements have been reported.

Materials planning is one of the most complex tasks in an industry. Presence of a large number of variables, operating in uncertain environment, is the main reason behind such complexity. As a result, optimization in a materials planning system requires a great deal of simplification. Materials planning is thus suggested in several levels, starting from long-range aggregate planning, going through disaggregated Master Production Scheduling, individual component planning and finally ending to shop floor scheduling. Each individual level has its own form of complexity. A large majority of these complex planning issues fall in the category of either sub-optimization or in totally infeasible solution space. Thus, optimization in a hierarchical materials planning is of high level of attention to the researchers, although results obtained so far is not considerable [1, 2]. The noted complexities in four individual levels of hierarchical planning system are explained below.

The first level of complexity starts in converting an aggregate production planning system into disaggregated master production scheduling. Linearity of cost functions, non-linearity of demand functions and other operating variables create this complexity. When resource (manpower, machine hours and inventory) availability and constraints are added to this, complexity increases several folds [3, 4]. As a result, the problem becomes a complex one, having conflicting constraints and thus, difficult to achieve objective. The master production scheduling is essentially the output of aggregate planning where master production scheduling process drives the material requirements planning (MRP) system. The determination of net requirements is the core of MRP processing. Lot-sizing is a significant aspect of the MRP process. Lot-sizes generally meet products requirements for one or more periods. Optimizing routines for lot-sizing problem have been shown to be all demanding from a computing stand point in both practical as well as research environment. The multi-item capacitated lot-sizing problem is found to be NP-hard [4]. The problem is even harder from practical point of view, since optimal solution methods have failed to solve all but very few problem. It has been found that most methods require extensive computational power. Thus their applicability is rather limited. So a heuristic method has been developed to solve the lot-sizing problem, bypassing parameters to the next step of planning.

For the multi-item capacitated lot-sizing problems, the various heuristics, which have been proposed over the years, are classified into a number of classes. Heuristics belonging to the period-by-period heuristic work from period 1 to period H. Consider a period t in the process. One certainly has to produce $\max\{0, d_{it}, I_{i,t-1}\}$ for all products i in order to avoid stock outs in the current period, where d_{it} is the demand for item i in period t and I_{it} is the inventory of item i at the end of period t. Infeasibility occurs when the net demand in some period t, i.e. $\sum_{i=1}^{N}\max\{0, d_{it}-I_{i,t-1}\}$ may exceed available capacity. The lot-sizing problem now can be stated as

$$Minimize\ Z(X)=\sum_{i=1}^{N'}\sum_{j=1}^{H}(S_i\delta(x_{ij})+h_iI_{ij})$$

$$subject\ to\ I_{ij}=I_{i,j-1}+x_{ij}-D_{ij} \qquad i=1,2,\ldots,N' \text{ and } j=1,2,\ldots,H$$

$$I_{i0}=I_{iH}=0 \qquad i=1,2,\ldots,N'$$

$$\sum_{i=1}^{N'}k_ix_{ij}\le C_j \qquad j=1,\ldots,H$$

$$0\le x_{ij}\le x_{\max i} \qquad i=1,2,\ldots,N' \text{ and } j=1,2,\ldots,H$$

$$I_{ij}\ge 0 \qquad i=1,2,\ldots,N' \text{ and } j=1,2,\ldots,H$$

where N' = number of total items after meeting the maximum lot-size limitation

$= N+\sum_{i=1}^{N}n_i, \quad n_i=\left\lceil\frac{d_{\max i}}{x_{\max i}}\right\rceil-1$, where

$d_{\max i}$ = maximum periodic demand for the ith item.

$x_{\max i}$ = the limited lot-size for item i which cannot be exceeded in any period.

N = The number of original item

Production scheduling is another complex step of hierarchical production planning system, which even in the simplest possible form, may become a difficult task with the possibility of multi-variables, containing constraints and sometimes, conflicting objectives [5]. Its integration can be ensured if a suitably selected planning variable can be passed from upper disaggregation model to this level. Its solvability in real-time is of prime importance, which ultimately leads to undesirable NP-hardness. Scheduling is a subject in which problems look easy, if not trivial. They are, on the contrary, among the hardest in mathematics [6, 7]. According to Baker, "Scheduling is the allocation of resources over time to perform a collection of tasks". A production scheduling specifies the order of assigning of each job to the respective resource (i.e. machine) and also specifies the start and end time of each job in a manufacturing system. Scheduling is a decision-making task and the objective is to find an appropriate schedule in terms of certain performance criteria (for example, minimizing makespan or minimizing flow-time, minimizing tardiness, etc.) [6]. Production scheduling problem has received ample attention from both researchers and practitioners, because an efficient production schedule contributes to reduction of production cost and inventory cost, increase in profit and increase in 'on-time' delivery to customers. The theory of scheduling includes a variety of techniques that are useful in solving scheduling problems. Indeed, the scheduling field has become a focal point for the development, application and evaluation of combinatorial procedures (COP), simulation techniques, network methods and heuristic solution approaches. The selection of an appropriate technique depends on the complexity of the problem, nature of the model and the choice of the criterion, as well as other factors [8]. However, a local search optimization technique or a heuristic can be used, in order to trade-off between time to solve a problem and accuracy of results. This research shows that Pareto optimal solution method provides better solution than even a neighborhood search technique, a local search technique. This research aims at applying Pareto optimal technique [9] to select the right schedule. Most studies on production scheduling aim to minimize makespan, that is, the total completion time of all jobs. The objective of this research, in case of scheduling, is to find trade-offs among total completion time $\sum C_i$, maximum lateness L_{max}, and total machine idle time I, where $I = \sum_{i=1}^{k} I_{b_i}$, $L_{max} = \max_j\{T_j\}$ and $T_j = \max\{0, L_j\}$ for jobs j, $j = 1, 2, \ldots, n$, and batch i.

It must be acknowledged that optimization at an individual level may end up in a highly sub-optimized and even a non-optimized solution. While heuristics have been suggested by many to solve an independent planning level, solution to an integrated flow of hierarchical materials planning has never been reported so far [10, 11]. This necessitates an integrated solution at several levels of production planning with appropriate heuristics, where production planning is a part of total product planning loop.

A limitation of current research on applying optimization technique is the selection of unjustified objective function. Traditionally, it is assumed that a parameter needs to be optimized through right operations management technique [12-14]. However, there is no basis as to why a particular parameter is selected as the objective function. This research provides an idea that AHP can be used to justify selection of the right parameter as the objective function of an optimization technique. The following Figure 1.1 shows the summary of the research:

Thus, this research aims at optimizing materials planning system in the total supply chain which integrates different levels of planning system.

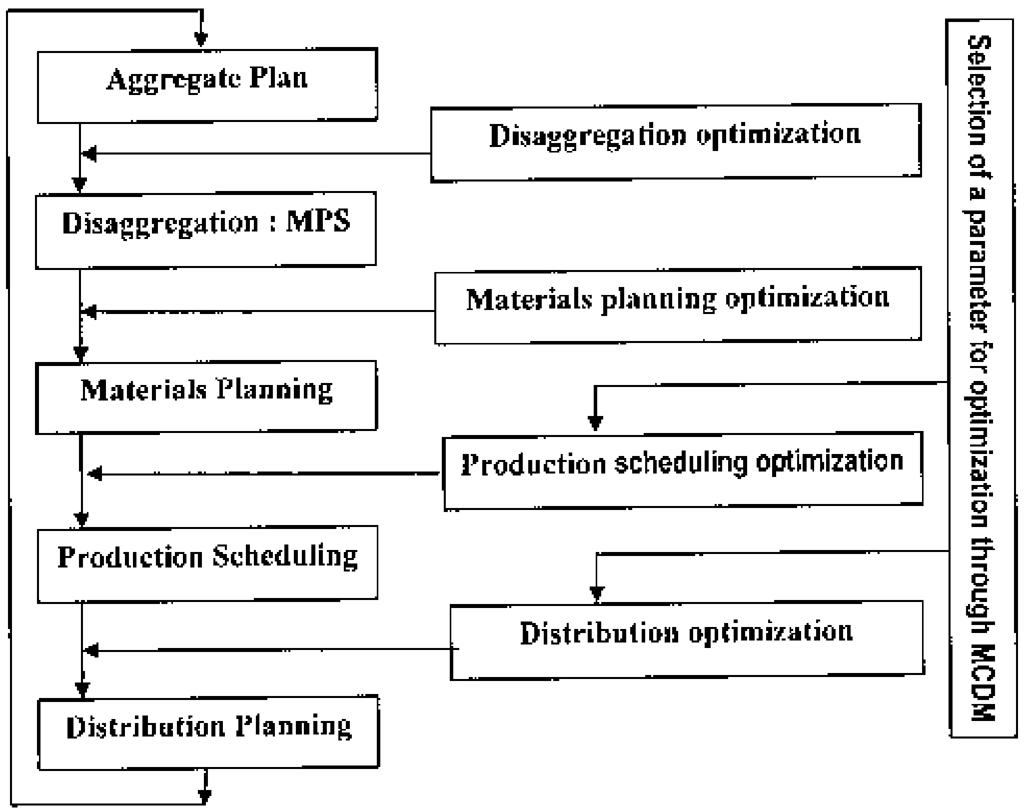

Figure 1.1 Hierarchical Production Planning and Distribution System

1.2 Objectives of the Research Work

The objectives of the research work have been defined as follows:

1. To configure aggregation-disaggregation of material planning system.
2. To develop mathematical models and heuristics for the optimization of aggregate planning, master production scheduling, material requirement planning through lot-sizing technique.
3. To implement, simulate and run the heuristics to minimize the total cost.

4. To identify the production scheduling parameters that affect subsequent planning steps.
5. To select the balancing parameter i.e. total completion time, maximum lateness, machine idle time with MCDM (multi criteria decision making) technique.
6. To develop a Pareto optimal algorithm for minimizing total completion time, maximum lateness, and machine idle time of a production scheduling system.
7. To implement, simulate and run the Pareto optimal algorithm.
8. To identify distribution system parameters that affect subsequent marketing.
9. To select the parameter of distribution for optimization with MCDM technique.
10. To design and optimize downstream distribution plan, with selected variables.

1.3 Organization of the Thesis

This thesis is organized as follows. The second chapter deals basically with aggregate planning and master production scheduling which have been optimized through lot sizing optimization. This chapter also includes various lot sizing techniques, background of lot sizing problem, heuristic methods of solution of present real life lot sizing problem and computational results and conclusion. The third chapter deals with production scheduling optimization. This chapter presents a description of the multi-criterion scheduling concept, literature survey of production scheduling problem, a modified Pareto-optimal algorithm to solve multi-criterion scheduling problem, an algorithm for neighborhood search technique, problem settings for a single machine scheduling problems, computational results of the modified algorithm and the neighborhood search heuristic and finally the conclusion on the multi-criterion perspective of this problem under consideration. The fourth chapter concentrates on distribution planning optimization. This chapter includes introduction of distribution planning, its background, application of transportation-based optimization technique, analysis of computational results and conclusion. The fifth chapter consists of conclusions and recommendations for future.

Chapter 2
Aggregate Planning

2.1 Introduction

Aggregate planning is one of the several important functions in a manufacturing organization of today and this would remain so in future. It is the age of manufacturing. The manufacturing industries are now facing a time of intense international competition, which will only become more severe in the days to come. Aggregate planning is also known by such names as production planning, operation planning. It is an activity that considers the best use of production resources in order to satisfy production goals over a certain period named the planning horizon. Production planning typically encompasses three time ranges for decision making: long-term, medium-term and short-term. The long-term planning usually focuses is on anticipating aggregate needs and involves such strategic decisions as product, equipment and process choices, facility location and design, and resource planning. Medium-term planning deals with making decisions on material requirements planning (MRP) and establishing production quantities or lot sizing over the planning period, so as to optimize some performance criteria such as minimizing overall costs, while meeting demand requirements and satisfying existing capacity restrictions. The short-term planning, on the other hand, focuses on day-to-day decision making on scheduling of operations such as job sequencing, controlling etc in a workshop. The research work focuses mainly on medium-term production planning and especially on single-level lot sizing decisions. In the spectrum of production planning, aggregate planning is intermediate-range capacity planning that typically covers a time horizon of 2 to 12 months, although in some companies it may extend to as much as 18 months. It is particularly useful for organizations that experience seasonal or other fluctuations in demand or capacity. Aggregate planning begins with a forecast of aggregate demand for the intermediate range. This is followed by general plan to meet the demand by setting output, employment, and finished-goods inventory levels or service capacities. Managers might consider a number of plans, each of which must be examined in the light of feasibility and cost. If a plan is reasonably good but has more weakness, it may be revised and improved. Conversely, a poor plan should be discarded and alternative plans be sought considered until an acceptable one is found out. The production plan is essentially the output of aggregate planning.

Aggregate planners are concerned with the quantity and the timing of expected demand. If total expected demand for the planning period is much different from available capacity over that same period, the major approach of planners will be to try to achieve a balance by altering capacity, demand or both. On the other hand, even if capacity and demand are approximately equal for the planning horizon as a whole, planners may still be faced with the problem of dealing with uneven demand within the planning interval. In some periods, expected demand may exceed projected capacity, in others expected demand may be less than projected capacity, and in some periods the two may be equal. The task of aggregate planners is to achieve rough equality of demand and capacity over the entire planning horizon. Moreover, planners are usually concerned with minimizing the cost of aggregate plan. Effective aggregate planning requires good information. First, the available resources over the planning period must be known. Then, a forecast of expected demand must be available.

From forecasts and customer orders, production planning determines the requirement of human and material resources to produce efficiently the outputs demanded. The goal is to effectively allocate system capacity (plant, equipment, and manpower) over a designated time horizon.

Production plan indicates the organization's strategic position in response to the expected demand for its output. A good production plan with the optimal use of resources should yield such results as (i) be consistent with organizational policy, (ii) meet demand requirements, (iii) be within capacity constraints, and (iv) minimize costs. However, for a constant demand for a product, the planning activity becomes trivial. But with a stochastic demand, the system must have a sound production planning; and the associated planning problem is said to be dynamic. Some major strategy variables associated with production planning for stochastic demand are the production rate, the inventory level, the work force size, etc. These variables could be varied, modified or even kept fixed, or be nonexistent in a given organization, depending on its peculiarities and policies.

2.2 Disaggregating the Aggregate Plan

For the production plan to be translated into meaningful terms for production, it is necessary to disaggregate the aggregate plan. The result of disaggregating the aggregate plan is a master schedule showing the quantity and timing of specific end items for a scheduled horizon. A master schedule shows the planned output for individual products rather than an entire product group, along with the timing of production.

2.2.1 Master Production Scheduling

Production planning is an input to the Master Production Scheduling (MPS), where the master production schedule is a statement of what end items a company plans to produce by quantity and time period. MPS is a disaggregation and implementation of the production plan. It translates the production plan into specific products or product modules and specifies the time period for their completion.The master schedule is the heart of production planning and control. The master schedule has three inputs: the beginning inventory, which is the actual quantity on hand from the preceding period; forecasts for each period of the schedule; and customer orders, which are quantities already committed to customers. The master scheduling process uses this information on a period-by-period basis to determine the projected inventory, production requirements, and the resulting uncommitted inventory. The master production scheduling process drives the material requirements planning system.

2.2.2 Material Requirements Planning System

The intense global competition in manufacturing has thrown a strong challenge to the management to seek new and more effective ways of managing production to maintain or to achieve a competitive edge. Therefore, many companies have to implement computer-based production and inventory control systems. The most widely adapted systems are called material requirements planning (MRP) and manufacturing resource planning.

MRP system is a computer-based information system that translates master schedule requirements for end items into time-phased requirements for subassemblies, components, and raw materials. Hence, requirements for end items generate requirements for lower-level components, which are broken down by planning periods so that ordering, fabrication, and assembly can be scheduled for timely completion of end items while inventory levels are kept reasonably low. Material requirements planning is as much a philosophy as it is a technique, and as much an approach to scheduling as it is to inventory control. MRP begins with a schedule for finished goods that is converted into a schedule of requirements for the subassemblies, components parts, and raw materials needed to produce the finished items in the specified time frame.

The primary inputs of MRP are a bill of materials, which tells the composition of a finished product; a master schedule, which tells how much finished product is desired and when; and an inventory records file, which tells how much inventory is on hand or on order. The planner processes this information to determine the net requirements for each period of the planning horizon. The materials that a firm must actually acquire to meet the demand generated by the master schedule are the net material requirements. The determination of the net requirements is the core of MRP processing. So there are two major distinguishing features of MRP, (1) requirement for items controlled by MRP are calculated based on schedules for higher-levels items as opposed to being forecast, and (2) plans are time phased in the form of lot-sizing showing order releases and receipts by time periods throughout some planning horizon. So lot-sizing is a significant aspect of the materials requirement planning process and acts as a major component of a balanced MRP operation.

2.2.3 Lot-Sizing Problem

The determination of lot sizes in an MRP system is a complicated and difficult problem. Lot sizes are the product quantities issued in the planned order receipt and planned order release sections of an MRP schedule. For products produced in-house, lot sizes are the production quantities of batch sizes. For purchased products, these are the quantities ordered from the supplier. Lot sizes generally meet product requirements for one or more periods. Lot sizing decisions give rise to the problem of identifying when and how much of a product to produce such that setup, production and holding costs are minimized. Making the right decisions in lot sizing will affect directly the system performance and its productivity, which are important for a manufacturing firm's ability to compete in the market. Therefore, developing and improving solution procedures for lot sizing problems is very important.

Most lot-sizing techniques deal with how to balance the setup or order costs and holding costs associated with meeting the net requirements generated by the MRP planning process. In the past few years there have been several activities in computer based production and inventory control dealing with how to select lot-sizes in the face of an essentially deterministic but time-varying demand pattern. Presently, lot-sizing problem has taken its place as one of the most important functions in an industrial enterprise. However, optimizing routines for lot-sizing problems have been shown to be all too demanding from a computing standpoint in both practical as well as research environment. The present work would seek for an efficient means of obtaining an optimal multi-item lot-sizing solution to research problems. This would facilitate development of improved heuristics appropriate for practical settings. Research on the relevant fields has yielded several mathematical and heuristic policies which produce optimal and near optimal results. The ever increasing importance of this issue therefore calls for further research in this field.

The complexity of lot sizing problems depends on the features taken into account by the model. The following characteristics affect classifying, modeling and the complexity of lot sizing decisions.[15]

Planning Horizon

The planning horizon is the time interval on which the master production schedule extends into the future. The planning horizon may be finite or infinite. A finite-planning horizon is usually accompanied by dynamic demand and an in finite planning horizon by stationary demand. In addition, the system can be observed continuously or at discrete time points, which then classifies it as a continuous or discrete-type system. In terms of time period terminology, lot sizing problems fall into the categories of either big bucket or small bucket problems. Big bucket problems, are those where the time period is long enough to produce multiple items (in multi-item problem cases), while for small bucket problems the time period is so short that only one item can be produced in each time period. Another variant of the planning horizon is a rolling horizon usually considered when there is uncertainty in data. Under this assumption, optimal approaches for each horizon act as heuristics but cannot guarantee the optimal solution.

Number of Levels

Production systems may be single-level or multi-level. In single-level systems, usually the final product is simple. Raw materials, after processing by a single operation such as forging or casting, are changed to final product. In other words, the end item is directly produced from raw materials or purchased materials with no intermediate subassemblies. Product demands are assessed directly from customer orders or market forecasts. This kind of demand, as will be further discussed later, is known as independent demand. In multi-level systems, there is a parent–component relationship among the items. Raw materials after processing by several operations change to end products. The output of an operation (level) is input for another operation. Therefore, the demand at one level depends on the demand for its parents' level. This kind of demand is named dependent demand. Multi-level problems are more difficult to solve than single-level problems. Multi-level systems are further distinguished by the type of product structure, which includes serial, assembly, disassembly and general or MRP systems.

Number of Products

The number of end items or final products in a production system is another important characteristic that affects the modeling and complexity of production planning problems. There are two principal types of production system in terms of number of products. In single-item production planning there is only one end item (final product) for which the planning activity has to be organized, while in multi-item production planning, there are several end items. The complexity of multi-item problems is much higher than that of single-item problems. van Hoesel and Wagelmans [16] provide theoretical results for the performance of algorithms for the single item capacitated lot sizing problem. (See also Section 4 of this paper.) Resources or capacities in a production system include manpower, equipment, machines, budget, etc. When there is no restriction on resources, the problem is said to be uncapacitated, and when capacity constraints are explicitly stated, the problem is named capacitated. Capacity restriction is important, and directly affects problem complexity. Problem solving will be more difficult when capacity constraints exist.

Deterioration of Items

In the case that deterioration of items is possible, we encounter restrictions in the inventory holding time. This in turn is another characteristic which would affect problem complexity.

Demand

Demand type is considered as an input to the model of the problem. Static demand means that its value does not change over time, it is stationary or even constant, while dynamic demand means that its value changes over time. If the value of demand is known in advance (static or dynamic), it is termed deterministic, but if it is not known exactly and the demand values occurring are based on some probabilities, then it is termed probabilistic. In independent demand cases, an item's requirements do not depend on decisions regarding another item's lot size. This kind of demand can be seen in single-level production systems.

In multi-level lot sizing, where there is a parent–component relationship among the items, because the demand at one level depends on the demand for their parents (pervious level), it is called dependent. Problems with dynamic and dependent demands are much more complex than problems with static and/or independent demands. Also, problems with probabilistic demand will be more complex than problems with deterministic demand.

Setup Structure

Setup structure is another important characteristic that directly affects problem complexity. Setup costs and/or setup times, are usually modeled by introducing zero–one variables in the mathematical model of the problem and cause problem solving to be more di4cult. Usually, production changeover between different products can incur setup time and setup cost. There are two types of setup structure: simple setup structure and complex setup structure. If the setup time and cost in a period are independent of the sequence and the decisions in previous periods, it is termed a simple setup structure, but when it is dependent on the sequence or previous periods, it is termed a complex setup. Three types of complex setups will now be described. First, if it is possible to continue the production run from the previous period into the current period without the need for an additional setup, thus reducing the setup cost and time, the structure is named setup carry-over. It can also be define a second type of complex setup, family or major setup, caused by similarities in manufacturing process and design of a group of item(s). An item setup or minor setup also occurs when changing production among items within the same family. If there is sequence-dependent setup, item setup cost and time depend on the production sequence; this is the third type of complex setup structure. It is obvious that the complex structures are more awkward in both modeling and solving the lot sizing problems.

Inventory Shortage

Inventory shortage is another characteristic affecting modeling and complexity of problem solving. If shortage is allowed it means that it is possible to satisfy the demand of the current period in future periods (backlogging case), or it may be allowable for demand not to be satisfied at all (lost sales case). The combination of backlogging and lost sales is also possible. Problems with shortage are more difficult to solve than without shortage.

2.3 Literature Study

The importance of lot-sizing in inventory management has been noteworthy over the years, since it is one of the basic features of the MRP. The MRP on the other hand, has the central importance in manufacturing resource planning and comprehensive MRP system. This has been evident from efforts by researchers from amongest the academics and industries yielding vast literatures containing abstract mathematical approach as well as highly pragmatic techniques. The literatures have been found places in a large numbers of journals. Section 2.3.1. presents some of the lot-sizing techniques and Section 2.3.2 summarizes the historical background study on the subject. Dixon-Silver heuristic used Silver-Meal heuristic and Wagner and Whitin algorithm. Section 2.3 rigorously describes these two heuristics, since the present work is fundamentally an extension of Dixon-Silver's work.

2.3.1 Lot-Sizing Techniques

The various approaches and techniques of lot-sizing as developed are presented below.

2.3.1.1 Period Order Quantity

The period order quantity (POQ) uses the same type of economic reasoning as the EOQ (Economic Order Quantity which is for fixed demand or order), but determines the number of periods to be covered by each order rather than the number of units to order. This results in a fixed order cycle as opposed to a fixed quantity as in EOQ. Total cost per period as a function of t, the cycle time in periods is given by

$$C(t) = k/t + h(rt)/2.$$

POQ is an improvement over EOQ as it eliminates remnants, and it performs quite well if demand is relatively stable. However, like EOQ, it does not take full advantage of knowledge of future period-to-period variations in demand. Some other techniques described subsequently outperform POQ when variation in demand is significant [17].

2.3.1.1 Part-Period Algorithm

The part-period algorithm can determine order sizes under conditions of known, but varying, demand rates. While the algorithm does not ensure optimality, it does approach optimal techniques. It equates the part-period value derived from order and holding costs to the generated part-period value. The generated part-period for an item is the number of parts held in inventory multiplied by the number of time periods over which the parts are held. In calculating the generated number of part-periods, it is assumed that no holding costs are incurred for items consumed in the period in which they arrive.

To express order cost and holding cost in part-periods, it is necessary to divide the order cost by the holding cost per part per period. The order cost and holding cost part-periods are referred to as the derived part-period value. The derived part-period value is the number of part-periods it takes to make order cost and holding cost equal. A generated part-period value is obtained by accumulating part-periods over the demand time horizons for one or more periods. When the generated part-period value is first greater than the derived part-period value, an order should be placed. The order quantity will be the accumulated demand up to the time period for the next order [17].

2.3.1.3 Lot-For-Lot

The simplest lot-sizing technique is lot-for-lot. A lot is scheduled in each period in which a demand occurs for a quantity equal to the net requirement.

Lot-for-lot ordering results in a zero inventory balance each period, but does involve many orders. It is most appropriate where the item has a large carrying cost and a small ordering cost, such as large assembles with expensive components. Another situation where lot-for-lot is appropriate is when demand is very sporadic and one or a few units are needed only occasionally. Lot-for-lot also provides a steadier flow of work than other lot-sizing techniques which produce fewer and larger orders [17].

2.3.2 Heuristic Techniques

The next three techniques are heuristics. They aim at providing a good, although not necessarily optimal solution with a reasonable amount of computing. All the three techniques use stopping rules. That is, they start from the first period and test prospective orders covering the first period, then the first and second periods, then the first, second, and third periods, and so forth, until a stopping criterion is met. An order is scheduled covering demands in all periods up through the stopping period. Then the process is repeated starting at the next period after the last stopping period.

Least Unit Cost

The first of these rules is called least unit cost (LUC). The unit costs of orders covering successively greater numbers of periods are calculated. The unit cost for each prospective order is obtained by dividing the sum of the ordering and carrying costs by the number of units on the order. The first time cost per unit goes up, the prior period becomes the stopping period.

LUC is widely used in industry, and on the surface appears to be a reasonable approach to lot-sizing. However, closer analysis has raised some serious questions concerning the basic logic of the technique [17].

Least Period Cost

The least period cost method [18] was developed by Silver and Meal and is generally referred to as Silver-Meal. This procedure seeks to determine the total costs of ordering and carrying for lots covering successively greater numbers of periods into the future and to select the lot with the least total cost per period covered [17].

Least Total Cost

The idea for the Least Total Cost (LTC) method (also called part-period-balancing), was developed by Matties and Mendoza. The concept stems from the fact that in the basic EOQ model, the inventory carrying cost is equal to the ordering cost at the optimum point. In the LTC procedure, lot-sizes covering successively greater numbers of periods into the future are tested until the largest lot is obtained for which the carrying cost is less than or equal to the ordering cost. The Authors presented this method to determine the lot for which the carrying cost was close to the ordering cost. This means that sometimes the carrying cost would be greater than the ordering cost. However, this is not the method presented by the original authors, and moreover it did not perform well because it has a bias toward orders that are too large [17].

Look Ahead/Look Back

Look ahead/look back is a technique used to adjust a schedule of order already obtained by using some other technique. It was originally proposed as a refinement of LTC. However, look ahead/look back can be applied just as well to adjust schedules produced by other heuristics.

Look ahead/look back has the effect of moving orders scheduled for periods of low demand into nearly periods of higher demand. This reduces the number of part-periods and, therefore, the carrying cost. Aucamp and Fogarty have substantially improved and extended the technique. For one thing, their algorithm also takes into account the fact that if an order is moved forward or back to a period in which another order is scheduled, an ordering cost is saved. Their claim is that regardless of what schedule they start with, the end result is virtually optimal.

However, look ahead/look back is not widely used. The reasons are that adding this procedure makes lot-sizing more complex, adds to the amount of computation, and may only improve results marginally if a good lot-sizing procedure has been selected to arrive at the initial lot-sizes [17].

Dynamic Lot-Sizing Problem

The dynamic lot-sizing problem (DLSP) has received considerable attention from both academics and industry during the past two decades. Specifically, the problem is that of determining lot-sizes for a single item when demand is deterministic and time varying. Time is discretized into periods (e.g. days, weeks and months) and production can be initiated only at the start of a period. Each time that production is initiated, a set-up cost is incurred. A holding cost is incurred for each unit of inventory that is carried from one period to the next. The objective is to minimize the total of set-up and holding costs, while ensuring that all demand is satisfied on time. The dynamic demand, coordinated lot-size problem determines the time-phased replenishment schedule (i.e., timing and order quantity) that minimizes the sum of inventory and ordering costs for a family of items. A joint shared fixed setup cost is incurred each time one or more items of the product family are replenished, and a minor setup cost is charged for each item replenished. In addition, a unit cost is applied to each item ordered. Demand is assumed to be deterministic but dynamic over the planning horizon and must be met through current orders or inventory. Coordinated lot-size problems are often encountered in production, procurement, and transportation planning . The mathematical complexity of the coordinated lot-size problem is NP-complete indicating that it is unlikely that a polynomial bound algorithm will be discovered for its solution. For this reason, a significant literature base detailing alternative mathematical formulations and exact solution approaches for the problem is rapidly evolving in an effort to solve large industry problems.[19] This paper [20] considers the determination of lot sizes for multiple products that can be jointly replenished. A fixed set-up or order cost AO (often referred to as a major set-up cost) is incurred whenever any product is ordered or produced, independently of the number or type of products; and an extra cost Ai (usually referred to as a minor or line set-up cost) is added if product i is included in the joint order. The demand for each item is discrete, and varies in time, but is known over a given time horizon H. Linear holding costs are charged on the end-of-period inventories and backlogging is not permitted. The variable unit purchase cost for each product is constant throughout the horizon, so that the purchase cost of any item for total demand in the horizon is invariant of the replenishment policy. The problem is to determine a replenishment schedule for all items that minimizes the total set-up plus inventory holding cost over the horizon. Many dynamic programming solutions exist for this problem, but they are computationally complex. For example, when specialized to the multi-product dynamic lot-size problem Zangwill's method' has a computational complexity that is exponential in the number of products, while Veinott's solutions are computationally exponential in the number of time periods. Other solutions that are computationally exponential in the number of products have also been proposed. However these solutions are of no use for practical problems, which usually involve many items and many time periods, so efforts have shifted to the development of heuristic solutions. Unfortunately, though these heuristics are relatively simple, when compared with the optimum dynamic programming solutions, they have two major disadvantages. First, they generally depend on the Wagner-Whitin dynamic programming solution for the single-item dynamic lot-size problem. Second, it is not known how good these heuristics are. Because a typical practical problem involves many items, and managers find it difficult to understand dynamic programming solutions, these heuristics are not desirable from a practical standpoint. A heuristic which overcomes these two problems has been given. This relies on a lower bound obtained from decomposing the problem into single-item problems. The decomposition gives an easily computed lower bound. The aim of this paper is two-fold: first, it gives two simple heuristics and determines their theoretical worst-case performances, and second it gives an improved version of the heuristic in Atkins and Iyogun. All these heuristics are generalized versions of existing single-item heuristics-the part period balancing (PPB1) heuristic and a variant of PPB1 denoted by PPB2, and the Silver- Meal (SM) heuristic. The generalized Silver-Meal heuristic was shown to perform very well on a wide set of problems. The part-period balancing heuristic is known to perform well in practice and it is simple, but it has a worst-case performance of 1/3. It will be shown that when this heuristic is generalized to the multi-product dynamic lot-size problem, the worst-case performance of the generalized heuristic cannot be less than 1/3. The other heuristic, PPB2, which is a simple variant of the part- period balancing heuristic, has a worst-case performance of ½. It will be shown also that when this heuristic is generalized to the multiple product problem then the worst-case performance is preserved. The remainder of the paper is organized as follows. The second section gives a brief description of the problem and the lower bound. The following section describes the two heuristics, the generalized PPB1 (GPPB1) and the generalized PPB2 (GPPB2), and establishes their worst-case performances. Considerable recent attention has focused on the "Bullwhip Effect," a term coined by Proctor and Gamble. Dynamic programming techniques applied to stock minimization have also been used to quantify the Bullwhip Effect. The availability of an exact solution to the continuous differential inventory equations seemsto have been overlooked [21]. For example, when discussing equations withtime delays, none of the text books on differential equations or Laplace transforms point out that such equations can be solved exactly in terms of the Lambert Wfunction (Corless et al , 1996). This paper begins to address this omission. The aim is to solve exactly the equations for a model that has been shown to be practically valuable, and that has been studied in some detail. Only from analytical solutions can the precise behavior of a model be carefully assessed over a wide range of conditions. This contributes valuable conceptual information to managers and expert system developers, who depend on behavioral heuristics. Therefore, a goal of this paper [21] is to provide tools that help guide the exploration of the parameter space with numerical techniques. Since numerical treatments of unstable solutions require more care, such approaches should benefit.

Many optimal and heuristic techniques have been developed for variations of this problem.

Single Item Uncapacitated Lot-Sizing Problem

First the concept of single item comes and there is no capacity restriction. Some of the most widely used heuristics for lot-sizing are: Silver-Meal heuristic [22], least unit cost heuristic [23]. These heuristics are not directly applicable to the present work on scheduling problem. The reason is that these heuristics made the following assumptions:

(i) no capacity restrictions,

(ii) only one product to be produced, and

(iii) quantity produced to meet demand in only integer number of periods.

The effective use of the available capacity of plant could not be made in these heuristics. But when capacity constraint is realistically imposed in the scheduling problem, the available capacity use becomes necessary. This part of consideration is an important contribution to the present work.

The Silver-Meal heuristic calculates the lot size as the total demand for an integer number of periods that give the minimum total set-up and holding costs per unit time. The least unit cost heuristic calculates the lot-sizes in the same way as the Silver-Meal heuristic. But the exception is that, it minimizes the total costs per unit number of products produced rather than minimizing the total costs per unit time as is done in the Silver-Meal heuristic. For multiple products to be produced with no capacity constraints, the above heuristics can be applied to each of the products independently.

Multi Item Uncapacitated Lot-Sizing Problem

Frequently, multiple items are produced on a single machine. This machine has finite capacity and it is usually loaded to or near capacity. Most of the existing methods for the multi-item dynamic lot-sizing problem implicitly assume that capacity is unlimited and hence their use will frequently result in excessive over or under loading in some periods. Therefore, in practice, planned lot-sizes may be split into smaller lots with some demand backlogged. This resulted to the orders are not being produced on time and the economics of scale of batch production is lost.

Multi Item Capacitated Lot-Sizing Problem

The multi-item capacitated lot-sizing problem (CLSP) is found to be NP-hard when the single-item capacitated dynamic lot-sizing problem is already proven to be NP-hard [24-28]. The problem is even harder from practical point of view, since optimal solution methods have failed to solve all but very small problems within reasonable computation times. Moreover, since very few workable techniques have been reported, methods to obtain optimum solutions could not be available easily. It has been found that most methods require extensive computational power, thus, their applicability is rather limited. As a consequence efforts are now being given to develop heuristics for the multi-item capacitated lot-sizing problems. The various heuristics, which have been proposed over the years, are classified into a number of classes. **The first group** of heuristics falling in a class could be called **"common sense"** heuristics. The heuristics belonging to this class can be found in Eisenhut [29], Lambrecht and Vandervcken [30], Dixon-Silver [31] etc. Many different variants have been proposed, for these common-sense heuristics, but they can basically be classified into two categories, such as

(i) the period-by-period heuristics, and

(ii) improvement heuristics.

(i) Period by period heuristic: Heuristics belonging to the period-by-period heuristic work from period 1 to period H. Consider a period t in the process. One certainly has to produce $\max\{0, d_{it}, I_{i,t-1}\}$ for all products i in order to avoid stock outs in the current period, where d_{it} is the demand for item i in period t and I_{it} is the inventory of item i at the end of period t. The remaining capacity (if any) can be used to produce demand for some future period, in which case future set-up costs may be saved at the expense of added inventory-holding costs. To indicate the viability of producing demand for a future period in the period under consideration, all heuristics use a priority index. The priority indices used by the heuristics are more sophisticated in that they try to capture the potential savings per time period and per unit demand. Although the exact Priority index may differ from heuristic to heuristic, they all proceed in the same way. Priority indices are calculated for all products and for all future periods. These priority indices are used to include future demands into the current production lot either until no more with a positive index or until the capacity limit is hit.

Besides the difference in using priority index, the period-by-period heuristics also differ in the way in which they ensure feasibility. Infeasibility occurs when the net demand in some period t, i.e. $\sum_{i=1}^{N}\max\{0, d_{it}-I_{i,t-1}\}$ may exceed available capacity. Two different approaches can be used to overcome this problem. The first one is the feedback mechanism. When an infeasible period is encountered, demand with negative priority indices is shifted from the period to an earlier period. A second approach, look ahead mechanism, however, calculates a priority the required cumulative production up to period t (for all t) such that no infeasibility will arise in period $(t + 1)$. This pure single-pass heuristics require smaller computation time.

(ii) Improvements heuristics: The second category of heuristics called improvements heuristics start with a solution for the entire horizon and then try to improve this solution in cost effective fashion by going through a set of simple local improvement steps.

The second group of heuristics is all based on optimum seeking **mathematical programming methods** which are truncated in some way to reduce computational effort.

The Mathematical-programming based heuristics are (i) Relaxation heuristics (ii) Branch-and-Bound procedure (iii) Linear programming based heuristics. Heuristics belonging to the class can be found in Wagner-Whitin's algorithm [28], Macs [32] Mixed-integer-programming formulation etc. In Wagner-Whitin's algorithm capacity constraints are relaxed i.e. the capacity may be infinite. So the problem decomposes into N number of single-item uncapacitated dynamic lot sizing problems for which it provides an effective method of solution. The first approach of this type is attributed to Newson (33). Starting from the Wagner-Whitin solutions for each product, the heuristic proceeds as follows.

(i) Select a period in which capacity is violated. For products with a set-up in that period, calculate the next best WW solution (i.e. the best solution for the problem where production in the violated period is forced to zero).

(ii) Select the next best plan for the product yielding the smallest extra cost per unit capacity absorption, thereby releasing some capacity in the violated period.

(iii) The method proceeds in this way until all infeasibilities are removed.

The above approach has two drawbacks. Firstly, it may end up with no feasible solution at all, and secondly it restricts itself to WW schedules, whereas the optimal solution may not satisfy the WW condition $x_{it}I_{i,t-1} = 0$ at all.

Mathematical-programming based heuristics are not considered because these methods may not be very transparent to the casual user and these heuristics limit their regular use in industry.

Wagner-Whitin Algorithm

The "square root formula" for an economic lot-size under the assumption of a steady-state demand rate is well known. The calculation is based on balancing of the costs of holding inventory against the costs of placing an order. When the assumption of a steady-state demand rate is dropped, i.e., when the amounts demanded in each period are known but are different and furthermore, when inventory costs vary from period to period, the square root formula (applied to the overall average demand and costs) no longer assures a minimum cost solution.

The mathematical model may be viewed as a "one-way temporal feasibility" problem, in that it is feasible to order inventory in period t for demand in period $t+k$ but not vice versa. This suggests that the same model also permits an alternative interpretation as the following "one-way technological feasibility" problem.

Mathematical Model

As in the standard lot size formulation, one assumption is that the buying (or manufacturing) costs and selling price of the item are constant throughout all time periods, and consequently only the costs of inventory management are of concern. In the t-th period, $t = 1, 2, \ldots, H$, we let

d_t = amount demanded,

h_t = holding cost per unit of inventory carried forward to period $t + 1$,

S_t = ordering (or set-up) cost,

x_t = amount ordered (or manufactured or size of the lot), and

c_t = unit variable cost, which can vary from period to period.

Let all period demands and costs are non-negative. The problem is to find a programme $x_t \geq 0, \quad t = 1, 2, \ldots, H$, such that all demands are met at a minimum total cost; any such program, will be termed optimal.

Of course one method of solving the optimization problem is to enumerate 2^{H-1} combinations of either ordering or not ordering in each period (it has been assumed that an order is placed in the first period). A more efficient algorithm evolves from a dynamic programming characterization of an optimal policy.

Let I denote the inventory entering a period and I_0 initial inventory; for period t

$$I = I_0 + \sum_{j=1}^{t-1} x_j - \sum_{j=1}^{t-1} d_j \geq 0. \qquad (2.1)$$

The functional equation representing the minimal cost policy for periods t through H, given incoming inventory I, as

$$f_t(I) = \min \left[h_{t-1} I + \delta(x_t) s_t + f_{t+1} (I + x_t - d_t)\right], \qquad (2.2)$$

$$x_t \geq 0,$$

$$I + x_t \geq d_t,$$

where

$$\delta(x_t) = \begin{cases} 0 & if \ x_t = 0 \\ 1 & if \ x_t > 0 \end{cases}. \qquad (2.3)$$

In period H

$$f_H(I) = \min \left[h_{H-1} I + \delta(x_H) s_H\right],$$

$$x_H \geq 0, \qquad (2.4)$$

$$I + x_H \geq d_H.$$

Thereby obtaining an optimal solution as I for period 1 is specified. Assumption 2 below establishes that it is permissible to confine consideration to only $H + 2 - t$, $t > 1$, values of I at period t.

By taking cognizance of the special properties of the model, an alternative functional equation has been formulated which has the advantage of potentially requiring less than H periods' data to obtain an optimal program; that is, it may be possible without any loss of optimality to narrow the program commitment to a shorter "planning horizon" than H periods on the sole basis of data for this horizon. Just as one may prove that in a linear programming model it suffices to investigate only basic sets of variables in search of an optimal solution, it is demonstrated that in the model an optimal solution exists among a very simple class of policies.

It is necessary to postulate that $d_t \geq 0$ is demand in period 1 net of starting inventory. Then the fundamental proposition underlying the approach asserts that it is sufficient to consider programs in which at period t one does not both place an order and bring in inventory.

Characteristics:

(1) There exists an optimal program such that $I_{x_t} = 0$ for all t (where I is inventory entering period t).

(2) There exists an optimal program such that for all t, $x_t = 0$ or $x_t = \sum_{j=t}^{k} d_j$ for some k, $t \leq k \leq N$.

(3) There exists an optimal program such that if d_{t^*} is satisfied by some $x_{t^{**}}$, $t^{**} < t^*$, then d_t, $t = t^{**} + 1, ..., t^* - 1$, is also satisfied by $x_{t^{**}}$.

For the particular cost structure assumed, it can be shown that an optimal policy has the property that $I_{t-1}x_t = 0$, for $t = 1, 2, \ldots, H$. That is, the requirements in a period are satisfied either entirely from procurement in the period or entirely from procurement in a prior period.

The property of an optimal solution stated above implies that we need consider only procurement programs where $x_t = 0$, or $x_t = d_t + d_{t+1} + \ldots + d_k$, for some $k = t, t + 1, \ldots, H$. To efficiently investigate such programs, the following algorithm can be used.

Let F_k be the minimum cost program for periods 1, 2, ..., k, when $I_k = 0$ is required. Let j be the last period prior to k having an ending inventory of zero. Thus $I_j = 0$, $I_k = 0$, and $I_t > 0$, for $t = j+1, j+2, ..., k-1$. Therefore, $x_{j+1} = d_{j+1} + d_j+2 + ... + d_k$. Define M_{jk} to be the cost incurred in periods $j + 1$ through k. It is

$$M_{jk} = x_{j+1} + C_{j+1}x_{j+1} + \sum_{t=j+1}^{k-1} h_t I_t .$$

Since

$$I_t = x_{j+1} - \sum_{t=j+1}^{t} d_t = \sum_{t=j+1}^{k} d_t, \quad for\ j < t < k, \text{ and}$$

$$M_{jk} = x_{j+1} + C_{j+1}x_{j+1} \sum_{t=j+1}^{k-1} h_t \sum_{t=j+1}^{k} d_t .$$

With this definition of M_{jk}, we can write the following recursive equation for F_k.

$$F_k = \min [F_j + M_{jk}], \qquad k = 1, 2, ..., H \text{ and } 0 \leq j < k, \qquad (2.5)$$

where $F_o = 0$. The logic motivating equation (2.5) is that for a k-period horizon with zero initial and final inventories and no shortages allowed. there will be some period where the last procurement is made. Call this period $j+1$, and by the property of an optimal solution, $I_j = 0$. Assume that we have found the optimal policy, and hence minimum cost F_t, for every $t < k$, where assumption is $I_t = 0$. Thus F_j is known and M_{jk} can be computed. The minimum cost for a k-period horizon results from selecting the optimal period for the last procurement. By trying all $j < k$, we can find the value of j, say j_k*, which minimizes F_j+M_{jk}. Last procurement is in period j_{k^*+1}.

The procedure is to determine in sequence the values F_1, F_2, ..., F_H. When F_H is found, having the minimum cost value for the H-period horizon and j_{H^*} can be used to work backward to extract the optimal lot sizes.

Silver-Meal Heuristic Model

It is a simple heuristic method for selecting replenishment quantities under conditions of deterministic time-varying demand where replenishment are restricted to the beginning by a period.

It has been wished to select the order quantity Q so as to minimize the costs per unit time over the time period that Q lasts. When there is restriction to replenishments at the beginning of a period the search is restricted to a set of Q's lasting for one, two, three, etc., periods, i.e., searching is on a time variable T which can take on the values of 1, 2, 3, etc.

Symbols

Suppose the following symbols have been designed. $F(j)$ is the demand rate (assumed constant) during the j-th period (where period 1 is the period immediately following the present moment at which a replenishment decision has to be made).

$T = 1, 2, 3, \ldots$ is the decision variable, the time duration that the current replenishment quantity is to last.

R and $G(j)$ are quantities to be used in the algorithm,

S is the ordering cost in the unit of currency,

C is the unit variable cost in the unit of currency per piece,

I is the inventory carrying charge expressed as a decimal fraction per period.

$M = \frac{S}{CI}$.

Algorithm

The algorithm is as follows:

Step 1: Initialization

Set $T = 1$,

$R = F(1)$, and

$G(1) = M$.

Step 2

Is $T^2 F(T+1) > G(T)$?

No - go to Step 3

Yes - go to Step 4

Step 3

Set $T = T+1$

Evaluate $R = R + F(T)$, and

$G(T) = G(T-1) + (T-1)\, F(T)$

go to Step 2

Step 4: Calculation of replenishment quantity

Q = current value of R (because R is defined in such a way that it has accumulated total demand through the end of period T).

$$= \sum_{j=1}^{t} F(j).$$

The most complicated operation in the algorithm is seen to be straight multiplication of two terms or the squaring of a number.

Dixon-Silver Model

One class of "common sense" heuristics considered here was initiated by Eisenhut [29] and could be called period-by-period heuristics. Eisenhuts procedure was later extended by Lambrecht and Vander Vaken [30], Dixon and Silver [[31]. In Eisenhut heuristic there is no guarantee one will find a feasible solution when only positive priority indices are considered, the reason being, that net demand in some period t, i.e., $\sum_{i=1}^{N} \max\{0, d_{it} - I_{i,t-1}\}$ may exceed available capacity.

Lambrecht and Vanderveken [28], Dixon and Silver both are period-by-period heuristic and based on Wagner-Whitin condition. These period-by-period heuristics have the advantages that their computation time is low. Both heuristics use the priority index which is derived from the well-known Silver-Meal heuristic for the single level uncapacitated dynamic lot-sizing problem.

Lambrecht and Vanderveken use a feedback mechanism (Backtracking) when an infeasible period is encountered, i.e. they try to shift excess demand to leftover capacity in previous periods, taking into consideration setup and holding costs, until the infeasibility in period t is removed.

Dixon and Silver, on the other hand, perform a priority (look ahead) computation of the cumulative production requirements up to period t (for all t) such that no infeasibility will arise in period (t + 1).

From the comparison study of Maes and Van Wassenhove [32], backtracking procedure creates a lot of additional setups whereas in a look-ahead procedure demand to be shifted to earlier periods is incorporated in planned production lots. Indeed, when capacity constraints are tight it may not be possible to shift demand backwards such that it can be added to an already planned production lot. Instead demand may have to be split up and several extra setups may be necessary to fit everything. This explains why rather large differences between Dixon and Silver and the other heuristics occur. On the basis of the results of Maes and Van Wassenhove's [32] comparison study it can be concluded that a look ahead procedure such as the one used by Dixon-Silver[31] should be preferred to a backtracking procedure used by Lambrecht and Vandervaken. However, when a strong trend in demand prevails, one should use a look-ahead procedure to ensure feasibility rather than relying on a backtracking routine as in Lambrecht and Vandervaken. So a good heuristic should have a look ahead mechanism to ensure feasibility at the outset and period-by-period heuristic take advantage when capacities are tight and difference in capacity absorption across products are large.

Considering these points as discussed above the Dixon and Silver heuristic is considered for further improvements in the present work.

Dixon-Silver model determines lot-sizes for a group of products that are produced at a single machine. It is assumed that the requirements for each product are known period by period, out to the end of some common time horizon. For each product there is a fixed setup cost incurred each time production takes place. Unit production and holding costs are assumed linear. The objective of the model is to determine lot-sizes so that the total costs are minimized, with no back-logging and having capacity restriction.

The input to the model would include all the costs and product data for each item, such as inventory holding cost, setup cost, setup time, production rate or capacity absorption rate, safety stock, initial inventory and ending inventory. Forecasted demand would be given for each item in each period. In addition, available capacity would be used period by period as input data. The mathematical model is presented below:

Mathematical model

$$\text{Minimize } Z(X) = \sum_{i=1}^{N}\sum_{j=1}^{H}(S_i\delta(x_{ij}) + h_i I_{ij})$$

Subject to $I_{ij} = I_{i,j-1} + x_{ij} - D_{ij}$ $\quad i = 1, 2, \ldots, N$ and $j = 1, 2, \ldots, H$

$I_{i0} = I_{iH} = 0$ $\quad i = 1, 2, \ldots, N$ and $j = 1, 2, \ldots, H$

$\sum_{i=1}^{N} k_i x_{ij} \le C_j$ $\quad j = 1, 2, \ldots, H$

$x_{ij},\ I_{ij} \ge 0$ $\quad i = 1, 2, \ldots, N$ and $j = 1, 2, \ldots, H$

where N = the number of items,

H = the time horizon,

D_{ij} = the given demand for item i in period j,

I_{ij} = the inventory of item i at the end of period j (after period j production and demand satisfied),

x_{ij} = the lot-size of item i in period j,

S_i = the setup cost for item i,

h_i = the unit holding cost for item i,

k_i = the capacity absorption rate for item i,

C_j = the capacity in period j,

$$\delta(x_{ij}) = \begin{cases} 1 & if\, x_{ij} > 0 \\ 0 & if\, x_{ij} = 0 \end{cases}$$

$\delta(x_{ij})$ is a binary setup variable indicating whether a setup cost must be incurred for item i in period j or not.

2.4 Development of the Model

This section deals with the modification of the Dixon-Silver model with new parameters: setup time and limited lot-size per setup. The modified models are more attractive than the Dixon-Silver model since the setup time and the limited lot-size per setup would be two important parameters from management point of view. In this regard two models have been formulated. The model with setup time, its heuristic method of solution has been presented in section 2.4.1.The model with the limited lot-size per setup, its heuristic method of solution, and sample output have been presented in Section 2.4.2.

2.4.1 Lot-Size Model with Setup Time

The lot-size model with setup time included is presented below showing the mathematical model, heuristic and sample calculations. The input to the model would include all the costs and product data for each item, such as inventory holding cost, setup cost, setup time, production rate or capacity absorption rate, safety stock, initial inventory and ending inventory. Forecasted demand would be given for each item in each period. In addition, available capacity would be used period by period as input data. The mathematical model is presented below.

Mathematical model

$$\textit{Minimize } Z(X) = \sum_{i=1}^{N}\sum_{j=1}^{H}(S_i\delta(x_{ij}) + h_i I_{ij})$$

Subject to $I_{ij} = I_{i,j-1} + x_{ij} - D_{ij}$ $\quad i = 1, 2, \ldots, N$ and $j = 1, 2, \ldots, H$

$I_{i0} = I_{iH} = 0$ $\quad i = 1, 2, \ldots, N$

$\sum_{i=1}^{N}\left[k_i x_{ij} + St_i.\delta(x_{ij})\right] \le C_j$ $\quad j = 1, 2, \ldots, H$

$x_{ij}, I_{ij} \ge 0$ $\quad i = 1, 2, \ldots, N$ and $j = 1, 2, \ldots, H$

where St_i = setup time for item i.

Heuristic Method of Solution

Several methods have been proposed for a solution of the multi-item constrained dynamic lot-sizing problem (DLSP). Most of these techniques have weakness or limitation that either they can not guarantee the generation of a feasible solution or become computationally prohibitive. It has been proved that even the single-item problem with constant capacity is

NP-hard [8-11]. That is, it is in a class of problems that are extremely difficult to solve in a reasonable amount of time. When the setup time would be included, the problem would become strictly NP-hard. Therefore, a simple heuristic has been developed which would guarantee a feasible solution. The heuristic method of solution is presented below in steps.

Step 1 Creation of an equivalent demand matrix:

- Convert the initial demand matrix into equivalent demand matrix with the use of initial inventory, ending inventory and safety stock.
- Use the initial inventory to satisfy as much demand as possible in the first few periods. The net requirements will be that demand not satisfied by the initial inventory. During the calculation of the net demands, the amount of the safety stock should be maintained.

  Let Iin_i = initial inventory for item i,

  $Iend_i$ = ending inventory for item i,

  $Irem_i$ = remaining initial inventory for item i, and

  SS_i = safety stock for item i.

  d_{ij} = equivalent demand for product i in period j.

  Initially set $Irem_i = Iin_i - SS_i$ and period $j = 1$.

  Then set $d_{ij} = \begin{cases} 0 & \text{if } Irem_i > D_{ij} \\ D_{ij} - Irem_i & \text{if } Irem_i \le D_{ij} \end{cases}$.

  Compute $Irem_i = Irem_i - D_{ij}$.

  Set $j = j + 1$ and recycle till $Irem_i > 0$.

- Since the amount of the safety stock is always maintained, the demand in the last period H would be partially satisfied by the safety stock of the period H-1. If ending inventory is desired, then the requirements in period H should be increased by the desired ending inventory. Then

  $d_{iH} = D_{iH} + Iend_i - SS_i$.

- Compute the net demands for all $i = 1, 2, \ldots, N$.

Step 2 Check the feasibility of the problem:

Feasibility Condition:

$$\sum_{j=1}^{H} CR_j \leq \sum_{j=1}^{H} C_j,$$

where $CR_j = \sum_{i=1}^{N} k_i d_{ij}$,

CR_j = demand in terms of capacity unit for period j,

k_i = capacity absorption rate for product i

If the feasibility condition is not satisfied, the problem is infeasible i.e. all demands cannot be met with the available capacity.

Step 3 Use the Dixon-Silver heuristic with inclusion of setup time [through steps 3.1 to 3.12]

Step 3.1

- Start at period 1, i.e. set R=1 [R = 1, 2, …, H]. When lot-sizing of period 1 is complete, then lot-sizing is started for period 2 up to period H.

Step 3.2

- Initialize lot-size x_{ij} by equalizing to demand d_{ij}, i.e.,

$$x_{ij} = d_{ij} \qquad i = 1, 2, \ldots, N \text{ and } j = 1, 2, \ldots, H.$$

Step 3.3

- Initially set the value of the time supply to one i.e., $T_i = 1$, where $i = 1, 2, \ldots, N$.

  Time supply (T_i) denotes the integer number of period requirements that this lot will exactly satisfy.

Step 3.4

- Produce $d_{iR} > 0$, in the lot-sizing period R, where $i = 1, 2, \ldots, N$.

- After producing d_{iR} calculate remaining capacity in period R, denoted by RC_R, by

$$RC_R = C_R - \sum_{i=1}^{N} k_i\, d_{iR}\,.$$

- Let I'_{ij} be the amount of inventory at the end of period j for item i, resulting from only the currently scheduled production in period R. Initialize I'_{ij} with zero, i.e.,

$$I'_{ij} = 0, \qquad i = 1, 2, \ldots, N \text{ and } j = 1, 2, \ldots, H.$$

Step 3.5

- Let AP_j be the amount of inventory (in capacity units) resulted from the production of period R that will be used in period j. Then

$$AP_j = \sum_{i=1}^{N} k_i \left(I'_{i,j-1} - I'_{i,j}\right).$$

- Let CR_j be the total demand (in capacity units) in period j. Then

$$CR_j = \sum_{i=1}^{N} k_i\, d_{ij}\,.$$

- The production plan for period R is feasible if and only if the following condition is satisfied for $t = 2, \ldots, H$.

$$\sum_{j=R+1}^{R+t-1} AP_j \geq \sum_{j=R+1}^{R+t-1} (CR_j - C_j + St_j)\,.$$

- Determine the earliest period t_c at which the above feasibility constraint is not satisfied, i.e.,

$$t_c = \min\left\{\, t \;\middle|\; \sum_{j=R+1}^{R+t-1} AP_j < \sum_{j=R+1}^{R+t-1} (CR_j - C_j + St_j)\right\}.$$

To remove infeasibility upto t_c, extra amount is to be produced with the use of remaining capacity RC_R of period R.

If there is no infeasibility, set $t_c = H + 1$.

Step 3.6

- Consider only items i' which have

  (1) $T_{i'} < t_c$,

(2) RC_R is sufficient to produce $d_{i',R+T_{i'}}$, and

(3) $d_{i',R+T_{i'}} > 0$.

To decide the best item (from a cost standpoint) to be produced in period R, calculate the priority index $U_{i'}$ for all of these items, where

$$U_{i'} = \frac{AC(T_{i'}) - AC(T_{i'}+1)}{k_{i'} d_{i',T_{i'}+1}} \text{, and} \qquad (3.1)$$

$$AC(T_{i'}) = \left\{ S_{i'} + h_{i'} \sum_{j=R}^{R+T_{i'}-1} (j-R) d_{i',j} \right\} / T_{i'}.$$

Among these find the one, denoted by i, that has the largest $U_{i'}$.

- U_i is the marginal decrease in average costs per unit of capacity absorbed.
- $AC(T_i)$ is average cost per unit time of a lot of item i which will satisfy T_i periods' requirements. This is from the Silver-Meal model in which future setup cost may be saved at the expense of added inventory holding cost.

Step 3.7

- Check the value of U_i.

(a) If Ui > 0, then it is economic to produce $d_{i,R+T_i}$ in period R.

Increase the value of lot-size x_{iR} and inventory I'_{ij} by $d_{i,R+T_i}$, i.e.,

$$x_{iR} = x_{iR} + d_{i,R+T_i}$$

$$I'_{ij} = I'_{ij} + d_{i,R+T_i} \qquad j = R+1, \ .., R+T_i.$$

Decrease the value of lot-size $x_{i,R+T_i}$, demand $d_{i,R+T_i}$ and remaining capacity RC_R by $d_{i,R+T_i}$, i.e., set

$$x_{i,R+T_i} = x_{i,R+T_i} - d_{i,R+T}$$

$$d_{i,R+T_i} = d_{i,R+T_i} - d_{i,R+T_i} = 0$$

$$RC_R = RC_R - d_{i,R+T_i}.$$

- Set $T_i = T_i + 1$ and continue from Step 3.5.

(b) If $U_i \leq 0$, then it is not economic to increase T_i of any item, because of the increase of the total cost.

- Check the value of t_c.

  (i) If $t_c > H$, then no infeasibilities left and lot-sizing of the current period is complete. Go to Step 3.12.

  (ii) If $t_c < H$, there are infeasibilities and production of one or more item is to be increased and it is done through Steps 3.8 to 3.11.

Step 3.8

- Calculate the value of Q, where

$$Q = \max_{R+t_c-1 \leq t \leq H} \left[\sum_{j=R+1}^{t} \left(CR_j - (C_t - St_j) - AP_j \right) \right].$$

- Q is the amount of production still needed in the current period to eliminate infeasibilities in the later period because the available capacity is not sufficient to meet the demands of those periods.

Step 3.9

- Consider only items i' for which

  i. $T_{i'} < t_c$, and

  ii. $d_{i',R+T_{i'}} > 0$.

  To decide the best item (from a cost standpoint) to be produced in period R, calculate the priority index $\Delta_{i'}$ for all of these items, where

$$\Delta_{i'} = \frac{AC(T_{i'}+1) - AC(T_{i'})}{k_{i'} d_{i',T_{i'}+1}}.$$

- Find the one, denoted by i, that has the smallest $\Delta_{i'}$.

Step 3.10

- Let $W = k_i d_{i,R+T_i}$.
- Compare the value of Q with W.

(a) If $Q > W$,

Increase the value of lot-size x_{iR}, and inventory I'_{ij} by $d_{i,R+T_i}$, i.e.,

$$x_{iR} = x_{iR} + d_{i,R+T_i}$$

$$I'_{ij} = I'_{ij} + d_{i,R+T_i} \qquad j = R+1, \ldots, R+T_i.$$

Decrease the value of lot-size $x_{i,R+T_i}$, demand $d_{i,R+T_i}$ and remaining capacity RC_R by $d_{i,R+T_i}$, i.e.,

$$x_{i,R+T_i} = x_{i,R+T_i} - d_{i,R+T_i}$$

$$d_{i,R+T_i} = d_{i,R+T_i} - d_{i,R+T_i} = 0$$

$$RC_R = RC_R - d_{i,R+T_i}.$$

Set $Q = Q - W$ and $T_i = T_i + 1$.

Continue from Step 3.9.

(b) If $Q \leq W$,

Set $IQ = \left\lceil \frac{Q}{k_i} \right\rceil$.

Increase the value of lot-size x_{iR} and inventory I'_{ij} by IQ, i.e.,

$$x_{iR} = x_{iR} + IQ$$

$$I'_{ij} = I'_{ij} + IQ.$$

Decrease the value of lot-size $x_{i,R+T_i}$ and demand $d_{i,R+T_i}$ by IQ, i.e.,

$$x_{i,R+T_i} = x_{i,R+T_i} - IQ$$

$$d_{i,R+T_i} = d_{i,R+T_i} - IQ.$$

Step 3.11

- Set $R = R + 1$.
- Check the value of R.

    (a) If $R < H$, then continue from Step 3.3.

    (b) If $R > H$, lot-sizing is complete up to period H.

Step 3.12

- Calculate the values of

    i. Forecasted machine time required/period.

    ii. Total expected setup cost.

    iii. Total expected inventory holding cost.

    iv. Total expected safety stock cost.

- Stop.

2.4.2 Model with the Limited Lot-Size Per Setup

The lot-size model with the limited lot-size per setup is presented below showing the mathematical model, heuristic and sample calculations. Like the previous model, the input would include all the cost and product data for each item, such as inventory holding cost, setup cost, the limited lot-size per setup, production rate or capacity absorption rate, safety stock, initial inventory and ending inventory. Forecasted demand would be given for each item in each period. In addition, available capacity would be used period by period as input data. It is to be noted that Dixon-Silver heuristic allows only one setup for each item in each period. But the limitation on lot-size may need more than one setup in a particular period. So should this limitation be incorporated into Dixon-Silver heuristic, each time an item when processed in a new setup is to be considered a new item. This may call for splitting an item into several new items in a particular period. However, the maximum number of the new splitted items will be restricted by the maximum periodical demand of the item. As for example, for the ith item if the maximum periodic demand and the limited lot-size be respectively $d_{\max i}$ and $x_{\max i}$, the number of new items will be $n_i = \left\lceil \frac{d_{\max i}}{x_{\max i}} \right\rceil - 1$. Thus the total number of new items will be $\sum_{i=1}^{N} n_i$, where

N is the number of items. So after meeting the lot-size limitation, the total number of items to be considered in the model should be $N' = N + \sum_{i=1}^{N} n_i$.

In view of the above discussions, the model may now be presented as follows.

Mathematical Model

$$Minimize\ Z(X) = \sum_{i=1}^{N'} \sum_{j=1}^{H} (S_i \delta(x_{ij}) + h_i I_{ij})$$

Subject to $I_{ij} = I_{i,j-1} + x_{ij} - D_{ij}$ $\quad i = 1, 2, \ldots, N'$ and $j = 1, 2, \ldots, H$

$I_{i0} = I_{iH} = 0 \quad i = 1, 2, \ldots, N'$

$\sum_{i=1}^{N'} k_i x_{ij} \le C_j \quad j = 1, \ldots, H$

$0 \le x_{ij} \le x_{\max i} \quad i = 1, 2, \ldots, N'$ and $j = 1, 2, \ldots, H$

$I_{ij} \ge 0 \quad i = 1, 2, \ldots, N'$ and $j = 1, 2, \ldots, H$

where N' = number of total items after meeting the maximum lot-size limitation

$= N + \sum_{i=1}^{N} n_i$, $\quad n_i = \left\lceil \frac{d_{\max i}}{x_{\max i}} \right\rceil - 1$. where

$d_{\max i}$ = maximum periodic demand for the ith item.

$x_{\max i}$ = the limited lot-size for item i which cannot be exceeded in any period.

Heuristic Method of Solution

The original two-item problem with constant capacity is NP-hard. In the present work a new constraint on upper limit of the limited lot-size is considered. With this new constraint the problem is also NP-hard. Therefore, a simple heuristic has been developed which guarantees a feasible solution.

Step 1 Creation of an equivalent demand matrix:

- Using the same technique of Step 1 of Section 3.2.1, the given $N \times H$ demand matrix is converted into an equivalent $N \times H$ demand matrix with the use of initial inventory, ending inventory and safety stock.

Step 2 Check the feasibility of the problem:

- The feasibility of the problem for N items is checked using the same formulas of Step 1 of Section 3.1.2.

Step 3 Convert the multi-setup problem into single setup problem [through steps 3.1 and 3.2]

Step 3.1

- Find the maximum demand $d_{\max i}$ for each item i by using the formula

$$d_{\max i} = \max \{d_{ij} \mid j = 1, 2, \ldots, H\}.$$

- Find the number of new items n_i to be considered to satisfy demand $d_{\max i}$ by using the formula

$$n_i = \left\lceil \frac{d_{\max i}}{x_{\max i}} \right\rceil - 1.$$

Then the number of total items after limiting the lot-size is

$$N' = N + \sum_{i=1}^{N} n_i \, .$$

Item i is splitted into $n_i + 1$ items. Let the new items are $i_0, i_1, \ldots, i_{n_i}$.

Initially set $d_{rem\,ij} = d_{ij}$ and $l = 0$.

Then set $d_{i_l j} = \begin{cases} d_{rem\,ij} & \text{if } d_{rem\,ij} \le x_{\max i} \\ x_{\max i} & \text{if } d_{rem\,ij} > x_{\max i} \end{cases}$.

Compute $d_{rem\,ij} = \begin{cases} 0 & \text{if } d_{rem\,ij} \le x_{\max i} \\ d_{rem\,ij} - x_{\max i} & \text{if } d_{rem\,ij} > x_{\max i} \end{cases}$.

Set $l = l + 1$ and recycle up to $l = n_i$.

- Now the equivalent demand matrix $N \times H$ is converted into a new demand matrix $N' \times H$

Step 3.2

- Initialize the values of setup cost, holding cost and capacity absorption rate for the N' new items from that of the N items by using the formulas

$$S_{i_0} = S_{i_1} = \ldots = S_{i_{ni}} = S_i,$$

$$h_{i_0} = h_{i_1} = \ldots = h_{i_{ni}} = h_i,$$

$$k_{i_0} = k_{i_1} = \ldots = k_{i_{ni}} = k_i.$$

Step 4 Apply the Dixon-Silver heuristic with inclusion of the limited lot-size per setup [through Steps 4.1 to 4.13]

Step 4.1

- Start at period 1, i.e. set $R = 1$ [$R = 1, 2, \ldots, H$]
- After completing the lot-sizing of period 1, the lot-sizing of period 2 is started.

Step 4.2

- Initialize lot-size x_{ij} by equalizing to demand d_{ij}, i.e.,

$$x_{ij} = d_{ij} \qquad i = 1, 2, \ldots, N' \text{ and } j = 1, 2, \ldots, H.$$

- Calculate remaining allowable amount that can be produced by the following equation.

$$x_{rem\,ij} = x_{\max i} - x_{ij} \qquad i = 1, 2, \ldots, N' \text{ and } j = 1, 2, \ldots, H.$$

where

$x_{rem\,ij}$ = remaining allowable amount that can be produced if x_{ij} is produced at period j for item i.

Step 4.3

- Initially set the value of time supply to one i.e. $T_i = 1$, where $i = 1, 2, \ldots, N'$.

  Time supply T_i denote the integer number of periods requirements that this lot will exactly satisfy.

Step 4.4

- For each item i, $i = 1, 2, \ldots, N'$, produce d_{iR} (> 0) in the lot-sizing period R.

- After producing d_{iR} calculate remaining capacity in period R, denoted by RC_R, by

$$RC_R = C_R - \sum_{i=1}^{N'} k_i\, d_{iR}.$$

- Let I'_{ij} be the amount of inventory at the end of period j for item i, resulting from only the currently scheduled production in period R. Initialize I'_{ij} with zero, i.e.,

$$I'_{ij} = 0, \qquad i = 1, 2, \ldots, N' \text{ and } j = 1, 2, \ldots, H.$$

Step 4.5

- Let AP_j be the amount of inventory (in capacity units) resulted from the production of period R that will be used in period j. Then

$$AP_j = \sum_{i=1}^{N'} k_i \left(I'_{i,j-1} - I'_{i,j} \right).$$

- Let CR_j be the total demand (in capacity units) in period j. Then

$$CR_j = \sum_{i=1}^{N'} k_i\, d_{ij}.$$

- The production plan for period R is feasible if and only if the following condition is satisfied for $t = 2, \ldots, H$.

$$\sum_{j=R+1}^{R+t-1} AP_j \geq \sum_{j=R+1}^{R+t-1} \left\{ CR_j - C_j \right\}.$$

- Determine the earliest period t_c at which the above feasibility constraint is not satisfied, i.e.,

$$t_c = \min\left\{ t \,\middle|\, \sum_{j=R+1}^{R+t-1} AP_j < \sum_{j=R+1}^{R+t-1} (CR_j - C_j) \right\}.$$

To remove infeasibility upto t_c, extra amount is to be produced with the use of remaining capacity RC_R of period R.

If there is no infeasibility, set $t_c = H + 1$.

Step 4.6

- Consider only items i' which have

(1) $T_{i'} < t_c$,

(2) RC_R is sufficient to produce x_{can},

where $x_{can} = \min\{d_{i',R+T_{i'}}, x_{rem\ i'R}\}$, and

(3) $x_{can} > 0$.

By equation (1) find the item, denoted by i, that has the largest U_i.

Step 4.7

- Check the value of U_i.

(a) If Ui > 0, then it is economic to produce xcan in period R.

Increase the value of lot-size x_{iR}, inventory I'_{ij} and $x_{rem\ i,R+T_i}$ by x_{can}, i.e., set

$$x_{iR} = x_{iR} + x_{can}$$

$$I'_{ij} = I'_{ij} + x_{can} \qquad j = R+1, \ldots, R+T_i$$

$$x_{rem\ i,R+T_i} = x_{rem\ i,R+T_i} + x_{can}.$$

Decrease the value of lot-size $x_{i,R+T_i}$, demand $d_{i,R+T_i}$, remaining capacity RC_R and $x_{rem\ iR}$ by x_{can}, i.e., set

$$x_{i,R+T_i} = x_{i,R+T_i} - x_{can}$$

$d_{i,R+T_i} = d_{i,R+T_i} - x_{can}$

$RC_R = RC_R - x_{can}$

$x_{rem\,iR} = x_{rem\,iR} - x_{can}$.

- Set $T_i = T_i + 1$ and continue from Step 4.5.

(b) If $U_i \leq 0$, then it is not economic to increase T_i of any item (total cost increases).

- Check the value of t_c.

  (i) If $t_c > H$, then no infeasibilities left and lot-sizing of the current period is complete. Go to Step 4.12.

  (ii) If $t_c < H$, there are infeasibilities and production of one or more item is to be increased and it is done through Steps 4.8 to 4.11.

Step 4.8

- Calculate the value of Q, where

$$Q = \max_{R+t_c-1 \leq t \leq H} \left[\sum_{j=R+1}^{t} \left(CR_j - C_j - AP_j \right) \right].$$

- Q is the amount of production still needed in the current period to eliminate infeasibilities in the later period because the available capacity is not sufficient to meet the demands of those periods.

Step 4.9

- Consider only items i' for which

  i. $T_{i'} < t_c$,

  ii. RC_R is sufficient to produce x_{can},

  where $x_{can} = \min\{d_{i',R+T_{i'}}, x_{rem\,i'R}\}$, and

  iii. $x_{can} > 0$.

To decide the best item (from a cost standpoint) to be produced in period R, calculate the priority index $\Delta_{i'}$ for all of these items, where

$$\Delta_{i'} = \frac{AC(T_{i'}+1) - AC(T_{i'})}{k_{i'} d_{i',T_{i'}+1}}.$$

- Among these find the one, denoted by i, that has the smallest Δ_i.

Steps 4.10

- Let $W = k_i x_{can}$.

- Compare the value of Q with W.

(a) If $Q > W$,

Increase the value of lot-size x_{iR}, inventory I'_{ij} and $x_{rem\ i,R+T_i}$ by x_{can}, i.e., set

$$x_{iR} = x_{iR} + x_{can}$$

$$I'_{ij} = I'_{ij} + x_{can} \qquad j = R+1, \ldots, R+T_i$$

$$x_{rem\ i,R+T_i} = x_{rem\ i,R+T_i} + x_{can}.$$

Decrease the value of lot-size $x_{i,R+T_i}$, demand $d_{i,R+T_i}$, remaining capacity RC_R and $x_{rem\ iR}$ by x_{can}, i.e., set

$$x_{i,R+T_i} = x_{i,R+T_i} - x_{can}$$

$$d_{i,R+T_i} = d_{i,R+T_i} - x_{can}$$

$$RC_R = RC_R - x_{can}$$

$$x_{rem\ iR} = x_{rem\ iR} - x_{can}.$$

Set $Q = Q - W$ and $T_i = T_i + 1$, and continue from Step 4.9.

(b) If $Q \le W$,

Set $IQ = \left\lceil \frac{Q}{k_i} \right\rceil$.

Increase the value of lot-size x_{iR}, inventory I'_{ij} and $x_{rem\ i,R+T_i}$ by IQ, i.e., set

$$x_{iR} = x_{iR} + IQ$$

$$I'_{ij} = I'_{ij} + IQ. \qquad j = R+1, \ldots, R+T_i$$

$x_{rem\ i,R+T_i} = x_{rem\ i,R+T_i} + IQ.$

Decrease the value of lot-size $x_{i,R+T_i}$, demand $d_{i,R+T_i}$ and $x_{rem\ iR}$ by IQ, i.e., set

$x_{i,R+T_i} = x_{i,R+T_i} - IQ$

$d_{i,R+T_i} = d_{i,R+T_i} - IQ$

$x_{rem\ iR} = x_{rem\ iR} - IQ.$

Step 4.11

- Set $R = R + 1$.
- Check the value of R.

  (a) If $R < H$, then continue from Step 4.3.

  (b) If $R > H$, lot-sizing is complete up to period H for N' items.

Step 4.12

- Convert the $N' \times H$ lot-sizing matrix into $N \times H$ lot-sizing matrix by applying the formula

  $x_{i,t} = \sum_{j=0}^{n_i} x_{ij,t}$.

Step 4.13

- Calculate the values of

  i. Forecasted machine time required/period.

  ii. Total expected setup cost.

  iii. Total expected inventory holding cost.

  iv. Total expected safety stock cost.

- Stop.

2.5 Computational Results with Real Life Data

The algorithm developed by Dixon and Silver [31] to generate feasible solution for multi-item single level capacitated lot-sizing problem was tested by a programming language in PC version. Thus a near optimal solution was obtained. The results are detailed in Section 2.5.1 below. This algorithm has been extended in the present work. The setup time and the upper limit on the lot-size have been included in the original algorithm. Thus the Dixon-Silver algorithm is separately extended with these two new parameters as described in section 2.4. This section presents the results obtained from the modified models using a programming language in PC version. Section 2.5.2 shows results with setup time consideration, and Section 2.5.3 shows the results with upper bound on the limited lot-size.

2.5.1 Results of a Multi-item Single Level Capacitated Lot-sizing Problem

The Dixon-Silver algorithm has been used with real life data. Data has been collected from a renowned furniture company. The products are fixed chairs. Twelve models of fixed chairs have been considered here, and these models are given in Figure 2.1. It is assumed that the entire production to meet demands is done in the plant and no subcontracting is permissible. Moreover, a further assumption is made that plant capacity could not be increased.

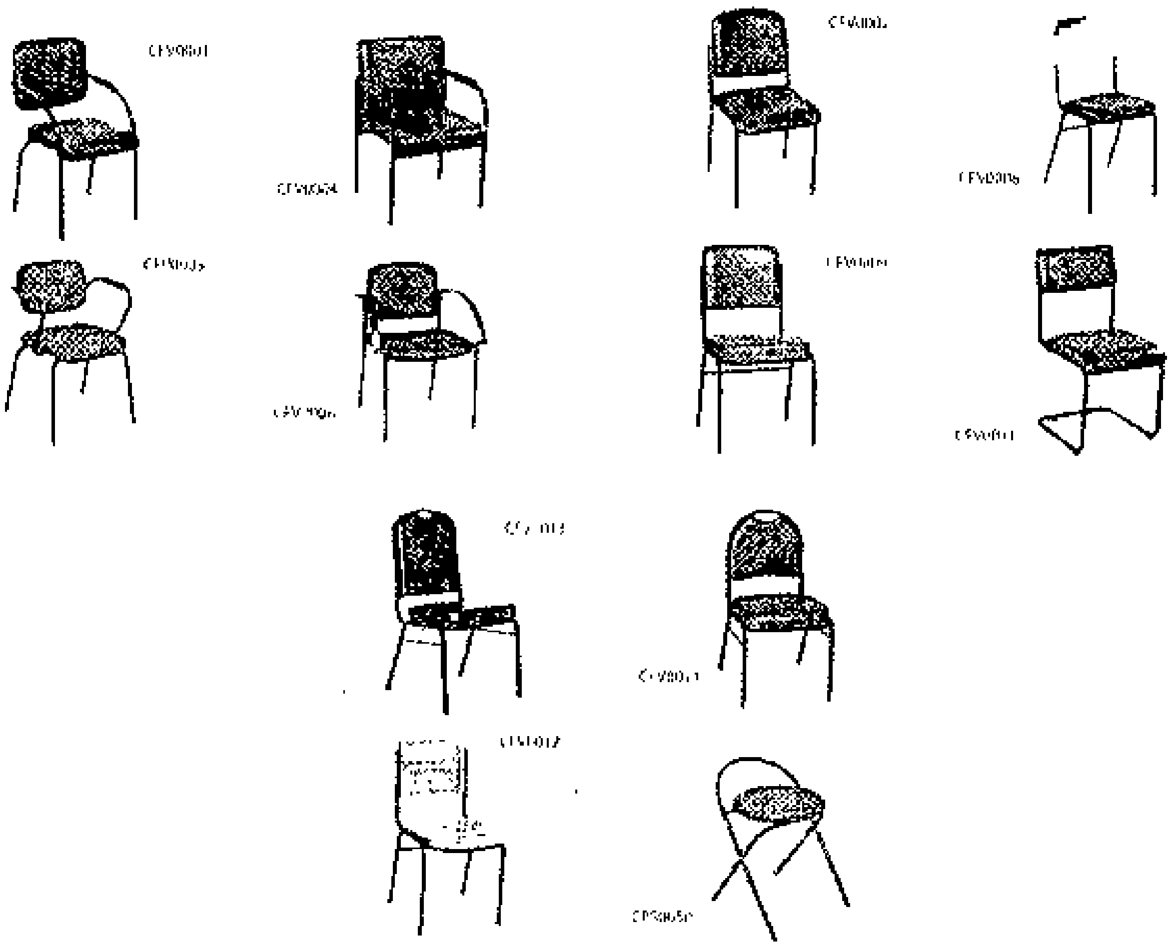

Figure 2.1 Twelve models of fixed chairs that have been considered as sample product.

Product data

The relevant product data (e.g., holding cost, setup cost, production rate, safety stock, initial inventory and ending inventory) has been depicted in Table 2.1. The problem size has been restricted at 12 products and 12 time periods; each time period corresponds to a month.

Table 2.1 Relevant product data for the particular machine.

Item No (i)	Holding Cost (h_i)	Setup Cost (S_i)	Production Rate ($1/k_i$)	Safety Stock (SS_i)	Initial Inventory (Iin_i)	Ending Inventory ($Iend_i$)
01	12.0	200.0	6	50	150	90
02	12.0	300 0	5	60	100	120
03	12.0	300 0	5	50	150	120
04	12.0	250.0	7	100	200	220
05	12.0	300.0	10	130	250	220
06	12.0	300.0	9	150	250	200
07	12.0	250.0	8	100	100	200
08	12.0	200.0	8	60	250	200
09	12.0	200.0	7	100	400	500
10	12.0	200.0	7	150	220	210
11	12.0	250.0	8	90	130	130
12	12.0	200.0	12	70	200	100

2. Product demand plant capacity

Product demands are quite seasonal and the same seasonal indices are used for all the products. Forecasted demand and the capacity of the machine are shown in Table 2.2. It has been assumed that the capacity per month is the total number of hours available per month. In this problem, Period 1 corresponds to the month of January, Period 2 corresponds to the month of February. Thus the machine capacity in Period 1 is the total production hours in January. There is two shifts (8 hours in each shift) in the factory. There is one hour for rest, tea etc in each shift. There is six working days in a week. To be on the safe side, it has been assumed that there is some overtime in some month for overproduction due to higher demand. Also there is some holidays in some month for different festival. As for example, the machine capacity in Period 2 is 14 hr × 24 days = 330 hours. Similarly the machine capacity for the other periods has been calculated.

Table 2.2 Forecasted demand and capacity of the hypothetical machine.

Item No	Period 1	2	3	4	5	6	7	8	9	10	11	12
01	90	60	80	80	90	80	70	75	60	60	50	50
02	80	70	80	80	75	90	90	80	80	60	60	50
03	100	60	60	50	80	80	90	100	90	120	80	150
04	180	165	125	150	200	180	120	150	145	240	220	220
05	200	190	280	260	200	210	200	130	120	240	240	210
06	400	240	245	250	230	200	230	205	145	380	255	190
07	450	350	350	380	340	360	400	450	450	400	450	350
08	200	250	250	200	150	160	190	100	250	100	250	100
09	500	500	450	400	450	500	400	400	700	450	700	110
10	350	250	220	225	120	130	130	145	115	204	200	150
11	300	200	200	100	160	100	130	100	90	140	120	90
12	150	95	95	100	100	90	75	75	60	130	105	90
	Forecasted Machine Requirements (hours)											
	370	330	370	350	370	350	370	370	350	300	350	300

3. Equivalent demand schedule

An equivalent demand schedule is generated such that starting and ending inventory are accommodated. In addition, demands are adjusted such that in the heuristic solution, the inventory at the end of any period never drops below the safety stock level. Table 2.3 depicts the equivalent demand after considering initial inventory, ending inventory and safety stock.

Table 2.3 Equivalent demand with the use of initial inventory, ending inventory and safety stock.

Item No	Period 1	2	3	4	5	6	7	8	9	10	11	12
01	0	50	80	80	90	80	70	75	60	60	50	90
02	40	70	80	80	75	90	90	80	80	60	60	110
03	0	60	60	50	80	80	90	100	90	120	80	220
04	80	165	125	150	200	180	120	150	145	240	220	340
05	80	190	280	260	200	210	200	130	120	240	240	300
06	300	240	245	250	230	200	230	205	145	380	255	240
07	450	350	350	380	340	360	400	450	450	400	450	450
08	10	250	250	200	150	160	190	100	250	100	250	240
09	200	500	450	400	450	500	400	400	700	450	700	510
10	280	250	220	225	120	130	130	145	115	204	200	210
11	260	200	200	100	160	100	130	100	90	140	120	130
12	20	95	95	100	100	90	75	75	60	130	105	120
	Forecasted Machine Requirements (hours)											
	370	330	370	350	370	350	370	370	350	300	350	300

4. Results

Table 2.4 shows the final lot-sizes and forecasted machine hour requirements for each period, and Table 2.5 shows the inventories at the end of each period for all items.

Table 2.4 Final lot-sizes and forecasted machine time requirements for Dixon-Silver heuristic.

Item No	Period 1	2	3	4	5	6	7	8	9	10	11	12
01	0	50	80	80	90	80	70	135	60	50	90	0
02	40	70	80	80	75	90	122	188	0	60	110	0
03	0	60	60	50	80	80	90	195	115	80	220	0
04	80	165	125	150	200	180	120	295	240	220	0	340
05	80	190	280	260	200	210	200	130	120	240	240	300
06	300	240	245	250	230	200	230	205	145	380	255	240
07	450	350	350	380	340	360	400	450	450	400	450	450
08	10	250	250	200	150	160	190	100	350	0	250	240
09	200	500	450	400	450	500	400	400	843	309	698	510
10	280	250	220	225	120	130	130	260	204	200	145	65
11	260	200	200	100	160	100	130	190	0	260	0	130
12	20	95	95	100	100	90	75	75	60	130	105	120
	Forecasted Machine Requirements (hours)											
	221.0	318.6	318.0	297.2	291.1	291.3	288.7	370 0	350.0	300.0	350.0	300.0

Table 2.5 Inventories at the end of each period for all items.

Item No	Period 1	2	3	4	5	6	7	8	9	10	11	12
01	60	50	50	50	50	50	50	110	110	100	140	90
02	60	60	60	60	60	60	92	200	120	120	170	120
03	50	50	50	50	50	50	50	145	170	130	270	120
04	100	100	100	100	100	100	100	245	340	320	100	220
05	130	130	130	130	130	130	130	130	130	130	130	220
06	150	150	150	150	150	150	150	150	150	150	150	200
07	100	100	100	100	100	100	100	100	100	100	100	200
08	60	60	60	60	60	60	60	60	160	60	60	200
09	100	100	100	100	100	100	100	100	243	102	100	500
10	150	150	150	150	150	150	150	265	354	350	295	210
11	90	90	90	90	90	90	90	180	90	210	90	130
12	70	70	70	70	70	70	70	70	70	70	70	100

Other results are tabulated below:

Total available machine time ($\sum_{t=1}^{H} C_t$)	: 4180.0 hour
Total setup time ($\sum_{i=1}^{N} n_i St_i$)	: 0.0 hour
where n_i is the number of setup for item i.	
Total forecasted machine time	: 3695.9 hour
Total inventory holduingcost, $C_{inv} = \sum_{i=1}^{N} \sum_{t=1}^{H} (I_{it} - SS_i)$	: Tk. 49,332.00
Total expected safety-stock cost, $C_{ST} = \sum_{i=1}^{N} SS_i$	: Tk. 159,840.00
Total expected setup cost, $C_{set} = \sum_{i=1}^{N} n_i S_i$	: Tk. 32,850.00
Total expected cost ($C_{inv} + C_{ss} + C_{set}$)	: Tk. 242,022.00

2.5.2 Results of Multi-Item Single Level Capacitated Lot-Sizing Problem with Setup Time

In the real life problem in Section 2.5.1 machine setup time to produce each product item is included. Relevant product data including setup time for each item has been presented in Table 2.6. In the present work setup time has been taken from the factory. Use of the set up time would obviously be a more realistic approach. Forecasted demands and capacities as presented in Table 2.2 are also used in the present case. The equivalent demands after considering initial inventory, ending inventory and safety stock are also same as presented in Table 2.3.The extended heuristic algorithm as developed in section 2.4 has been applied to the problem. Table 2.7 shows the final lot-sizes and forecasted machine hour requirements for each period, and Table 2.8 shows the inventories at the end of each period for all items.

Table 2.6 Relevant product data for the extended heuristic with setup time.

Item No (i)	Holding Cost (h_i)	Setup Cost (S_i)	Setup Time (St_i)	Production Rate ($1/k_i$)	Safety Stock (SS_i)	Initial Inventory (Iin_i)	Ending Inventory ($Iend_i$)
01	12.0	200.0	0.50	6	50	150	90
02	12.0	300.0	0.50	5	60	100	120
03	12.0	300.0	0.50	5	50	150	120
04	12.0	250.0	0.33	7	100	200	220
05	12.0	300.0	0.25	10	130	250	220
06	12.0	300.0	0.33	9	150	250	200
07	12.0	250.0	0.25	8	100	100	200
08	12.0	200.0	0.50	8	60	250	200
09	12.0	200.0	0.33	7	100	400	500
10	12.0	200.0	0.50	7	150	220	210
11	12.0	250.0	0.50	8	90	130	130
12	12.0	200.0	0.33	12	70	200	100

Table 2.7 Final lot-sizes and forecasted machine time requirements for the extended heuristic with setup time.

Item No	Period 1	2	3	4	5	6	7	8	9	10	11	12
01	0	50	80	80	90	80	70	135	60	50	90	0
02	40	70	80	80	75	90	170	140	0	170	0	0
03	0	60	60	50	80	80	163	218	99	0	220	0
04	80	165	125	150	200	180	120	295	240	220	0	340
05	80	190	280	260	200	210	200	130	120	240	240	300
06	300	240	245	250	230	200	230	205	145	380	255	240
07	450	350	350	380	340	360	400	450	450	400	450	450
08	10	250	250	200	150	160	190	100	350	0	250	240
09	200	500	450	400	450	500	400	400	825	325	700	510
10	280	250	220	225	120	130	130	260	204	200	175	35
11	260	200	200	100	160	100	130	190	0	159	101	130
12	20	95	95	100	100	90	75	75	60	130	105	120
	Forecasted Machine Requirements (hours)											
	224.8	323.5	322.9	302.0	296.0	296.1	317.7	369.9	348.0	299.5	349.2	298.9

Table 2.8 Inventories for the heuristic with setup time.

Item No	Period 1	2	3	4	5	6	7	8	9	10	11	12
01	60	50	50	50	50	50	50	110	110	100	140	90
02	60	60	60	60	60	60	140	200	120	230	170	120
03	50	50	50	50	50	50	123	241	250	130	270	120
04	100	100	100	100	100	100	100	245	340	320	100	220
05	130	130	130	130	130	130	130	130	130	130	130	220
06	150	150	150	150	150	150	150	150	150	150	150	200
07	100	100	100	100	100	100	100	100	100	100	100	200
08	60	60	60	60	60	60	60	60	160	60	60	200
09	100	100	100	100	100	100	100	100	225	100	100	500
10	150	150	150	150	150	150	150	265	354	350	325	210
11	90	90	90	90	90	90	90	180	90	109	90	130
12	70	70	70	70	70	70	70	70	70	70	70	100

The following results have also been found after applying the heuristic algorithm with setup time.

Table 2.9 Time and cost after applying the heuristic algorithm with setup time.

Total available machine time ($\sum_{t=1}^{H} C_t$)	: 4180.0 hour
Total setup time ($\sum_{i=1}^{N} n_i St_i$) where n_i is the number of setup for item i.	: 52.5 hour
Total forecasted machine time	: 3748.4 hour
Total inventory holduing cost, $C_{inv} = \sum_{i=1}^{N} \sum_{t=1}^{H} (I_{it} - SS_i)$	: Tk. 53,124.00
Total expected safety-stock cost, $C_{ss} = \sum_{i=1}^{N} SS_i$	: Tk. 159,840.00
Total expected setup cost, $C_{set} = \sum_{i=1}^{N} n_i S_i$	: Tk. 32,500.00
Total expected cost ($C_{inv} + C_{ss} + C_{set}$)	: Tk. 245,464.00

2.5.3 Results with the Limited Lot-Size per Setup

Relevant product data including the limited lot-size per setup for each item has been depicted in Table 2.10. The limited lot-size per setup for each item has been taken arbitrarily. The demands and capacities are extracted from Table 2.2. The equivalent demands after considering initial inventory, ending inventory and safety stock are extracted from Table 2.3. To illustrate the algorithm a few sample calculations for the period 8 have been shown. Forecasted demand and capacity with limited lot size per setup are depicted in Table 2.11.

Table 2.13 shows the final lot-sizes and forecasted machine hour requirements for each period, and Table 2.14 shows the inventories at the end of each period for all items.

Table 2.10 Relevant Product data for the heuristic with the limited lot-size per setup.

Item No	Holding Cost	Setup Cost	Maximum Lot-Size	Production Rate	Safety Stock	Initial Inventory	Ending Inventory
01	12.0	200.0	150	6	50	150	90
02	12.0	300.0	150	5	60	100	120
03	12.0	300.0	150	5	50	150	120
04	12.0	250.0	150	7	100	200	220
05	12.0	300.0	200	10	130	250	220
06	12.0	300.0	200	9	150	250	200
07	12.0	250.0	200	8	100	100	200
08	12.0	200.0	200	8	60	250	200
09	12.0	200.0	200	7	100	400	500
10	12.0	200.0	200	7	150	220	210
11	12.0	250.0	200	8	90	130	130
12	12.0	200.0	200	12	70	200	100

The maximum periodic demand for item 9 is

$$d_{\max 9} = \max\{d_{1j} \mid j = 1, 2, \ldots, H\}$$
$$= \max\{200, 500, 450, 400, 450, 500, 400, 400, 700, 450, 700, 510\}$$
$$= 700$$

The limited lot-size for item 9 is $x_{\max 9} = 200$.

Then the number of new items to be considered to satisfy demand $d_{\max 9}$ is

$$n_1 = \left\lceil \frac{d_{\max 9}}{x_{\max 9}} \right\rceil - 1 = \left\lceil \frac{700}{200} \right\rceil - 1 = 4 - 1 = 3$$

Similarly, the number of new items to be considered to satisfy demands $d_{\max i}$ are

n_1	n_2	n_3	n_4	n_5	n_6	n_7	n_8	n_9	n_{10}	n_{11}	n_{12}
0	0	1	2	1	1	2	1	3	1	1	0

Then the number of total items after limiting the lot-size is

$$N' = N + \sum_{i=1}^{N} n_i = 12 + 13 = 25.$$

Item 9 is splitted into $n_1 + 1 = 4$ items. Let the new items are $9_0, 9_1, \ldots, 9_3$.

Continue the same calculation for other demands. From Table 2.3, the new demand matrix for N'=25 items can be obtained as shown in Table 2.11.

Table 2.11 Demand after considering limitation on the maximum allowable lot-size.

Item No	Period 1	2	3	4	5	6	7	8	9	10	11	12
01_0	0	50	80	80	90	80	70	75	60	60	50	90
02_0	40	70	80	80	75	90	90	80	80	60	60	110
03_0	0	60	60	50	80	80	90	100	90	120	80	150
04_0	80	150	125	150	150	150	120	150	145	150	150	150
05_0	80	190	200	200	200	200	200	130	120	200	200	200
06_0	200	200	200	200	200	200	200	200	145	200	200	200
07_0	200	200	200	200	200	200	200	200	200	200	200	200
08_0	10	200	200	200	150	160	190	100	200	100	200	200
09_0	200	200	200	200	200	200	200	200	200	200	200	200
10_0	200	200	200	200	120	130	130	145	115	200	200	200
11_0	200	200	200	100	160	100	130	100	90	140	120	130
12_0	20	95	95	100	100	90	75	75	60	130	105	120
03_1	0	0	0	0	0	0	0	0	0	0	0	70
04_1	0	15	0	0	50	30	0	0	0	90	70	150
04_2	0	0	0	0	0	0	0	0	0	0	0	40
05_1	0	0	80	60	0	10	0	0	0	40	40	100
06_1	100	40	45	50	30	0	30	5	0	180	55	40
07_1	200	150	150	180	140	160	200	200	200	200	200	200
07_2	50	0	0	0	0	0	0	50	50	0	50	50
08_1	0	50	50	0	0	0	0	0	50	0	50	40
09_1	0	200	200	200	200	200	200	200	200	200	200	200
09_2	0	100	50	0	50	100	0	0	200	50	200	110
09_3	0	0	0	0	0	0	0	0	100	0	100	0
10_1	80	50	20	25	0	0	0	0	0	4	0	10
11_1	60	0	0	0	0	0	0	0	0	0	0	0

Initialize setup cost, holding cost and production rate for the items 9_0, 9_1, 9_2 and 9_3 from that of the item 9 as follows.

$$S_{9_0} = S_{9_1} = S_{9_2} = S_{9_3} = S_9 = 200.0,$$

$$h_{9_0} = h_{9_1} = h_{9_2} = h_{9_3} = h_9 = 12.0,$$

$$k_{9_0} = k_{9_1} = k_{9_2} = k_{9_3} = k_9 = 1/7.$$

Similarly set the value of setup cost, holding cost and production rate for the $N^* = 25$ new items from those of the N = 12 items.

Item No	Holding Cost	Setup Cost	Production Rate
01_0	12.0	200.0	6
02_0	12.0	300.0	5
03_0	12.0	300.0	5
04_0	12.0	250.0	7
05_0	12.0	300.0	10
06_0	12.0	300.0	9
07_0	12.0	250.0	8
08_0	12.0	200.0	8
09_0	12.0	200.0	7
10_0	12.0	200.0	7
11_0	12.0	250.0	8
12_0	12.0	200.0	12
03_1	12.0	300.0	5
04_1	12.0	250.0	7
04_2	12.0	250.0	7
05_1	12.0	300.0	10
06_1	12.0	300.0	9
07_1	12.0	250.0	8
07_2	12.0	250.0	8
08_1	12.0	200.0	8
09_1	12.0	200.0	7
09_2	12.0	200.0	7
09_3	12.0	200.0	7
10_1	12.0	200.0	7
11_1	12.0	250 0	8

Now apply the modified Dixon-Silver heuristic with the limited lot-size for 25 items. The lot sizes for the new items are shown in Table 2.12.

Table 2.12 Lot sizes for $N' = 25$ items.

Item No	Period 1	2	3	4	5	6	7	8	9	10	11	12
01_0	50	150	150	0	150	0	150	0	0	45	90	0
02_0	110	150	150	0	150	0	45	0	150	50	110	0
03_0	120	0	50	0	150	150	50	0	150	150	0	140
04_0	150	150	150	55	150	150	150	120	150	150	150	145
05_0	200	200	200	70	200	200	200	130	200	200	200	120
06_0	200	200	200	200	200	200	200	200	200	200	200	145
07_0	200	200	200	200	200	200	200	200	200	200	200	200
08_0	10	200	200	200	200	200	200	0	200	100	200	200
09_0	200	200	200	200	200	200	200	200	200	200	200	200
10_0	200	200	200	200	200	200	200	200	40	0	200	200
11_0	200	200	200	200	200	200	0	200	20	120	130	0
12_0	200	110	0	200	0	200	0	0	200	35	120	200
03_1	0	0	0	0	0	0	0	0	0	0	70	0
04_1	15	0	0	80	0	0	0	0	150	10	150	150
04_2	0	0	0	0	0	0	0	0	0	0	40	0
05_1	0	140	0	0	10	0	0	0	80	0	100	0
06_1	200	0	35	0	30	35	0	0	200	75	0	0
07_1	200	200	200	200	200	200	200	200	200	200	0	180
07_2	50	0	0	0	0	0	50	0	50	100	0	0
08_1	100	0	0	0	0	0	0	50	0	90	0	0
09_1	0	200	200	200	200	200	200	200	200	200	200	200
09_2	150	0	0	150	0	0	0	200	50	0	200	110
09_3	0	0	0	0	0	0	0	100	0	100	0	0
10_1	175	0	0	0	0	0	0	0	4	0	10	0
11_1	60	0	0	0	0	0	0	0	0	0	0	0

Convert the $N' \times H$ lot-sizing matrix into $N \times H$ lot-sizing matrix by applying the formula

$$x_{i,j} = \sum_{l=0}^{n_i} x_{i_l,j}.$$

As an example let us compute $x_{9,8}$.

$$x_{9,8} = \sum_{l=0}^{n_1} x_{9_l,8}$$

$$= \sum_{l=0}^{3} x_{9_l,8}$$

$$= x_{9_0,8} + x_{9_1,8} + x_{9_2,8} + x_{9_3,8}$$

$$= 200 + 200 + 200 + 100$$

$$= 700.$$

Table 2.13 Final lot-sizes and forecasted machine time requirements for the heuristic with the limited lot-size per setup.

Item No	Period 1	2	3	4	5	6	7	8	9	10	11	12
01	50	150	150	0	150	0	150	0	0	45	90	0
02	110	150	150	0	150	0	45	0	150	50	110	0
03	120	0	50	0	150	150	50	0	150	150	70	140
04	165	150	150	135	150	150	150	120	300	160	340	295
05	200	340	200	70	210	200	200	130	280	200	300	120
06	400	200	235	200	230	235	200	200	400	275	200	145
07	450	400	400	400	400	400	450	400	450	500	200	380
08	110	200	200	200	200	200	200	50	200	190	200	200
09	350	400	400	550	400	400	400	700	450	500	600	510
10	375	200	200	200	200	200	200	200	44	0	210	200
11	260	200	200	200	200	200	0	200	20	120	130	0
12	200	110	0	200	0	200	0	0	200	35	120	200
	Forecasted Machine Requirements (hours)											
	365.1	327.5	318.3	272.3	338.7	299.9	274.6	262.2	346.3	296.5	343.8	288.8

Table 2.14 Inventories for the heuristic with the limited lot-size per setup.

Item No	Period 1	2	3	4	5	6	7	8	9	10	11	12
01	110	200	270	190	250	170	250	175	115	100	140	90
02	130	210	280	200	275	185	140	60	130	120	170	120
03	170	110	100	50	120	190	150	50	110	140	130	120
04	185	170	195	180	130	100	130	100	255	175	295	370
05	250	400	320	130	140	130	130	130	290	250	310	220
06	250	210	200	150	150	185	155	150	405	300	245	200
07	100	150	200	220	280	320	370	320	320	420	170	200
08	160	110	60	60	110	150	160	110	60	150	100	200
09	250	150	100	250	200	100	100	400	150	200	100	500
10	445	395	375	350	430	500	570	625	554	350	360	410
11	90	90	90	190	230	330	200	300	230	210	220	130
12	400	415	320	420	320	430	355	280	420	325	340	450

The following results have also been found after applying the heuristic algorithm with the limited lot-size per setup.

Total available machine time ($\sum_{i=1}^{H} C_t$)	: 4180.0 hour
Total setup time ($\sum_{i=1}^{N} n_i St_i$) where n_i is the number of setup for item i.	: 0.0 hour
Total forecasted machine time	: 3734.0 hour
Total inventory holduingcost, $C_{inv} = \sum_{i=1}^{N} \sum_{t=1}^{H} (I_{it} - SS_i)$	: Tk. 227,208.00
Total expected safety-stock cost, $C_{ss} = \sum_{i=1}^{N} SS_i$	: Tk. 159,840.00
Total expected setup cost, $C_{set} = \sum_{i=1}^{N} n_i S_i$	: Tk. 44,350.00
Total expected cost ($C_{inv} + C_{ss} + C_{set}$)	: Tk. 431,398.00

The results of three models have been summarized below.

Parameter	**Dixon & Silver**	**With Set up Time**	**With Limited Lot-size**
Total available machine time	4180.0 hr	4180.0 hr	4180.0 hr
Total forecasted machine time	3695.9 hr	3748.4 hr	3734.0 hr
Total Set-up time requirements	0.0 hr	52.5 hr	0.0 hr
Total inventory holding cost	Tk.49,332.00	Tk.53,124.00	Tk.227,208.00
Total safety stock cost	Tk.159,840.00	Tk.159,840.00	Tk.159,840.00
Total setup cost	Tk.32,850.00	Tk.32,500.00	Tk.44,350.00
Total expected cost	Tk.242,022.00	Tk.245,464.00	Tk.431,398.00

The inclusion of setup time will result in machine occupation time to be increased. The consideration of set up time also led to increase in inventory holding cost. This increase in cost could be attributed to increased inventory held for meeting demand of the later period.

Effect of the limitation on the lot-size is dependent on the extent of reduction of the lot-size. It is obvious that the smaller the allowable lot-size, the greater will be the number of setup which will eventually lead to more splitted items. This in turn led to the increase number of required setups.

Costs due to implementation of this restriction on lot-size went up quite significantly. Further decrease in lot-size would obviously result in higher costs. But at the lower range of allowable lot-size, there has been a trend of slight increase in setup costs.

2.6 Conclusions

Lot-sizing problem has been recognized to be one of most important functions in industrial units. Thus efforts have been given to develop usable optimizing routines but within limited boundary conditions. Various models have been developed with restricted applications in real-life settings because of their demanding computational enormisity. Thus heuristic models have been evolved. These heuristics have given feasible solutions. The Dixon-Silver heuristic was used in the present work. The heuristic was extended to include two very important parameters such as, (i) plant or machine set up time and (ii) maximum limit of production lot-size from a machine. From analysis and results, the present work has demonstrated that feasible solutions could be obtained with competitive computer usage. The results of the two heuristics developed in the present work, have been discussed in Section 2.5.

Chapter 3
Scheduling

3.1 Introduction

Operations schedules are short-term plans designed to implement the master production schedule. Operations scheduling focuses on how best to use existing capacity, taking into account technical production constraints. Often several jobs must be processed at one or more workstations. Typically, a variety of tasks can be performed at each workstation. If schedules are not carefully planned to avoid bottlenecks, waiting lines may develop. In poorly scheduled job shops, it is not at all uncommon for jobs to wait for 95 percent of their total production cycle. This results in a long workflow cycle. A schedule is a timetable for performing activities, utilizing resources, or allocating facilities.

Most real-world scheduling problems are naturally multi-criterion. However, due to the lack of suitable solution techniques such problems are usually transformed into a single-objective problem. A solution is called *Pareto-optimal* if it is not possible to decrease the value of one objective without increasing the value of the other [34]. The difficulty that arises with this approach is the rise of a set of Pareto-optimal solutions, instead of a single optimum solution.

A Pareto-optimal solution is developed in this research work for a scheduling problem on a single machine with periodic maintenance and non-preemptive jobs. In literature, most of the scheduling problems address only one objective function, while in the real world, such problems are always associated with more than one objective. In this research work, both multi-objective functions and multi-maintenance periods are considered for the machine scheduling problem. To avoid the complexities involved in solving an explicit multi-objective optimization problem, multiple objective functions are consolidated and transformed into a single objective function after they are weighted and assigned proper weighting factors. In addition, periodic maintenance schedules are also considered in the model. The objective of the model addressed in this research work is to minimize the weighted function of the total job flow time, the maximum tardiness, and the machine idle time in a single machine problem with periodic maintenance and non-preemptive jobs. An algorithm is developed to solve this multiple criterion problem and to construct the pareto-set. The parametric analysis of the trade-offs of all solutions with all possible weighted combination of the criterions is analyzed. The result of a neighborhood search heuristic is also provided. Results are provided to explore the best schedule among all the Pareto-optimal sets and to compare the result of the modified Pareto-optimal algorithm with the result of the neighborhood search heuristic.

3.2 Literature Study

Most real-world scheduling problems are naturally multi-criterion. However, due to the lack of suitable solution techniques such problems are usually transformed into a single-objective problem. A solution is called *Pareto-optimal* if it is not possible to decrease the value of one objective without increasing the value of the other [34]. The difficulty that arises with this approach is the rise of a set of Pareto-optimal solutions, instead of a single optimum solution.

There are several approaches that deal with the multi-objective problems. Traditionally, the most common way is to combine the multiple criterions into a single scalar value by using weighted aggregating functions according to the preferences set by the scheduler (or decision-makers) and then to find a compromise solution that reflects these preferences [35]. However, in many real scenarios involving multi-criterion scheduling problems, it is preferable to present a set of promising solutions to the decision-makers so that the most adequate schedule can be chosen. This has increased the interest in investigating the application of Pareto-optimization techniques to multi-criterion scheduling problems. The aim in Pareto-optimization is to find a set of compromised solutions that represent a good approximation to the Pareto-optimality [34]. In recent years, several algorithms proposed for Pareto-optimization have been published because multi-objective optimization problems exist in almost any domain [36, 37]. The job shop scheduling problem (JSP) with a single objective is a widely researched problem in the area of production scheduling. In a job shop, several jobs require scheduling, each with different processing times on different machines. Many applications of JSPs in industry have been discussed in the literature. Operations research practitioners, production management experts, management scientists, mathematicians and computer scientists have discussed the scheduling theory. The solution procedure for solving the JSP differs as the objective of the scheduling differs. Most of the researchers concerning the job shop scheduling problem have focused on developing scheduling algorithms for a single objective measure. Much work has been done to solve JSPs by using single objective meta-heuristic procedures like simulated annealing algorithm, genetic algorithm and tabu search algorithm. These algorithms are generic optimization algorithms, i.e. they are intended for use on a wide range of optimization problems [38]. The real-world scheduling problems are multi-objective in nature. In such cases, several objectives are considered simultaneously when a schedule is generated. Simultaneous consideration of several objectives during scheduling totally modifies the scheduling approach. A scheduler who improves the schedule with respect to one objective may want to know how the schedule performs with respect to the other objectives. Thus the goal is to generate a feasible schedule that minimizes several objectives. This schedule is called a *Pareto optimal solution*. A single feasible schedule that minimizes several objectives may not exist. In other words, individual optimal solutions of each objective are usually different. Under such situations, the scheduler may be interested in having a schedule with weighted combination of several scheduling objectives as the performance measure. It is possible that the weights of various objectives are known before scheduling. This approach [38] permits computing of a unique strict Pareto optimal solution. It is also possible that the decision maker wants to choose a Pareto optimal solution according to the priorities existing at the time of decision making. In that case, a family of best trade-off schedules called the Pareto optimal set is to be found. The set of Pareto solutions is called the *Pareto front*. Therefore solving a multi-objective scheduling problem is a Pareto optimization problem. Generating the Pareto optimal set for the scheduling problem can be computationally expensive and is often infeasible, because of the complexity of the scheduling problem [38]. Moreover, when meta-heuristics are used, there is no guarantee that the Pareto set for a given multi-objective optimization problem like multi-objective scheduling can be generated. However, a set of non-dominated solutions can be generated close to the Pareto optimal set [38]. Many real-world optimization problems involve multiple (and often conflicting) objectives. These problems are relevant in a variety of engineering disciplines, scientific fields, and various industrial applications. Unlike single objective optimization problems, where one attempts to find the best solution (global optimum), in multi objective optimization problems, there may not exist one solution that corresponds to the best with respect to all objectives. Solving a multi-objective optimization problem consists of generating the Pareto frontier, the set of non-dominated solutions that represents the trade-off among the objective function values. Different approaches are used to approximate and generate such sets of Pareto optimal solutions. Some interactive approaches incorporate preferences into the optimization procedure to explore a specific region of the solution space, while other approaches focus on generating diverse sets of Pareto optimal solutions. Such sets of Pareto optimal solutions can be extremely large, which motivates the need for post-optimality analysis for multi objective optimization problems. The area of post-optimality analysis addressed in this paper focuses on obtaining a preferred subset of solutions from a very large set of solutions with acceptable objective function values. The goal in obtaining large sets of Pareto optimal solutions is to provide the decision-maker with a diverse set of such solutions. Although obtaining diverse Pareto optimal solutions is important, it is often impractical for a human decision-maker to manually examine each such solution, and hence, efficiently identify a good subset of such solutions. Previous research in this area has focused on generalizing the representation of the full set of Pareto optimal solutions with a smaller subset [39]. Such procedures are not post-optimality analysis procedures, but rather, extensions to multi-objective optimization procedures, which are designed to generate diverse sets of Pareto optimal solutions. Another area of research that incorporates preferences into the optimization procedures are interactive methods. These interactive methods provide a decision-maker with better control over the optimization process, allowing them to explore specific regions of the search space. However, solutions obtained are quite sensitive towards the preferences of the decision-maker. These approaches also require the decision-maker to have a thorough knowledge of the problem. This paper [39] analyzes a discrete optimization problem formulation for obtaining a preferred subset of Pareto optimal solutions from a larger set. This formulation alleviates the sensitivity of value function approaches, while obtaining a desired size subset of Pareto optimal solutions [39]. In recent years, several variations of multi objective evolutionary algorithms (MOEAs) [40] have been developed to handle MOPs [35]. Many of the suggested MOEAs have been employed in a variety of real-world applications [40]. These next generation algorithms have been improved in three dimensions compared to the previous generation of MOEAs introduced in the 1990's, which include the first (original) version of the non dominated sorting genetic algorithm (NSGA) of Srinivas and Deb (1994), the niched Pareto genetic algorithm (NPGA) of Nafploitis et al. (1994) and the multi objective genetic algorithm (MOGA) of Fonseca and Flemming (1993). First, the computational complexity of the existing MOEAs has been reduced from *O(mN3)* of the first generation to *O(mN2)* of the second generation so that solving larger-sized problems is not as computationally burdensome. [40]. The *m* and *N* are the number of objectives and the population size, respectively. Second, some degree of elitism is incorporated in most MOEAs to ensure the propagation of good non dominated solutions for faster convergence. In expensive MOPs, fast convergence towards Pareto optimal solutions is a highly desired feature of any promising algorithm. Third, new diversification strategies that are insensitive to the selection of the sharing factor have been employed. Given the variations of MOEAs, the idea of using dynamic population sizing has not been thoroughly investigated, and to date only a few studies have explored this idea. For example, Tan et al. (2001) introduced an increment in MOEA that uses dynamic population sizing based on the online discovered Pareto front and its desired population distribution density [40]. In another study, Shen and Daskin (2005) suggest a MOEA-based heuristic approach for finding tradeoffs between customer service and cost in an integrated supply chain design using a dynamic population sizing scheme. However, they do not address how the growing population size is controlled.

The related work of Farina et al. (2004) addresses dynamic MOPs, where the optimization is time-dependent and the objective functions, the constraints and/or the parameters of the problem, not the MOEA, vary with time (i.e., at each iteration of the optimization process). In this study [40], considering static MOPs, where optimization using FPGA is performed offline, and the characteristics of the MOP are not time-dependent. The majority of evolutionary multi objective optimization (EMO) studies that propose new MOEAs for solving MOPs evaluate the performance of those algorithms over a large number of generations (or solution evaluations). However, there is now a growing need for designing MOEAs capable of dealing with computationally- and/or financially-expensiveMOPs. Little work exists that considers expensive MOPs. Additionally, many real-world problems involve complicated, "black-box" objective functions that can make a large number of solutions evaluations computationally prohibitive [40]. Furthermore, repeatedly evaluating such complicated objective functions can be demanding on resources. Specifically, the motivation comes from simulation-based optimization research. Computer simulation of real-world systems tends to involve the construction of complicated models that capture the complex, nonlinear interrelationships between independent and dependent variables and can report the value of several system performance objectives simultaneously. These models [40] are used to evaluate candidate system design solutions in search of the best solution (or set of solutions) according to several performance objectives.

A multi-objective optimization algorithm capable of rapidly finding a diverse set of Pareto optimal solutions would be greatly beneficial in such a situation. The purpose of this research is to propose a multi-objective optimization methodology that finds evenly-distributed Pareto optimal solutions in a computationally-efficient manner. In addition to multiple objectives, periodic maintenance is also considered for this scheduling problem. An unexpected breakdown will make the shop behavior hard to predict, and thereby will reduce the efficiency of the production system. Maintenance can reduce the breakdown rate with minor sacrifices in production [41].

In literature, there are several approaches for handling multi-criterion problems. Branch and Bound technique is one of those approaches that could obtain a better solution for such problems. Branch and bound technique explores all the possible enumerations to find the best sequence with minimum value in $O(2^n)$ time complexity [42]. Liao and Chen [41] address minimizing the maximum tardiness of jobs in a periodically maintained single machine problem. A branch and bound algorithm is developed to find the optimal solution, and a heuristic solution is also devised for handling the large problem. The larger is the neighborhood, the better is the quality of the locally optimal solutions, and the greater is the accuracy of the final solution. At the same time, searching larger neighborhoods requires more time at each stage. Because of many runs of a neighborhood search algorithm, longer execution times per run lead to fewer runs within a specified time. For this reason, a larger neighborhood can produce a more effective heuristic algorithm only if the larger neighborhood can be searched in a very efficient manner. A survey of large-scale neighborhood search algorithms can be found in Ahuja [43]. For the single-machine problem, Adiri [44] assumes two cases of a breakdown, that is, the resumable and non-resumable cases assuming that machine idle time is unknown and follow a probabilistic distribution pattern. Mosheiov [45] solves the minimization of total completion time for two-parallel-machine-scheduling problem by assuming each machine is available in a specified interval. Lee [46] also studies in this area for other machine configurations including single and parallel machines.

Problem of scheduling on a single machine to minimize total weighted tardiness of jobs can be described as follows: there are n jobs to be processed, each job has an integer processing time, a weight and a due date. The objective is to minimize the total weighted tardiness of jobs. The problem belongs to the class of NP-hard problems. Some new properties of the problem associated with the blocks have been presented and discussed. These properties allow any to propose a new fast local search procedure based on a Tabu search approach with a specific neighborhood which employs blocks of jobs and a compound moves technique. A compound move consists in performing several moves simultaneously in a single iteration of algorithm and allows any to accelerate the convergence to good solutions. In the algorithm [47], an idea has been used which decreases the complexity for the search of neighborhood from O(n3) to O(n2). Additionally, the neighborhood is reduced by using some elimination criteria. The method presented in this paper [47] is deterministic one and has not any random element, as distinct from other effective but non-deterministic methods proposed for this problem, such as Tabu search of Crauwels, H. A. J., Potts, C. N., & Van Wassenhove, L. N. (1998) Computational experiments on the benchmark instances from OR-Library (http://people.brunel.ac.uk/ mastjjb/jeb/info.html) are presented and compared with the results yielded by the best algorithms discussed in the literature. These results show that the algorithm proposed allows us to obtain the best known results for the benchmarks in a short time. The presented properties and ideas can be applied in any local search procedures [47].

In many manufacturing systems, jobs that are completed early are held as finished-goods inventory until their due-dates, and hence one incurs earliness costs. Similarly, jobs that are completed after their due-dates incur penalty. The objective in such situations would, therefore, be to meet the due-dates of the respective jobs as closely as possible, and consequently minimize the sum of earliness and tardiness of jobs because earliness and tardiness of jobs greatly influence the performance of a schedule with respect to cost. In addition, a job incurs holding cost from the time of its arrival until its completion. Most studies on scheduling in such manufacturing systems assume unit earliness cost, unit tardiness cost and unit holding cost of a job. However, in reality such an assumption need not always hold and it is quite possible that there exist different costs of earliness, tardiness and holding for different jobs. In addition, most studies on job-shop scheduling assume that jobs are independent and that no assembly operations exist. The study [48] addresses the problem of scheduling in dynamic assembly job-shops (i.e. shops that manufacture multi-level jobs) with the consideration of jobs having different earliness, tardiness and holding costs. An attempt is made in this paper to present dispatching rules by incorporating the relative costs of earliness, tardiness and holding of jobs in the form of scalar weights. In the first phase of the study, relative costs (or weights for) earliness and tardiness of jobs are considered, and the dispatching rules are presented in order to minimize the sum of weighted earliness and weighted tardiness of jobs. In the second phase of the study, the objective considered is the minimization of the sum of weighted earliness, weighted tardiness and weighted flow time of jobs, and the dispatching rules are presented by incorporating the relative costs of earliness, tardiness and flow time of jobs. Simulation studies have been conducted separately for both phases of the current study, the performance of the scheduling rules have been observed independently, and the results of the simulation study have been reported. The proposed rules are found to be effective in minimizing the mean and maximum values of the measures of performance [48].

This paper [49] studies two models of two-stage processing with flow shop at the first stage followed by open shop at the second stage. The first model involves multiple machines at the first stage and two machines at the second stage, and the other involves multiple machines at both stages. In both models, the objective is to minimize the makespan. This problem is NP-complete, for which an efficient heuristic solution algorithm is constructed and its worst-case performance guarantee is analyzed for both models. An integer programming model and a branch and bound algorithm are proposed for model 1 and a lower bound is developed for model 2 as benchmarks for the heuristic algorithms. Computational experiences show that the heuristic algorithms consistently generate good schedule and the branch and bound algorithm is much efficient than the integer-programming model.

This research [50] presents an interesting scheduling problem common to freight consolidation terminals. This previously unstudied problem involves scheduling a set of inbound trailers to a fixed number of unload docks. The objective is to schedule the trailers to the unload docks to minimize the time span of the transfer operation. This study focuses on freight consolidation terminals in the parcel delivery industry. A simulation-based scheduling algorithm that uses a genetic algorithm to drive the search for new solutions is proposed. In addition to the introduction and discussion of the parcel hub scheduling problem, the contribution of this research is an approach that serves as the initial effort to solve this practical problem.

This work [51] presents the development and implementation of a production scheduling system for an electrical appliance manufacturer. Based on recent advances in optimization-based scheduling approaches, two different software architectures based on two different scheduling formulations, namely the RTN and the STN, are proposed to integrate information available in the different production units and stages with formal algorithmic tools. Optimization results indicate that significant economic benefits can be achieved (e.g. minimization of total operating costs) while ensuring full customer satisfaction as opposed to normal practices followed in the company relying on human expertise. The work indicates that it is possible to solve real-life manufacturing problems using optimization-based approaches but the integration of information in a timely fashion seems to be a major factor in successfully implementing the system and fully realizing its benefits.

The paper [52] deals with the problem of finding a job sequence that minimizes the makespan in m-machine flow shops under the no-idle condition. This condition requires that each machine must process jobs without any interruption from the start of processing the first job to the completion of processing the last job. Since the problem is NP-hard, we propose a constructive heuristic for solving it that significantly outperforms heuristics known so far.

This paper [53] considers the n-job, m-machine permutation flow shop with the objective of minimizing the mean flow time. Initial sequences that are structured to enhance the performance of local search techniques are constructed from job rankings delivered by a trained neural network. The network's training is done by using data collected from optimal sequences obtained from solved examples of flow shop problems. Once trained, the neural network provides rankable measures that can be used to construct a sequence in which jobs are located as close as possible to the positions they would occupy in an optimal sequence. The contribution of these 'neural' sequences in improving the performance of some common local search techniques, such as adjacent pairwise interchange and Tabu search is examined. Tests using initial sequences generated by different heuristics show that the sequences suggested by the neural networks are more effective in directing neighborhood search methods to lower local optima.

This paper [54] deals with the production and preventive maintenance control problem for a multiple-machine manufacturing system. The objective of such a problem is to find the production and preventive maintenance rates for the machines so as to minimize the total cost of inventory/backlog, repair and preventive maintenance. A two-level hierarchical control model is presented, and the structure of the control policy for both identical and non-identical manufacturing systems is described using parameters, referred to here as *input factors*. By combining analytical formalism with simulation-based statistical tools such as experimental design and response surface methodology, an approximation of the optimal control policies and values of input factors are determined. The results obtained extend those available in existing literature to cover non-identical machine manufacturing systems. A numerical example and a sensitivity analysis are presented in order to illustrate the robustness of the proposed approach. The extension of the proposed production and preventive maintenance policies to cover large systems (multiple machines, multiple products) is discussed..

This paper [55] deals with the problem of selecting and scheduling the orders to be processed by a manufacturing plant for immediate delivery to the customer site. Among the constraints to be considered are the limited production capacity, the available number of vehicles and the time windows within which orders must be served. At first the problem has been described as it occurs in practice in some industrial environments, and then has been presented an integer programming model that maximizes the profit due to the customer orders to be processed. A Tabu search-based solution procedure to solve this problem is developed and tested empirically with randomly generated problems. Comparisons with an exact procedure show that the method finds very good-quality solutions with small computation requirements.

The genetic algorithm with search area adaptation (GSA) has a capacity for adapting to the structure of solution space and controlling the tradeoff balance between global and local searches, even if one does not adjust the parameters of the genetic algorithm (GA), such as crossover and/or mutation rates [56]. But, GSA needs the crossover operator that has ability for characteristic inheritance ratio control. In this paper, the modified genetic algorithm has been proposed with search area adaptation (mGSA) for solving the Job-shop scheduling problem (JSP). Unlike GSA, the proposed method does not need such a crossover operator. To show the effectiveness of the proposed method, numerical experiments have been conducted by using two benchmark problems. It is shown that this method has better performance than existing Gas [56].

The effectiveness of the solution method based on simulated annealing (SA) mainly depends on how to determine the SA-related parameters. A scheme as well as parameter values for defining an annealing schedule should be appropriately determined, since various schemes and their corresponding parameter values have a significant impact on the performance of SA algorithms. In this paper [57], based on robust design a new annealing parameter design method has been proposed for the mixed-model sequencing problem which is known to be NP-hard. To show the effectiveness of the proposed method, extensive computation experiments are conducted. It was found that the robust designed method outperforms the SA algorithm.

One of the basic and significant problems [58], that a shop or a factory manager is encountered, is a suitable scheduling and sequencing of jobs on machines. One type of scheduling problem is job shop scheduling. There are different machines in a shop of which a job may require some or all these machines in some specific sequence. For solving this problem, the objective may be to minimize the makespan. After optimizing the makespan, the jobs sequencing must be carried out for each machine. The above problem can be solved by a number of different methods such as branch and bound, cutting plane, heuristic methods, etc. In recent years, researches have used genetic algorithms, simulated annealing, and machine learning methods for solving such problems. In this paper, a simulation model is presented to work out job shop scheduling problems with the objective of minimizing makespan. The model has been coded by Visual SLAM which is a special simulation language. The structure of this language is based on the network modeling. After modeling the scheduling problem, the model is verified and validated. Then the computational results are presented and compared with other results reported in the literature. Finally, the model output is analyzed.

This paper [59] considers the problem of scheduling part families and jobs within each part family in a flow shop manufacturing cell with sequence dependent family setups times where it is desired to minimize the makespan while processing parts (jobs) in each family together. Two evolutionary algorithms — a Genetic Algorithm and a Memetic Algorithm with local search — are proposed and empirically evaluated as to their effectiveness in finding optimal permutation schedules. The proposed algorithms use a compact representation for the solution and a hierarchically structured population where the number of possible neighborhoods is limited by dividing the population into clusters. In comparison to a Multi-Start procedure, solutions obtained by the proposed evolutionary algorithms were very close to the lower bounds for all problem instances. Moreover, the comparison against the previous best algorithm, a heuristic named CMD, indicated a considerable performance improvement.

This paper [60] studies the single machine scheduling problem for the objective of minimizing the expected number of tardy jobs. Jobs have normally distributed processing times and a common deterministic due date. A new approach has been developed for this problem that generate near optimal solutions. The original stochastic problem is transformed into a non-linear integer programming model and its relaxations. Computational study validates their effectiveness by comparison with optimal solutions.

This paper [61] considers the evaluation of the worst-case performance ratio between the best solution of the flow shop problem and the permutation flow shop with time delays considerations. It is observed that, even in the restricted case of two machines and unit execution time operations, the two models may generate different optimal values for the makespan. More specifically, it is shown that, in the two-machine case, the performance ratio between the best permutation schedule and the best flow shop schedule is bounded by 2. When the operations of the n jobs are restricted to be unit execution time, this ratio is reduced to $(2 - (3/n + 2))$ for the two-machine case, and is m for the m-machine case.

In this paper [62], filtered and recovering beam search algorithms for the single machine earliness/tardiness scheduling problem with no idle time has been presented and compared them with existing neighborhood search and dispatch rule heuristics. Filtering procedures using both priority evaluation functions and problem-specific properties have been considered. The computational results show that the recovering beam search algorithms outperform their filtered counterparts, while the priority-based filtering procedure proves superior to the rules-based alternative. The best solutions are given by the neighborhood search algorithm, but this procedure is computationally intensive and can only be applied to small or medium size instances. The recovering beam search heuristic provides results that are close in solution quality and is significantly faster, so it can be used to solve even large problems.

Scheduling for the flexible job-shop [63] is very important in both fields of production management and combinatorial optimization. However, it is quite difficult to achieve an optimal solution to this problem with traditional optimization approaches owing to the high computational complexity. The combining of several optimization criteria induces additional complexity and new problems. Particle swarm optimization is an evolutionary computation technique mimicking the behavior of flying birds and their means of information exchange. It combines local search (by self experience) and global search (by neighboring experience), possessing high search efficiency. Simulated annealing (SA) as a local search algorithm employs certain probability to avoid becoming trapped in a local optimum and has been proved to be effective for a variety of situations, including scheduling and sequencing. By reasonably hybridizing these two methodologies, an easily implemented hybrid approach for the multi-objective flexible job-shop scheduling problem (FJSP) has been developed. The results obtained from the computational study have shown that the proposed algorithm is a viable and effective approach for the multi-objective FJSP, especially for problems on a large scale.

In this study, a modified Pareto-optimal algorithm (determining the trade-offs between total completion time and maximum lateness) is developed for the multi-criterion scheduling problem with periodic maintenance. The specific problem considered in this paper is to minimize flow time, maximum lateness and machine idle time. These multiple objectives are transformed into a single objective function, cost function, by using an aggregate weighted sum method. All possible weight combinations are calculated for each sequence of Pareto-optimal set to present different level of importance of each objective. On the other hand, to generate various sets of Pareto-optimal sequences from different maintenance plans, different values for both time interval between two maintenance periods and amount of time to perform maintenance are computed for the same instance. Various maintenance plans give more flexibility to the scheduler (or decision-maker) to make a decision according to both his preferences and maintenance necessity/availability. A neighborhood search heuristic is also applied to the same instance in order to compare it with the modified algorithm.

3.3 Problem Description

There are n independent non-preemptive jobs, that is, once a job is started it must be completed to process them on a single machine without interruption. Each job j becomes available for processing at ready time zero and has a due date d_j. At every T unit of time, the machine is seized to hold for maintenance. A number of jobs that are grouped together to fit in every T amount of time is a *batch*. There could be machine idle time, I_b, before the maintenance starts after the last job in a batch is completed. The maintenance period is M which is also a fixed time. The total machine idle time is obtained by adding the idle time of all the batches.

The algorithm presented here for the problem combines all the criterions together in one schedule. The new approach starts with an initially obtained set of Pareto-optimal schedule for flow time and maximum tardiness minimization problem. It then includes machine idle time I and maintenance time M in each of these initially found sequences. Once the rescheduling of machine maintenance and idleness period of machine is completed, it then calculates the new values of flow time, maximum tardiness and machine idle time for which the assigned weights are w_1, w_2, and w_3, respectively.. All possible weight combinations, satisfying $w_1 + w_2 + w_3 = 1$, are assigned for criterions in each schedule of Pareto-optimal set. The minimum total cost among all the Pareto-optimal sequences according to certain weighted parameters gives the best sequence for the problem. It is clear that the problem is *NP*-hard since the problem that minimizes the maximum tardiness subject to periodic maintenance period and nonresumable jobs is *NP*-hard [41].

For two or more contradictory criterions, each criterion corresponds to a different optimal solution, but none of these trade-off solutions is optimal with respect to all criterions [35]. Thus, multi-criterion optimization does not try to find one optimal solution but a set of trade-off solutions. The fundamental difference is that multi-objective optimization deals with a set of Pareto-optimal solutions. The best schedule among the set that gives the most promising result for a particular set of weighted criterions is found.

Notation

The following notations are used throughout this work:

n	Number of jobs for processing at time zero
J_j	Job number j, $(j=1,2,\ldots,n)$
p_j	Processing time of job j
p_{ji}	Processing time of job j in batch i
C_j	Completion time of job j
d_j	Due date of job j
L_j	Lateness of job j, where $L_j = C_j - d_j$
T_j	Tardiness of job j, where $T_j = max\{0; L_j\}$, $L_{max} = \max_j\{T_j\}$
T	Time interval between two maintenance periods

M Amount of time to perform one maintenance

I_{bi} Machine idle time in batch i, (i= 1, 2, ..., r)

I Total machine idle time of a schedule

T_{bi} Total processing time for scheduled jobs in batch i, (i= 1, 2, ...,r)

m Iteration number.

3.4 Pareto-Optimal Algorithm

When there are multiple objectives, the concept of Pareto-optimality plays a role in scheduling. A schedule is Pareto-optimal if it is impossible to improve on one of the objectives without making at least one other objective worse. The scheduler may want to view a set of Pareto-optimal schedules before deciding which schedule to select, when there are multiple objectives. In this paper, the algorithm of determining trade-offs between total completion time and maximum lateness, initially proposed by Pinedo [34], is modified and extended, which includes periodic maintenance. In addition to the total completion time and the maximum lateness, the machine idle time is also considered as the third objective. A set of Pareto-optimal schedules represent the trade-offs between total completion time, maximum lateness and machine idle time.

There are many sequencing rules that can be applied to the jobs through the machines in a job shop according to the preferences. Two of those basic sequencing rules, shortest processing time (SPT) and earliest due date (EDD) are adapted in the modified Pareto-optimal algorithm. For explanatory convenience, we define two terms that are needed in the algorithm. The machine idle time of a batch, I_{bi}, is defined as the time by subtracting the total processing time for scheduled jobs in a batch, T_{bi}, from the time interval between two maintenance periods T (i.e., $I_{bi} = T - T_{bi}$). The total machine idle time of a schedule, I, is defined by summing all machine idle time of all batches (i.e., $I = \sum_{i=1}^{k} I_{bi}$).

Pareto-optimal algorithm determines the trade-offs between total completion time and maximum lateness only as initially presented by Pinedo [34]. A third objective, machine idle time, is added and the stated algorithm is modified and extended accordingly. The steps of the modified Pareto-optimal algorithm are outlined as follows:

Algorithm 1: *Modified Pareto-Optimal Algorithm*

Step 1. Set $m = 1$ (number of iteration)

a) Schedule the jobs by SPT rule and apply EDD rule to the jobs with same processing time as schedule $S_{SPT/EDD}$

b) Compute L_{max} *(SPT/EDD)*

c) Go to Step 8 to find machine idle time in the schedule $S_{SPT/EDD}$ and the revised $S_{SPT/EDD}$ is now called $S^*_{SPT/EDD}$ when maintenance time is included.

Step 2. Set $m = 2$

a) First schedule the jobs by EDD rule, and apply SPT rule to the jobs with same due date, as schedule $S_{EDD/SPT}$

b) Compute L_{max}*(EDD/SPT)*

c) Go to Step 8 to find machine idle time in the schedule $S_{EDD/SPT}$ and, on inclusion of maintenance time the revised $S_{EDD/SPT}$ is called $S^*_{EDD/SPT}$.

Step 3. Iteration $m = 3$.

Set $L_{max} = L_{max}(EDD)$ and $\bar{d}_j = d_j + L_{max}$.

Step 4. Set $k = n$, $J^c = \{1,...,n\}$, $\tau = \sum_{j=1}^{n} p_j$ and $\delta = \tau$.

Step 5. Find j^* in J^c such that

$\bar{d}_{j^*} \geq \tau$, and $p_{j^*} \geq p_l$ for all jobs l in J^c such that $\bar{d}_l \geq \tau$.

Put job j^* in position k of the sequence.

Step 6. If there is no job ℓ such that $\bar{d}_\ell < \tau$ and $p_\ell > p_{j^*}$, go to Step 7.

Otherwise find j^{**} such that $\tau - \bar{d}_{j^{**}} = \min_\ell(\tau - \bar{d}_\ell)$

For all ℓ such that $\bar{d}_\ell < \tau$ and $p_\ell > p_{j^*}$, Set $\delta^{**} = \tau - d_{j^{**}}$.

If $\delta^{**} < \delta$, then $\delta = \delta^{**}$.

Step 7. Set $k \leftarrow k - 1$, and $\tau \leftarrow \tau - p_{j^*}$. Update the set as $J^c = J^c - j^*$.

If $k \geq 1$ go to Step 5.

Step 8. Generate a batch by grouping a set of jobs such that $\sum_{j=1}^{n} p_j \leq T$

Repeat grouping of the remaining jobs to form other batches.

Set b_i = number of batches in one schedule, where $i = 1, 2, ..., r$.

Find machine idle time for one batch $I_{b_i} = T - \sum_{j=1}^{n} p_{ji}$

Find machine idle time for one schedule, $I = \sum_{i=1}^{r} I_{bi}$

Revise the schedule by adding the amount of time to perform maintenance, M,

to the end of each batch.

Compute $\sum_{j=1}^{n} C_j^*$, $L_{\max}^*$, and I^*.

Step 9. Set $L_{\max} = L_{\max} + \delta$.

If $L_{\max} \leq L_{\max}(SPT/EDD)$, set $m = m + 1$, $\overline{d}_j = \overline{d}_j + \delta$, and go to Step 4.

Otherwise STOP.

In Step 1, the algorithm starts with sequencing the jobs in SPT order. If two jobs have the same processing time, the job with smaller due date is placed earlier. Then $L_{max}(SPT/EDD)$ is calculated for this generated SPT/EDD schedule. This $L_{max}(SPT/EDD)$ value indicates when to stop the iterations in the algorithm. For the schedule of SPT/EDD ($S_{SPT/EDD}$), batches are generated by grouping sets of jobs according to $\sum_{j=1}^{n} p_j \leq T$.

The first Pareto-optimal schedule ($S^*_{SPT/EDD}$) is obtained after adding the maintenance time to the generated batches in $S_{SPT/EDD}$. The second Pareto-optimal schedule ($S^*_{EDD/SPT}$) is obtained in Step 2 which is similar to Step 1. The only difference is that instead of starting with SPT order, the procedure starts with EDD order and follows the same idea as in Step 1. In Step 3, due dates of the jobs are increased by $L_{max}(EDD/SPT)$ for the next iteration. Step 4 calculates the total processing time for n jobs and assigns that value to δ. Step 5 generates a Pareto-optimal schedule that minimizes $\sum_{j=1}^{n} C_j$ in which job k is scheduled last, if and only if

(i) $\overline{d}_k \geq \sum_{j=1}^{n} p_j$,

(ii) $p_k \geq p_\ell$ for all jobs ℓ in J^c such that $\overline{d}_\ell \geq \sum_{j=1}^{n} p_j$.

Step 6 determines the minimum increment δ in the L_{max} that would allow for a decrease in the minimum $\sum_{j=1}^{n} C_j$ from the new generated Pareto-optimal schedule. Maintenance time is included to the generated Pareto-optimal schedule after forming the batches in Step 8. Three objective values ($\sum_{j=1}^{n} C_j^*$, L_{max}^*, I_m^*) are also calculated at this point for all the Pareto-optimal schedules with periodic maintenance.

3.5 Computational Results with Bench Mark Data

Consider a single-machine scheduling problem with nine jobs, as given in Table 3.1, which is taken from Liao and Chen [41]. The time interval between two consecutive maintenances, T, is 8 hours and the amount of time to perform one maintenance, M, is 2 hours. Now, all possible Pareto-optimal schedules are generated to determine average flow time of jobs, $\overline{F}^*$ $(=\sum_{j=1}^{9} C^*_j / 9)$, job tardiness L_{max}^*, and machine idle time I^* for nine jobs.

Table 3.1 The processing time and due dates (in hour) for 9-job problem*

Jobs	1	2	3	4	5	6	7	8	9
p_j	1	5	3	5	2	2	3	4	4
d_j	1	13	2	30	10	13	20	12	14

* Liao and Chen (2003).

Step 1. An initial optimal schedule $S_{(SPT/EDD)}$: < 1-5-6-3-7-8-9-2-4 > is found by arranging jobs in SPT order and followed by $d_{[j]} \le d_{[k]}$ if $P_j = P_k$ and job j and k are adjacent (see Table 3.2). The maximum lateness, $L_{max}(SPT/EDD)$, equals to 11 corresponding to job 2. Now Step 8 is applied to find the machine idle time after the insertion of maintenance.

Table 3.2 Pareto-optimal schedule, $S_{(SPT/EDD)}$

Jobs	1	5	6	3	7	8	9	2	4
p_j	1	2	2	3	3	4	4	5	5
d_j	1	10	13	2	20	12	14	13	30
C_j	1	3	5	8	11	15	19	24	29
L_j	-	-	-	6	-	3	5	11	-

Step 8. A maintenance of 2 hours is inserted into the optimal schedule of Step 1 every 8 hours as shown in Table 3. Thus from the table, $L_{max}^*(SPT/EDD) = 22$, $\sum C_j^* = 1 + 3 + 5 + 8 + 13 + 17 + 24 + 35 + 45 = 151$ and $I^* = 0 + 1 + 4 + 3 = 8$ for the first Pareto-optimal schedule $S^*_{(SPT/EDD)}$: < 1-5-6-3-7-8-9-2-4 >. Another possible Pareto-schedule is now sought in Step 2.

Table 3.3 Revised schedule $S_{(SPT/EDD)}$ by inserting maintenance and idle times

Jobs	1	5	6	3	I_{b1}	M_1	7	8	I_{b2}	M_2	9	I_{b3}	M_3	2	I_{b4}	M_4	4
p_j	1	2	2	3	<u>0</u>	2	3	4	<u>1</u>	2	4	<u>4</u>	2	5	<u>3</u>	2	5
d_j	1	10	13	2	-	-	20	12	-	-	14	-	-	13	-	-	30
C_j	1	3	5	8	8	10	13	17	18	20	24	28	30	35	38	40	45
L_j	-	-	-	6	-	-	-	5	-	-	10	-	-	22	-	-	15

Step 2. Now instead of finding $S_{(SPT/EDD)}$, another schedule , $S_{(EDD/SPT)}$, is obtained by first applying EDD rule followed by SPT for the jobs with same *due dates* (not the same processing time as in $S_{(SPT/EDD)}$). These computational results using Table 3.1 are reported in Table 3.4.

Table 3.4 Second Pareto-optimal schedule, $S_{(EDD/SPT)}$

Jobs	1	3	5	8	6	2	9	7	4
p_j	1	3	2	4	2	5	4	3	5
d_j	1	2	10	12	13	13	14	20	30
C_j	1	4	6	10	12	17	21	24	29
L_j	-	2	-	-	-	4	7	4	-

This yields $S_{EDD/SPT}$:<1-3-5-8-6-2-9-7-4> and $L_{\max}(EDD/SPT)=7$. As in the previous iteration, maintenance and machine idle times are considered for this Pareto-schedule in the next step.

Step 8. As before, after inserting the maintenance time with appropriate idle time into Table 3.4, the revised schedule is shown in Table 5 in which $L^{*}_{\max}(EDD/SPT)=20$ corresponding to job 9; $\sum C_j^{*} = 1 + 4 + 6 + 14 + 16 + 25 + 34 + 37 + 45 = 182$, and $I^{*} = 2 + 2 + 3 + 1 = 8$ for the second Pareto-optimal schedule, $S^{*}_{EDD/SPT}$: <1-3-5-8-6-2-9-7-4>.

Table 3.5 Revised schedule $S_{(EDD/SPT)}$ for second Pareto schedule.

Jobs	1	3	5	I_{b1}	M_1	8	6	I_{b2}	M_2	2	I_{b3}	M_3	9	7	I_{b4}	M_4	4
p_j	1	3	2	2	2	4	2	2	2	5	3	2	4	3	1	2	5
d_j	1	2	10	-	-	12	13	-	-	13	-	-	14	20	-	-	30
C_j	1	4	6	8	10	14	16	18	20	25	28	30	34	37	38	40	45
L_j	-	2	-	-	-	2	3	-	-	12	-	-	20	17	-	-	15

Step 3. $L_{\max} = L_{\max}(EDD/SPT) = 7$ from Step 2 since $L_{\max}(EDD/SPT) \le L_{\max}(SPT/EDD)$ always. Therefore the due date is updated as $\bar{d}_j = d_j + 7$ to get the third Pareto-optimal schedule according to $\bar{d}_j$. This is reported in Table 3.6.

Table 3.6 Updated $\bar{d}_j = d_j + 7$ (in EDD order)

Jobs	1	3	5	8	6	2	9	7	4
d_j	1	2	10	12	13	13	14	20	30
$\bar{d}_j$	8	9	17	19	20	20	21	27	37

Step 4. Here, $J^c = \{1,2,3,4,5,6,7,8,9\}$, the total number of jobs, $k = |J^c| = 9$, and total processing time of the remaining jobs, $\tau = \sum p_j = 29$ and set $\delta = \tau = 29$ (at the beginning).

Step 5. J_4 satisfies condition $\bar{d}_{j*} \geq \tau$ (= 29) and the corresponding p_4 is 5. So J_4 is scheduled as the last job in the sequence, S_1:< ... 4>.

Step 6. None of the remaining jobs satisfies the conditions $\bar{d}_j < \tau$ and $p_j > p_{j*}$.

Step 7. The set statistics is updated as $J^c = \{1,2,3,5,6,7,8,9\}$, $k = |J^c| = 8$, and $\tau = 29 - 5 = 24$.

Since the Steps 5 to 7 are repeated likewise in order to get the third Pareto-optimal schedule, the results of this repeated search are summarized in Table 3.7, and the last search results in S_1: <1,5,6,3,8,2,9,7,4> which, in turn, yields the third Pareto optimal schedule as in Table 3.8. The maximum lateness for the third Pareto-optimal schedule is $L_{max}(S_1) = 7$.

Table 3.7 Repetition of Steps 5 through 7

Job (j)	Processing Time (P_j)	Schedule (S)	δ	τ
4	5	< ... 4>	29	24
7	3	< ... 7,4>	3	21
9	4	< ... 9,7,4>	1	17
2	5	< ... 2,9,7,4>	1	12
8	4	< ... 8,2,9,7,4>	1	8
3	3	< ... 3,8,2,9,7,4>	1	5
6	2	< ... 6,3,8,2,9,7,4>	1	3
5	2	< ..5,6,3,8,2,9,7,4>	1	1
1	1	<1,5,6,3,8,2,9,7,4>	1	0

Table 3.8 Third Pareto-optimal schedule, S_l

Jobs	1	5	6	3	8	2	9	7	4
p_j	1	2	2	3	4	5	4	3	5
d_j	1	10	13	2	12	13	14	20	30
C_j	1	3	5	8	12	17	21	24	29
L_j	-	-	-	6	-	4	7	4	-

Step 8. So for S^*_1: < 1-5-6-3-8-2-9-7-4> in Table 8, insertion of both maintenance and machine idle times lead to $L_{\max}{}^*(S_1) = 20$, $\sum C_j^* = 1 + 3 + 5 + 8 + 14 + 25 + 34 + 37 + 45 = 172$, and $I^* = 0 + 4 + 3 + 1 = 8$. The revised schedule is shown in Table 3.9.

Table 3.9 Revised schedule S_1

Jobs	1	5	6	3	I_{b1}	M_1	8	I_{b2}	M_2	2	I_{b3}	M_3	9	7	I_{b4}	M_4	4
p_j	1	2	2	3	0	2	4	4	2	5	3	2	4	3	1	2	5
d_j	1	10	13	2	-	-	12	-	-	13	-	-	14	20	-	-	30
C_j	1	3	5	8	8	10	14	18	20	25	28	30	34	37	38	40	45
L_j	-	-	-	6	-	-	2	-	-	12	-	-	20	17	-	-	15

Step 9. At this step, set $L_{max} = L_{max} + \delta = 7 + 1 = 8$. Since $L_{\max} = 8 < L_{\max}(SPT/EDD) = 11$, continue to the next iteration for another schedule. Table 3.10 summarizes the results of all the iterations to get a set of Pareto-optimal schedules.

Table 3.10 All the iterations of the algorithm

Iteration m	Schedule	Pareto-Optimal Sequence	$\sum_{j=1}^{9} C_j^*$, L_{max}^*, I_m^*	Current $d_j + \delta$	δ
1	SPT/EDD	<1-5-6-3-7-8-9-2-4>	151, 22, 8	30, 20, 14, 13, 13, 12, 10, 2, 1	-
2	EDD/SPT	<1-3-5-8-6-2-9-7-4>	182, 20, 8	30, 20, 14, 13, 13, 12, 10, 2, 1	7
3	S_1	<1-5-6-3-8-2-9-7-4>	172, 20, 8	37, 27, 21, 20, 20, 19, 17, 9, 8	1
4	S_2	<1-5-6-3-8-9-2-7-4>	137, 12, 0	38, 28, 22, 21, 21, 20, 18, 10, 9	2
5	S_3	<1-5-6-3-7-8-2-9-4>	151, 20, 8	40, 30, 24, 23, 23, 22, 20, 12,11	1
6	S_4	<1-5-6-3-7-8-9-2-4>	151, 22, 8	41, 31, 25, 24, 24, 23, 21, 13,12	Stop

After generating all possible Pareto-optimal schedules with respect to job completion time $\overline{F}^*$, job tardiness L_{max}^*, and machine idle time I^* for nine jobs, the total weighted function, $c(\overline{F}^*, L_{max}^*, I^*) = w_1(\sum_{j=1}^{9} C_j^*/9) + w_2 L_{max}^* + w_3 I^*$, where w_1 = 0.5, w_2 = 0.4, w_3 = 0.1 (arbitrarily chosen) for 6 schedules is calculated [see Table 3.11]. The minimum-weighted schedule is $S^* = S_2$: <1-5-6-3-8-9-2-7-4> corresponding to $c(\overline{F}^*, L_{max}^*, I^*)$ = 12.411.

Table 3.11 A Pareto-Optimal Set

Iteration, m	Schedule	Pareto-Optimal Sequence	$\sum_{j=1}^{9} C_j^*$, L_{max}^*, I_m^*	$c(\overline{F}^*, L_{max}^*, I^*)$
1	SPT/EDD	<1-5-6-3-7-8-9-2-4>	151, 22, 8	17.989
2	EDD/SPT	<1-3-5-8-6-2-9-7-4>	182, 20, 8	18.911
3	S_1	<1-5-6-3-8-2-9-7-4>	172, 20, 8	18.356
4	**S_2**	**<1-5-6-3-8-9-2-7-4>**	**137, 12, 0**	**12.411***
5	S_3	<1-5-6-3-7-8-2-9-4>	151, 20, 8	17.189
6	S_4	<1-5-6-3-7-8-9-2-4>	151, 22, 8	17.989

* The best schedule with the minimum weighted function

3.6 Neighborhood Search Algorithm

As a second approach to the multi-criterion scheduling problem, a neighborhood search technique is considered. Many discrete optimization problems of practical interest cannot be solved optimally in the reasonable time. A practical approach to these problems is to use heuristics which do not guarantee the optimality of the solution, but near-optimal solutions can be obtained in a tolerable time limit. Neighborhood search starts with a feasible schedule and iteratively tries to improve the solution. At each stage, it searches the "neighborhood" of the current solution to find an improved solution. The search terminates when it finds a solution that is at least as good as any of its neighbors; such a solution is called a *locally optimal solution*. Typically, multiple runs of the neighborhood search are performed with different starting schedules called *seeds*, and the best locally optimal solution is selected. A comprehensive discussion of neighborhood search can be found in Ehrgott and Klamroth [64].

A method of taking one sequence as a seed and systematically creating a collection of related sequences is the generating mechanism. In this work, the single adjacent pairwise interchange operation serves as a generating mechanism for the example. The neighborhood of the seed sequence is a list of $(n-1) = 9-1 = 8$, distinct sequences for this particular generating mechanism. The single adjacent pairwise interchange is $O(n^2)$ in size (Baker, 1998). The search is illustrated on the numerical example. The performance measure of all the neighborhood sequences that is evaluated with respect to the initial seed is the weighted function. The same weight combinations, as given earlier, are used to evaluate the objectives (See Tables 3.12, 3.13 and 3.14). The following steps of neighborhood search, initially presented by Baker [42], are applied to the numerical example.

Algorithm 2: *Neighborhood Search*

Step 1. Obtain a sequence to be an initial seed and evaluate it with respect to the performance measure.

Step 2. Generate and evaluate all the sequences in the neighborhood of the seed. If none of the sequences is better than the seed with respect to the performance measure, stop. Otherwise proceed.

Step 3. Select one of the sequences in the neighborhood that improved the performance measure. Let this sequence be the new seed. Return to Step 2.

The single adjacent pairwise interchange mechanism is applied to the initial seeds, and the performance measure (weighted function) of each seed is compared with the performance measure of its neighborhood. Instead of generating all the sequences in the neighborhood of the seed, when a neighborhood gives an improved performance measure, the search stops, and that sequence becomes the new seed for the next stage. When a search of the new neighborhood produces no improvement, the search procedure terminates. The details of three seeds with their neighborhood sequences and their performance measures are presented in Tables 3.12, 3.13, and 3.14.

Table 3.12 Solution with a given initial seed, S: < 1-2-3-4-5-6-7-8-9>

	Schedule	$\sum_{j=1}^{9} C_j, L_{max}, I_m$	$0.5\overline{F}' + 0.4L_{max}' + 0.1I'_m$
	Stage 1		
Seed:	1-2-3-4-5-6-7-8-9	183, 24, 3	20.067
Neighborhood:	2-1-3-4-5-6-7-8-9	187, 24, 3	20.289
	1-3-2-4-5-6-7-8-9	231, 34, 11	27.533
	1-2-4-3-5-6-7-8-9	185, 24, 3	20.178
	1-2-3-5-4-6-7-8-9	201, 30, 7	23.867
	1-2-3-4-6-5-7-8-9	183, 24, 3	20.067
	1-2-3-4-5-7-6-8-9	184, 24, 3	21.122
	1-2-3-4-5-6-8-7-9	182, 23, 2	19.511* selection
	Stage 2		
New Seed:	1-2-3-4-5-6-8-7-9	182, 23, 2	19.511
Neighborhood:	2-1-3-4-5-6-8-7-9	186, 23, 2	19.733
	1-3-2-4-5-6-8-7-9	230, 33, 10	26.978
	1-2-4-3-5-6-8-7-9	184, 23, 2	19.622
	1-2-3-5-4-6-8-7-9	202, 30, 7	23.922
	1-2-3-4-6-5-8-7-9	182, 23, 2	19.511
	1-2-3-4-5-8-6-7-9	184, 23, 2	19.622
	1-2-3-4-5-6-7-8-9	183, 24, 3	20.067
	1-2-3-4-5-6-8-9-7	183, 20, 2	18.367* selection
	Stage 3		
New Seed:	1-2-3-4-5-6-8-9-7	183, 20, 2	18.367* selection
Neighborhood:	2-1-3-4-5-6-8-9-7	187, 20, 2	18.589
	1-3-2-4-5-6-8-9-7	240, 30, 10	26.333
	1-2-4-3-5-6-8-9-7	185, 20, 2	18.478
	1-2-3-5-4-6-8-9-7	202, 24, 6	21.422
	1-2-3-4-6-5-8-9-7	183, 20, 2	18.367* selection
	1-2-3-4-5-8-6-9-7	185, 20, 2	18.478
	1-2-3-4-5-6-9-8-7	183, 22, 2	19.167
	1-2-3-4-5-6-8-7-9	182, 23, 2	19.511
Search terminates with weighted functional value = 18.367			

To compare the modified Pareto-optimal algorithm with the neighborhood search heuristic in case of bench mark data, the same instance with parameters $T = 8$, $M = 2$, $w_1 = 0.5$, $w_2 = 0.4$ and $w_3 = 0.1$ is used. The neighborhood search heuristic gives the best near-optimal schedule as S: <1-5-6-3-7-2-8-9-4> with the minimum weighted function equals to 18.367. On the other hand, the modified Pareto-optimal algorithm gives the best near-optimal schedule as S: <1-5-6-3-8-9-2-7-4> with the minimum weighted function equals to 12.410. It can be concluded that the modified Pareto-optimal algorithm provides a better result than the neighborhood search heuristic for this instance.

3.7 Computational Results with Real Life Data

Consider a single-machine scheduling problem with twelve jobs, as given in Figure 2.1, which is taken from a furniture company. The time interval between two consecutive maintenances, T, is 25 hours and the amount of time to perform one maintenance, M, is 4 hours. Now, all possible Pareto-optimal schedules are generated to determine average flow time of jobs, $\overline{F}^*$ $(=\sum_{j=1}^{9} C^*_j/12)$, job tardiness L_{max}^*, and machine idle time I^* for nine jobs.

Table 3.13 The processing time and due dates (in minute) for 12-job problem*

Jobs	1	2	3	4	5	6	7	8	9	10	11	12
p_j	10	12	12	9	6	5	7	7	8	8	7	5
d_j	30	85	70	55	15	10	20	25	20	45	50	25

Step 1. An initial optimal schedule $S_{(SPT/EDD)}$: < 6-12-5-7-8-11-9-10-4-1-3-2 > is found by arranging jobs in SPT order and followed by $d_{[j]} \le d_{[k]}$ if $P_j = P_k$ and job j and k are adjacent (see Table 3.14). The maximum lateness, $L_{max}(SPT/EDD)$, equals to 42 corresponding to job 1. Now Step 8 is applied to find the machine idle time after the insertion of maintenance.

Table 3.14 Pareto-optimal schedule, $S_{(SPT/EDD)}$

Jobs	6	12	5	7	8	11	9	10	4	1	3	2
p_j	5	5	6	7	7	7	8	8	9	10	12	12
d_j	10	25	15	20	25	50	20	45	55	30	70	85
C_j	5	10	16	23	30	37	45	53	62	72	84	96
L_j	0	0	1	3	5	0	25	8	7	42	14	11

Step 8. A maintenance of 4 hours is inserted into the optimal schedule of Step 1 every 25 hours as shown in Table 3.15 Thus from the table, $L_{max}^*(SPT/EDD) = 67$, $\sum C_j^* = 5 + 10 + 16 + 23 + 36 + 43 + 51 + 66 + 75 + 97 + 109 + 128 = 659$ and $I^* = 2 + 3 + 8 + 3 = 16$ for

the first Pareto-optimal schedule $S^{*}_{(SPT/EDD)}$: < 6-12-5-7-8-11-9-10-4-1-3-2 > . The Cost = 55.86. Another possible Pareto-schedule is now sought in Step 2.

Table 3.15 Revised schedule $S_{(SPT/EDD)}$ by inserting maintenance and idle times

Jobs	6	12	5	7	I_{b1}	M_1	8	11	9	I_{b2}	M_2	10	4	I_{b3}	M_3	1	3	I_{b4}	M_4	2
p_j	5	5	6	7	2	4	7	7	8	3	4	8	9	8	4	10	12	3	4	12
d_j	10	25	15	20	-	-	25	50	20	-	-	45	55	-	-	30	70	-	-	85
C_j	5	10	16	23	25	29	36	43	51	54	58	66	75	83	87	97	109	112	116	128
L_j	-	-	1	3	-	-	11	-	31	-	-	21	20	-	-	67	39	-	-	43

Step 2. Now instead of finding $S_{(SPT/EDD)}$, another schedule , $S_{(EDD/SPT)}$, is obtained by first applying EDD rule followed by SPT for the jobs with same *due dates* (not the same processing time as in $S_{(SPT/EDD)}$). These computational results using Table 3.13 are reported in Table 3.16.

Table 3.16 Second Pareto-optimal schedule, $S_{(EDD/SPT)}$

Jobs	6	5	7	9	12	8	1	10	11	4	3	2
p_j	5	6	7	8	5	7	10	8	7	9	12	12
d_j	10	15	20	20	25	25	30	45	50	55	70	85
C_j	5	11	18	26	31	38	48	56	63	72	84	96
L_j	0	0	0	6	6	13	18	11	13	17	14	11

This yields $S_{(EDD/SPT)}$:<6-5-7-9-12-8-1-10-11-4-3-2> and $L_{\max}(EDD/SPT)$= 18. As in the previous iteration, maintenance and machine idle times are considered for this Pareto-schedule in the next step.

Step 8. As before, after inserting the maintenance time with appropriate idle time into Table 3.16, the revised schedule is shown in Table 3.17 in which $L_{\max}^{*}(EDD/SPT)$ = 43 corresponding to job 2; $\sum C_j^* = 5+11+18+37+42+49+68+76+83+96+108+128$ $= 721$, and $I^* = 7+5+0+4 = 16$ for the second Pareto-optimal schedule, $S^*_{EDD/SPT}$: <6-5-7-9-12-8-1-10-11-4-3-2>. The Cost = 48.84

Table 3.17 Revised schedule $S_{(EDD/SPT)}$ for second Pareto schedule.

Jobs	6	5	7	I_{b1}	M_1	9	12	8	I_{b2}	M_2	1	10	11	I_{b3}	M_3	4	3	I_{b4}	M_4	2
p_j	5	6	7	7	4	8	5	7	5	4	10	8	7	0	4	9	12	4	4	12
d_j	10	15	20	-	-	20	25	25	-	-	30	45	50	-	-	55	70	-	-	85
C_j	5	11	18	25	29	37	42	49	54	58	68	76	83	83	87	96	108	112	116	128
L_j	-	-	-	-	-	17	17	24	-	-	38	31	33	-	-	41	38	-	-	43

Step 3. $L_{max} = L_{max}(EDD/SPT) =$ 18 from Step 2 since $L_{max}(EDD/SPT) \le L_{max}(SPT/EDD)$ always. Therefore the due date is updated as $\bar{d}_j = d_j + 18$ to get the third Pareto-optimal schedule according to $\bar{d}_j$. This is reported in Table 3.18.

Table 3.18 Updated $\bar{d}_j = d_j + 18$ (in EDD order)

Jobs	6	5	7	9	12	8	1	10	11	4	3	2
d_j	10	15	20	20	25	25	30	45	50	55	70	85
$\bar{d}_j$	28	33	38	38	43	43	48	63	68	73	88	103

Step 4. Here, $J^c = \{1,2,3,4,5,6,7,8,9,10,11,12\}$, the total number of jobs, $k = |J^c| = 12$, and total processing time of the remaining jobs, $\tau = \sum p_j = 96$ and set $\delta = \tau = 96$ (at the beginning).

Step 5. J_2 satisfies condition $\bar{d}_{j*} \ge \tau$ (= 96) and the corresponding p_2 is 5. So J_2 is scheduled as the last job in the sequence, S_i: < ... 2>.

Step 6. None of the remaining jobs satisfies the conditions $\bar{d}_j < \tau$ and $p_j > p_{j*}$.

Step 7. The set statistics is updated as $J^c = \{1,3,4,5,6,7,8,9,10,11,12\}$, $k = |J^c| = 11$, and $\tau = 96 - 12 = 84$

Since the Steps 5 to 7 are repeated likewise in order to get the third Pareto-optimal schedule, the results of this repeated search are summarized in Table 3.19, and the last search results in S_I: <6,12,5,7,8,9,1,11,10,4,3,2> which, in turn, yields the third Pareto optimal schedule as in Table 3.20. The maximum lateness for the third Pareto-optimal schedule is $L_{max}(S_1) = 18$.

Table 3.19 Repetition of Steps 5 through 7

Job (j)	Processing Time (P_j)	Schedule (S)	δ	τ
2	12	<............................2>	96	96
3	12	<..........................3,2>	96	84
4	9	<.........................4,3,2>	96	72
10	8	<.....................10,4,3,2>	24	63
11	7	<................11,10,4,3,2>	15	55
1	10	<.............,1,11,10,4,3,2>	7	48
9	8	<............9,1,11,10,4,3,2>	7	38
8	7	<..........8,9,1,11,10,4,3,2>	7	30
7	7	<........7,8,9,1,11,10,4,3,2>	7	23
5	6	<......5,7,8,9,1,11,10,4,3,2>	7	16
12	5	<...12,5,7,8,9,1,11,10,4,3,2>	7	10
6	5	<6,12,5,7,8,9,1,11,10,4,3,2>	7	5

Table 3.20 Third Pareto-optimal schedule, S_1

Jobs	6	12	5	7	8	9	1	11	10	4	3	2
p_j	5	5	6	7	7	8	10	7	8	9	12	12
d_j	10	25	15	20	25	20	30	50	45	55	70	85
C_j	5	10	16	23	30	38	48	55	63	72	84	96
L_j	0	0	1	3	5	18	18	5	18	17	14	11

Step 8. So for S^*_1: < 6-12-5-7-8-9-1-11-10-4-3-2 > in Table 3.21, insertion of both maintenance and machine idle times lead to $L_{\max}^*(S_1) = 29$, $\sum C_j^* = 5 + 10 + 16 + 23 + 36 + 44 + 54 + 65 + 73 + 82 + 99 + 111 = 618$, and $I^* = 2 + 0 + 1 = 3$. The Cost = 37.65. The revised schedule is shown in Table 3.21.

Table 3.21 Revised schedule S_1

Jobs	6	12	5	7	I_{b1}	M_1	8	9	1	I_{b2}	M_2	11	10	4	I_{b3}	M_3	3	2
p_j	5	5	6	7	2	4	7	8	10	-	4	7	8	9	1	4	12	12
d_j	28	43	33	38	-	-	43	38	48	-	-	68	63	73	-	-	88	103
C_j	5	10	16	23	25	29	36	44	54	54	58	65	73	82	83	87	99	111
L_j	-	-	1	3	-	-	11	24	24	-	-	15	28	27	-	-	29	26

Step 9. At this step, set $L_{max} = L_{max} + \delta = 18 + 7 = 25$. Since $L_{\max} = 25 < L_{\max}(SPT/EDD) = 42$, continue to the next iteration for another schedule.

Table 3.22 Repetition of Steps 5 through 7

Job (j)	Processing Time (P_j)	Schedule (S)	δ	τ
2	12	<...........................2>	96	96
3	12	<.........................3,2>	96	84
4	9	<.......................4,3,2>	96	72
10	8	<....................10,4,3,2>	17	63
1	10	<..................1,10,4,3,2>	8	55
9	8	<................9,1,10,4,3,2>	8	45
11	7	<.............11,9,1,10,4,3,2>	8	37
8	7	<...........8,11,9,1,10,4,3,2>	8	30
7	7	<.........7,8,11,9,1,10,4,3,2>	8	23
5	6	<......5,7,8,11,9,1,10,4,3,2>	8	16
12	5	<...12,5,7,8,11,9,1,10,4,3,2>	8	10
6	5	: <6,12,5,7,8,11,9,1,10,4,3,2>	8	5

Fourth Pareto-optimal schedule, S_2 by inserting maintenance and idle time:

Table 3.23 Revised schedule S_2

Jobs	6	12	5	7	I_{b1}	M_1	8	11	9	I_{b2}	M_2	1	10	I_{b3}	M_3	4	3	I_{b4}	M_4	2
p_j	5	5	6	7	2	4	7	7	8	3	4	10	8	7	4	9	12	4	4	12
d_j	35	50	40	45	-	-	50	75	45	-	-	55	70	-	-	80	95	-	-	110
C_j	5	10	16	23	25	29	36	43	51	54	58	68	76	83	87	96	108	112	116	128
L_j	-	-	1	3	-	-	11	-	31	-	-	38	31	-	-	41	38	-	-	43

So for S^*_2: < 6-12-5-7-8-11-9-1-10-4-3-2 > in Table 3.23, insertion of both maintenance and machine idle times lead to $L_{max}^*(S_2) = 43$, $\sum C_j^* = 5 + 10 + 16 + 23 + 36 + 43 + 51 + 68 + 76 + 96 + 108 + 128 = 660$, and $I^* = 2 + 3 + 7 + 4 = 16$. The Cost = 46.30.

At this step, set $L_{max} = L_{max} + \delta = 25 + 8 = 33$. Since $L_{max} = 33 < L_{max}(SPT/EDD) = 42$, continue to the next iteration for another schedule.

Table 3.24 Repetition of Steps 5 through 7

Job (J)	Processing Time (P_j)	Schedule (S)	δ	τ
2	12	<.........................2>	96	96
3	12	<..........................3,2>	96	84
4	9	<........................4,3,2>	96	72
1	10	<.....................1,4,3,2>	9	63
10	8	<...................10,1,4,3,2>	9	53
9	8	<.................9,10,1,4,3,2>	9	45
11	7	<.............11,9,10,1,4,3,2>	9	37
8	7	<...........8,11,9,10,1,4,3,2>	9	30
7	7	<.........7,8,11,9,10,1,4,3,2>	9	23
5	6	<.......5,7,8,11,9,10,1,4,3,2>	9	16
12	5	<....12,5,7,8,11,9,10,1,4,3,2>	9	10
6	5	: <6,12,5,7,8,11,9,10,1,4,3,2>	9	5

Fifth Pareto-optimal schedule, S_3 by inserting maintenance and idle time:

Table 3.25 Revised schedule S_3

Jobs	6	12	5	7	I_{b1}	M_1	8	11	9	I_{b2}	M_2	10	1	I_{b3}	M_3	4	3	I_{b4}	M_4	2
p_j	5	5	6	7	2	4	7	7	8	3	4	8	10	7	4	9	12	4	4	12
d_j	43	58	48	53	-	-	58	83	53	-	-	78	63	-	-	88	103	-	-	118
C_j	5	10	16	23	25	29	36	43	51	54	58	66	76	83	87	96	108	112	116	128
L_j	-	-	1	3	-	-	11	-	31	-	-	21	46	-	-	41	38	-	-	43

So for S^{*3}: < 6-12-5-7-8-11-9-10-1-4-3-2 > in Table 3.25, insertion of both maintenance and machine idle times lead to $L_{\max}^*(S_3) = 43$, $\sum C_j^* = 5 + 10 + 16 + 23 + 36 + 43 + 51 + 66 + 76 + 96 + 108 + 128 = 658$, and $I^* = 2 + 3 + 7 + 4 = 16$. The Cost = 47.42.

At this step, set $L_{max} = L_{max} + \delta = 33 + 9 = 42$. Since $L_{\max} = L_{\max}(SPT/EDD) = 42$, So, STOP

Table 3.26 Repetition of Steps 5 through 7

Job (j)	Processing Time (P_j)	Schedule (S)	δ	τ
2	12	<............................2>	96	96
3	12	<..........................3,2>	96	84
1	10	<.........................4,3,2>	96	72
4	9	<.....................1,4,3,2>	9	63
10	8	<.................10,1,4,3,2>	9	53
9	8	<.................9,10,1,4,3,2>	9	45
11	7	<.............11,9,10,1,4,3,2>	9	37
8	7	<...........8,11,9,10,1,4,3,2>	9	30
7	7	<.........7,8,11,9,10,1,4,3,2>	9	23
5	6	<.......5,7,8,11,9,10,1,4,3,2>	9	16
12	5	<....12,5,7,8,11,9,10,1,4,3,2>	9	10
6	5	: <6,12,5,7,8,11,9,10,1,4,3,2>	9	5

Sixth Pareto-optimal schedule, S_4 by inserting maintenance and idle time:

Table 3.27 Revised schedule S_4

Jobs	6	12	5	7	I_{b1}	M_1	8	11	9	I_{b2}	M_2	10	4	I_{b3}	M_3	1	3	I_{b4}	M_4	2
p_j	5	5	6	7	2	4	7	7	8	3	4	8	9	8	4	10	12	3	4	12
d_j	52	67	57	62	-	-	67	92	62	-	-	87	97	-	-	72	112	-	-	127
C_j	5	10	16	23	25	29	36	43	51	54	58	66	75	83	87	97	109	112	116	128
L_j	-	-	1	3	-	-	11	-	31	-	-	21	20	-	-	67	39	-	-	43

So for S^*_4: < 6-12-5-7-8-11-9-10-4-1-3-2 > in Table 3.27, insertion of both maintenance and machine idle times lead to $L_{max}^*(S_4) = 43$, $\sum C_j^* = 5 + 10 + 16 + 23 + 36 + 43 + 51 + 66 + 75 + 97 + 109 + 128 = 659$, and $I^* = 2 + 3 + 8 + 3 = 16$. The Cost = 55.86.

Table 3.28 All the iterations of the algorithm

Iteration m	Schedule	Pareto-Optimal Sequence	$\sum_{j=1}^{12} C_j^*$ L_{max}^*, I_m^*	Current $d_j + \delta$	δ
1	SPT/EDD	< 6-12-5-7-8-11-9-10-4-1-3-2 >	659, 67, 16	10, 25, 15, 20, 25, 50, 20, 45, 55, 30, 70, 85	-
2	EDD/SPT	<6-5-7-9-12-8-1-10-11-4-3-2>	721, 43, 16	10, 15, 20, 20, 25, 25, 50, 45, 50, 55, 70, 85	18
3	S_1	< 6-12-5-7-8-9-1-11-10-4-3-2 >	618, 29, 3	28, 43, 33, 38, 43, 38, 48, 68, 63, 73, 88, 103	7
4	S_2	< 6-12-5-7-8-11-9-1-10-4-3-2 >	660, 43, 16	35, 50, 40, 45, 50, 75, 45, 55, 70, 80, 95, 110	8
5	S_3	< 6-12-5-7-8-11-9-10-1-4-3-2 >	658, 46, 16	43, 58, 48, 53, 58, 83, 53, 78, 63, 88, 103, 118	9
6	S_4	< 6-12-5-7-8-11-9-10-4-1-3-2 >	659, 67, 16	52, 67, 57, 62, 67, 92, 62, 87, 97, 72, 112, 127	Stop

After generating all possible Pareto-optimal schedules with respect to job completion time $\overline{F}^*$, job tardiness L_{max}^*, and machine idle time I^* for twelve jobs, the total weighted function, $c(\overline{F}^*, L_{max}^*, I^*) = w_1(\sum_{j=1}^{12} C_j^*/12) + w_2 L_{max}^* + w_3 I^*$, where $w_1 = 0.5$, $w_2 = 0.4$, $w_3 = 0.1$ (arbitrarily chosen) for 6 schedules is calculated [see Table 3.28]. The minimum-weighted schedule is $S^* = S_1$: < 6-12-5-7-8-9-1-11-10-4-3-2 > corresponding to $c(\overline{F}^*, L_{max}^*, I^*) = 37.65$.

Table 3.29 A Pareto-Optimal Set

Iteration, m	Schedule	Pareto-Optimal Sequence	$\sum_{j=1}^{12} C_j^*$, L_{max}^*, I_m^*	$c(\overline{F}^*, L_{max}^*, I^*)$
1	SPT/EDD	< 6-12-5-7-8-11-9-10-4-1-3-2 >	659, 67, 16	55.86
2	EDD/SPT	<6-5-7-9-12-8-1-10-11-4-3-2>	721, 43, 16	48.84
3	**S_1**	**< 6-12-5-7-8-9-1-11-10-4-3-2 >**	**618, 29, 3**	**37.65**
4	S_2	< 6-12-5-7-8-11-9-1-10-4-3-2 >	660, 43, 16	46.30
5	S_3	< 6-12-5-7-8-11-9-10-1-4-3-2 >	658, 46, 16	47.42
6	S_4	< 6-12-5-7-8-11-9-10-4-1-3-2 >	659, 67, 16	55.86

* The best schedule with the minimum weighted function

3.8 Neighborhood Search Algorithm

As a second approach to the multi-criterion scheduling problem, a neighborhood search technique is considered. Many discrete optimization problems of practical interest cannot be solved optimally in the reasonable time. A practical approach to these problems is to use heuristics which do not guarantee the optimality of the solution, but near-optimal solutions can be obtained in a tolerable time limit. Neighborhood search starts with a feasible schedule and iteratively tries to improve the solution. At each stage, it searches the "neighborhood" of the current solution to find an improved solution. The search terminates when it finds a solution that is at least as good as any of its neighbors; such a solution is called a *locally optimal solution*. A method of taking one sequence as a seed and systematically creating a collection of related sequences is the generating mechanism. In this work, the single adjacent pairwise interchange operation serves as a generating mechanism for the example. The neighborhood of the seed sequence is a list of $(n\text{-}1) = 12\text{-}1 = 11$, distinct sequences for this particular generating mechanism. The single adjacent pairwise interchange mechanism is applied to the initial seed, and the performance measure (weighted function) of each seed is compared with the performance measure of its neighborhood. Instead of generating all the sequences in the neighborhood of the seed, when a neighborhood gives an improved performance measure, the search stops, and that sequence becomes the new seed for the next stage. When a search of the new neighborhood produces no improvement, the search procedure terminates. The details of the seed with their neighborhood sequences and their performance measures are presented in Tables 3.30. Search terminates with weighted functional value = 68.917

Table 3.30 Solution with a given initial seed, S: < 1-2-3-4-5-6-7-8-9-10-11-12>

	Schedule	$\sum_{j=1}^{12} C_j^*$	L_{max}	I_m	Cost
	Stage 1				
Seed:	<1-2-3-4-5-6-7-8-9-10-11-12>	844	96	9	74.467
Neighborhood:	<2-1-3-4-5-6-7-8-9-10-11-12>	846	96	9	74.550
	<1-3-2-4-5-6-7-8-9-10-11-12>	844	96	9	74.467
	<1-2-4-3-5-6-7-8-9-10-11-12>	841	96	9	74.342 *
	Stage 2				
New Seed:	<1-2-4-3-5-6-7-8-9-10-11-12>	841	96	9	74.342
Neighborhood:	<2-1-4-3-5-6-7-8-9-10-11-12>	843	96	9	74.425
	<1-4-2-3-5-6-7-8-9-10-11-12>	844	96	9	74.467
	<1-2-3-4-5-6-7-8-9-10-11-12>	844	96	9	74.467
	<1-2-4-5-3-6-7-8-9-10-11-12>	898	103	16	80.217
	<1-2-4-3-6-5-7-8-9-10-11-12>	840	96	9	74.300 *
	Stage 3				
New Seed:	<1-2-4-3-6-5-7-8-9-10-11-12>	840	96	9	74.300
Neighborhood:	<2-1-4-3-6-5-7-8-9-10-11-12>	842	96	9	74.383
	<1-4-2-3-6-5-7-8-9-10-11-12>	843	96	9	74.425
	<1-2-3-4-6-5-7-8-9-10-11-12>	843	96	9	74.425
	<1-2-4-6-3-5-7-8-9-10-11-12>	899	103	16	80.258
	<1-2-4-3-5-6-7-8-9-10-11-12>	841	96	9	74.342
	<1-2-4-3-6-7-5-8-9-10-11-12>	841	96	9	74.342
	<1-2-4-3-6-5-8-7-9-10-11-12>	840	96	9	74 300
	<1-2-4-3-6-5-7-9-8-10-11-12>	886	103	16	79.717
	<1-2-4-3-6-5-7-8-10-9-11-12>	840	96	9	74.300
	<1-2-4-3-6-5-7-8-9-11-10-12>	839	96	9	74 258 *
	Stage 4				
New Seed:	<1-2-4-3-6-5-7-8-9-11-10-12>	839	96	9	74 258
Neighborhood:	<2-1-4-3-6-5-7-8-9-11-10-12>	841	96	9	74.342
	<1-4-2-3-6-5-7-8-9-11-10-12>	842	96	9	74.383
	<1-2-3-4-6-5-7-8-9-11-10-12>	842	96	9	74.383
	<1-2-4-6-3-5-7-8-9-11-10-12>	900	104	17	80.800
	<1-2-4-3-5-6-7-8-9-11-10-12>	840	96	9	74.300
	<1-2-4-3-6-7-5-8-9-11-10-12>	840	96	9	74.300
	<1-2-4-3-6-5-8-7-9-11-10-12>	839	96	9	74.258
	<1-2-4-3-6-5-7-9-8-11-10-12>	887	104	17	80.258
	<1-2-4-3-6-5-7-8-11-9-10-12>	838	96	9	74.217 *
	Stage 5				
New Seed:	<1-2-4-3-6-5-7-8-11-9-10-12>	838	96	9	74.217
Neighborhood:	<2-1-4-3-6-5-7-8-11-9-10-12>	840	96	9	74.300
	<1-4-2-3-6-5-7-8-11-9-10-12>	841	96	9	74.342
	<1-2-3-4-6-5-7-8-11-9-10-12>	841	96	9	74.342
	<1-2-4-6-3-5-7-8-11-9-10-12>	899	104	17	80.758
	<1-2-4-3-5-6-7-8-11-9-10-12>	839	96	9	74.258

	Schedule	$\sum_{j=1}^{12} C_j^*$	L_{max}	I_m	Cost
	<1-2-4-3-6-7-5-8-11-9-10-12>	839	96	9	74 258
	<1-2-4-3-6-5-8-7-11-9-10-12>	838	96	9	74.217
	<1-2-4-3-6-5-7-11-8-9-10-12>	838	96	9	74.217
	<1-2-4-3-6-5-7-8-9-11-10-12>	839	96	9	74 258
	<1-2-4-3-6-5-7-8-11-10-9-12>	838	96	9	74.217
	<1-2-4-3-6-5-7-8-11-9-12-10>	838	82	12	68.917 *
	Stage 6				
New Seed: Neighborhood	<1-2-4-3-6-5-7-8-11-9-12-10>	838	82	12	68.917 *
	<2-1-4-3-6-5-7-8-11-9-12-10>	840	82	12	69.000
	<1-4-2-3-6-5-7-8-11-9-12-10>	841	82	12	69.042
	<1-2-3-4-6-5-7-8-11-9-12-10>	841	82	12	69.042
	<1-2-4-6-3-5-7-8-11-9-12-10>	896	96	17	77.433
	<1-2-4-3-5-6-7-8-11-9-12-10>	839	82	12	68.958
	<1-2-4-3-6-7-5-8-11-9-12-10>	839	82	12	68.958
	<1-2-4-3-6-5-8-7-11-9-12-10>	838	82	12	68.917 *
	<1-2-4-3-6-5-7-11-8-9-12-10>	838	82	12	68.917 *
	<1-2-4-3-6-5-7-8-9-11-12-10>	839	82	12	68.958
	<1-2-4-3-6-5-7-8-11-12-9-10>	835	87	12	70.792
	<1-2-4-3-6-5-7-8-11-9-10-12>	838	96	9	74.217

To compare the modified Pareto-optimal algorithm with the neighborhood search heuristic in case of real life data, the same instance with parameters $T = 25$, $M = 4$, $w_1 = 0.5$, $w_2 = 0.4$ and $w_3 = 0.1$ is used. The neighborhood search heuristic gives the best near-optimal schedule as S: <1-2-4-3-6-5-7-11-8-9-12-10> with the minimum weighted function equals to 68.917. On the other hand, the modified Pareto-optimal algorithm gives the best near-optimal schedule as S: < 6-12-5-7-8-9-1-11-10-4-3-2 > with the minimum weighted function equals to 37.65. It can be concluded that the modified Pareto-optimal algorithm provides a better result than the neighborhood search heuristic for this instance.

The same instance shown in the example of real life data is repeated for nineteen levels of T (12, 13, ..., 30) and five levels of M (4, 5, 6, 7, 8) to show the performance of various sets of Pareto-optimal schedules for different maintenance plans. Table 3.31 shows the costs of Pareto-optimal algorithm and neighborhood search method for a particular weight combination and Table 3.32 shows for the all possible weight combinations. In both cases

Pareto-optimal algorithm gives better results than that of neighborhood search method. Also these have been shown in Figures 3.1, …, 3.10.

As the time to perform maintenance, M increases, both the completion time and the maximum lateness increases too. On the other hand, as the time interval between two maintenance periods, T changes, all three objectives are changing as well because of forming different batches.

Table 3.31 Pareto vs Neighborhood: Costs from One Weight Combination (w_1 =0.5, w_2 =0.4, w_3 =0.1)

M	T	Pareto	Neighborhood
	12	67.22	83.38
	13	72.34	79.62
	14	65.20	75.56
	15	58.85	80.57
	16	60 64	85.59
	17	53.04	90.61
	18	56.29	72.57
	19	60.42	70.07
	20	48.65	71.34
4	21	51.98	69.61
	22	55.40	67.72
	23	40.88	66.33
	24	43.59	68.97
	25	37.65	68.92
	26	39.73	61.70
	27	41.86	63.03
	28	43.98	57.16
	29	46.11	63.04
	30	38.21	60.82
	12	72.82	89.28
	13	77.86	84.82
	14	70.02	79.88
	15	63.11	84.89
	16	64.73	89.91
	17	56.61	94.93
	18	59.82	75.82
5	19	63.94	73.40

M	T	Pareto	Neighborhood
	20	51.57	74.23
	21	54.90	72.78
	22	58.32	70.37
	23	43.19	68.57
	24	45.90	71.22
	25	39.47	71.08
	26	41.56	63.73
	27	43.68	65.07
	28	45.81	58.71
	29	47.93	64.95
	30	39.51	62.32
6	12	78.42	95.17
	13	83.38	90.14
	14	74.85	84.19
	15	67.37	89.21
	16	68.83	94.23
	17	60.17	99.24
	18	63.34	79.07
	19	67.47	76.73
	20	54.48	77.13
	21	57.82	75.94
	22	61.23	73.01
	23	45.50	70.82
	24	48.21	73.46
	25	41.30	73.23
	26	43.38	65.77
	27	45.51	67.10
	28	47.63	60.22
	29	49.76	66.86
	30	40.81	63.83
	12	84.02	101.06
	13	88.89	95.47
	14	79.67	88.51
	15	71.63	93.53
	16	72.92	98.54
	17	63.74	103.96
	18	66.87	82.32
	19	70.99	80.07
	20	57.40	80.02
	21	60.73	79.11

M	T	Pareto	Neighborhood
7	22	64.15	75.65
	23	47.81	73.06
	24	50.43	76.10
	25	43.13	75.39
	26	45.21	67.80
	27	47.33	69.13
	28	49.46	61.72
	29	51.58	68.77
	30	42.51	65.34
8	12	89.62	119.15
	13	94.41	100.79
	14	84.50	92.83
	15	75.88	97.84
	16	77.01	103.26
	17	67.31	108.68
	18	70.39	85.57
	19	74.52	83.40
	20	60.32	82.91
	21	63.65	82.28
	22	67.07	78.29
	23	50.03	75.70
	24	52.74	78.74
	25	44.95	77.95
	26	47.03	69.83
	27	49.16	71.17
	28	51.28	63.23
	29	53.41	70.68
	30	44.21	67.25

Table 3.32: Pareto vs Neighborhood: Costs from all Weight combinations (w_1=0.1 to 0.8, w_2=0.1 to 0.8, w_3=0.1 to 0.8, and $w_1 + w_2 + w_3$ =1.0)

N	T	Pareto	Neighborhood
	12	2014.00	2426.00
	13	2245.00	2278.00
	14	2004.00	2111.00
	15	1758.00	2313.00
	16	1885.00	2515.00
	17	1573.00	2717.00
	18	1723.00	2032.00
	19	1894.00	2008.00
	20	1434.00	2017.00
4	21	1574.00	2021.00
	22	1716.00	1875.00
	23	1142.00	1880.00
	24	1255.00	1989.00
	25	**1002.00**	1966.00
	26	1088.00	1692.00
	27	1175.00	1736.00
	28	1262.00	1559.00
	29	1349.00	1741.00
	30	1049.00	1714.00
	12	2170.00	2589.00
	13	2399.00	2422.00
	14	2139.00	2229.00
	15	1877.00	2431.00
	16	2000.00	2633.00
	17	1673.00	2835.00
	18	1822.00	2122.00
	19	1993.00	2100.00
	20	1516.00	2096.00
5	21	1656.00	2109.00
	22	1798.00	1948.00
	23	1207.00	1941.00
	24	1320.00	2050.00
	25	1053.00	2025.00
	26	1139.00	1748.00
	27	1226.00	1792.00
	28	1313.00	1601.00
	29	1400.00	1794.00
	30	1085.00	1755.00
	12	2326.00	2752.00
	13	2553.00	2569.00
	14	2274.00	2347.00
	15	1996.00	2549.00
	16	2115.00	2751.00
	17	1773.00	2953.00
	18	1921.00	2212.00
	19	2092.00	2192.00

N	T	Pareto	Neighborhood
6	20	1598.00	2175.00
	21	1738.00	2197.00
	22	1880.00	2021.00
	23	1272.00	2002.00
	24	1385.00	2111.00
	25	1104.00	2084.00
	26	1190.00	1804.00
	27	1277.00	1848.00
	28	1364.00	1642.00
	29	1451.00	1847.00
	30	1121.00	1796.00
7	12	2482.00	2915.00
	13	2707.00	2716.00
	14	2409.00	2465.00
	15	2115.00	2667.00
	16	2230.00	2869.00
	17	1873.00	3083.00
	18	2020.00	2302.00
	19	2191.00	2284.00
	20	1680.00	2254.00
	21	1820.00	2285.00
	22	1962.00	2094.00
	23	1337.00	2063.00
	24	1448.00	2184.00
	25	1155.00	2143.00
	26	1241.00	1860.00
	27	1328.00	1904.00
	28	1415.00	1683.00
	29	1502.00	1900.00
	30	1169.00	1837.00
8	12	2638.00	3474.00
	13	2861.00	2863.00
	14	2544.00	2583.00
	15	2234.00	2785.00
	16	2345.00	2999.00
	17	1973.00	3213.00
	18	2119.00	2392.00
	19	2290.00	2376.00
	20	1762.00	2333.00
	21	1902.00	2373.00
	22	2044.00	2167.00
	23	1400.00	2136.00
	24	1513.00	2257.00
	25	1206.00	2214.00
	26	1292.00	1916.00
	27	1379.00	1960.00
	28	1466.00	1724.00
	29	1553.00	1953.00
	30	1217.00	1890.00

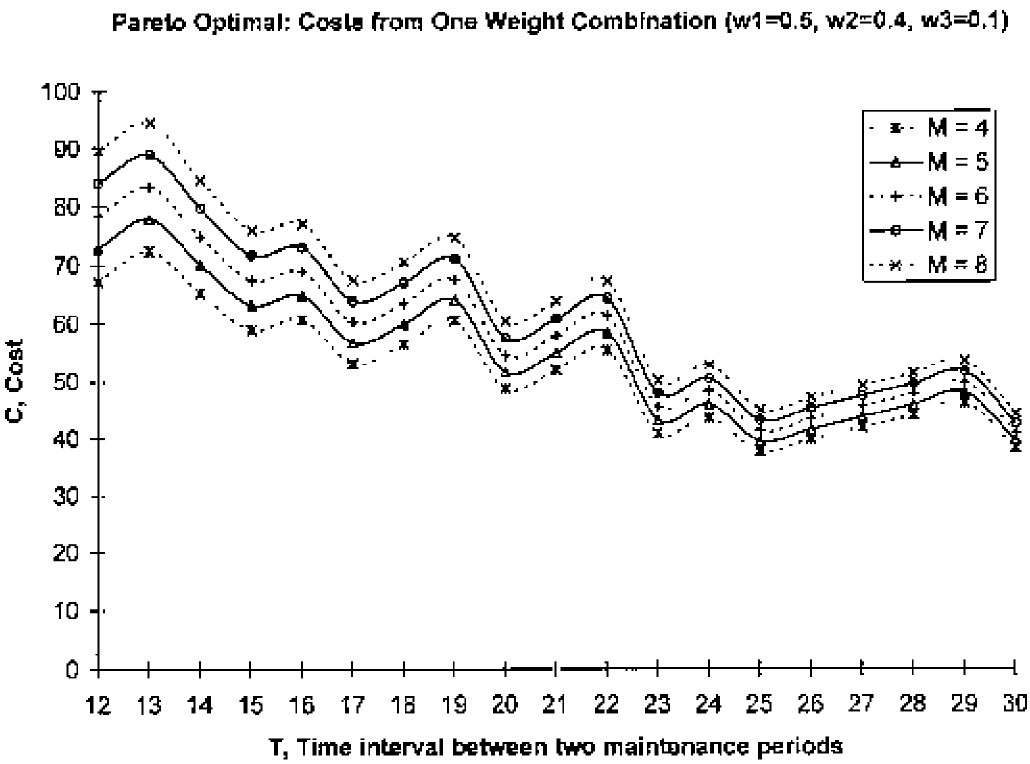

Figure 3.1 Pareto Optimal: Costs from One Weight Combination.

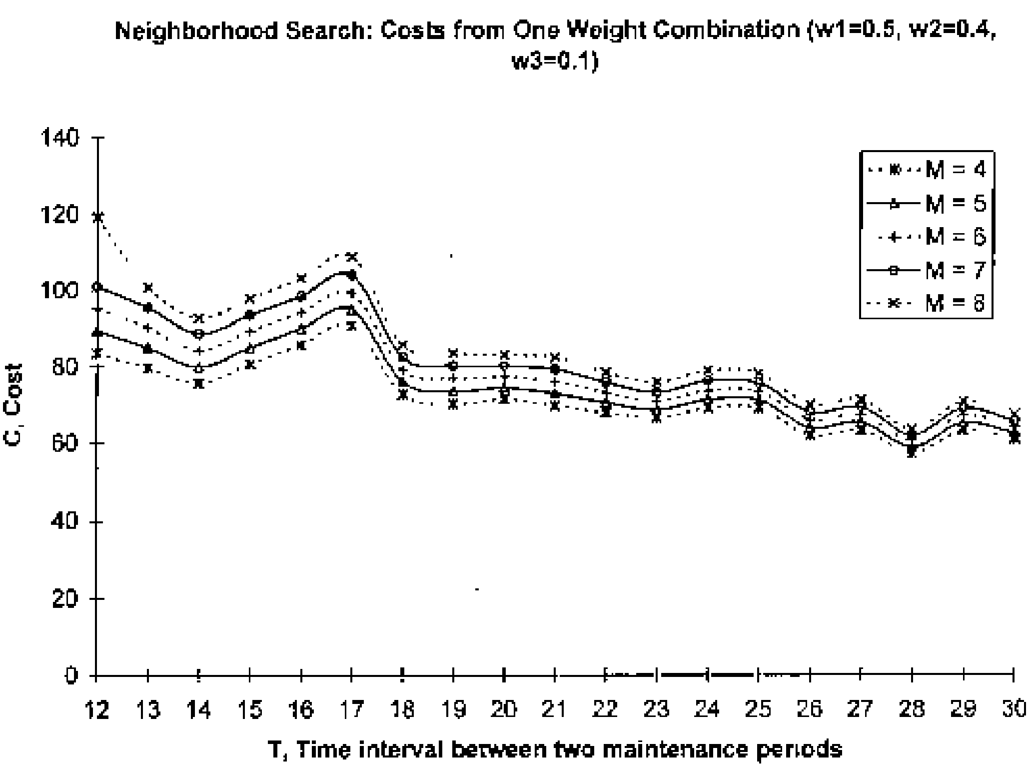

Figure 3.2 Neighborhood Search: Costs from One Weight Combination

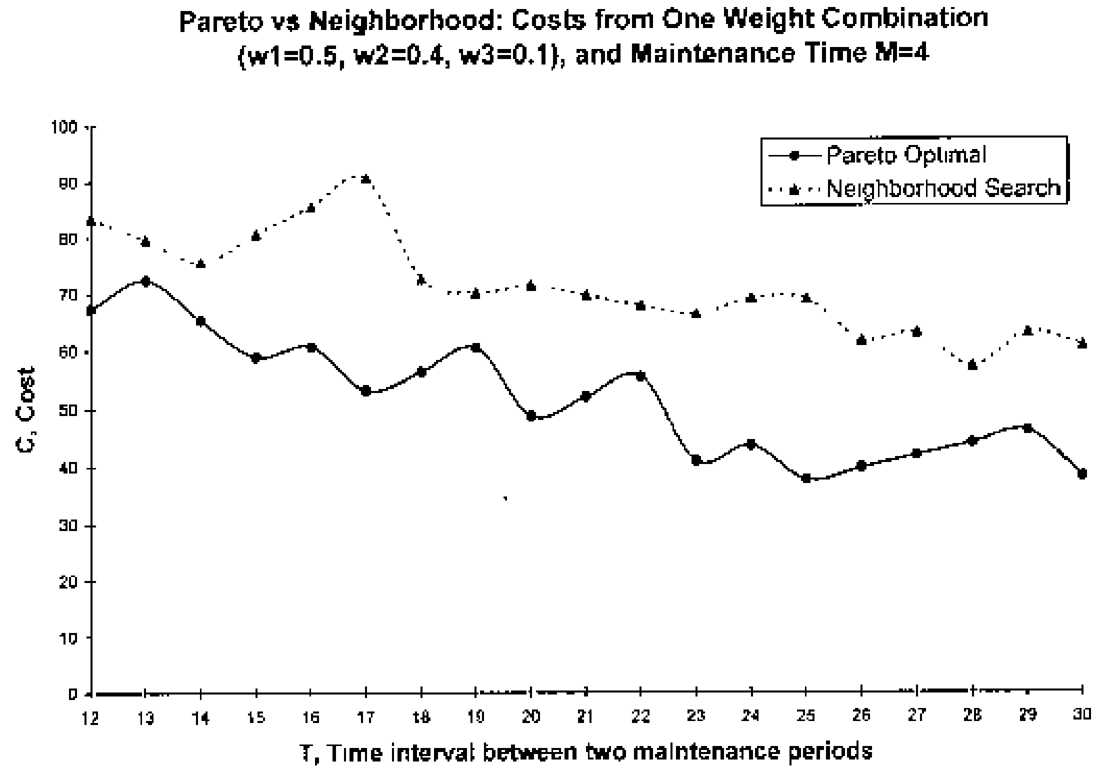

Figure 3.3 Pareto vs Neighborhood: Costs from One Weight Combination

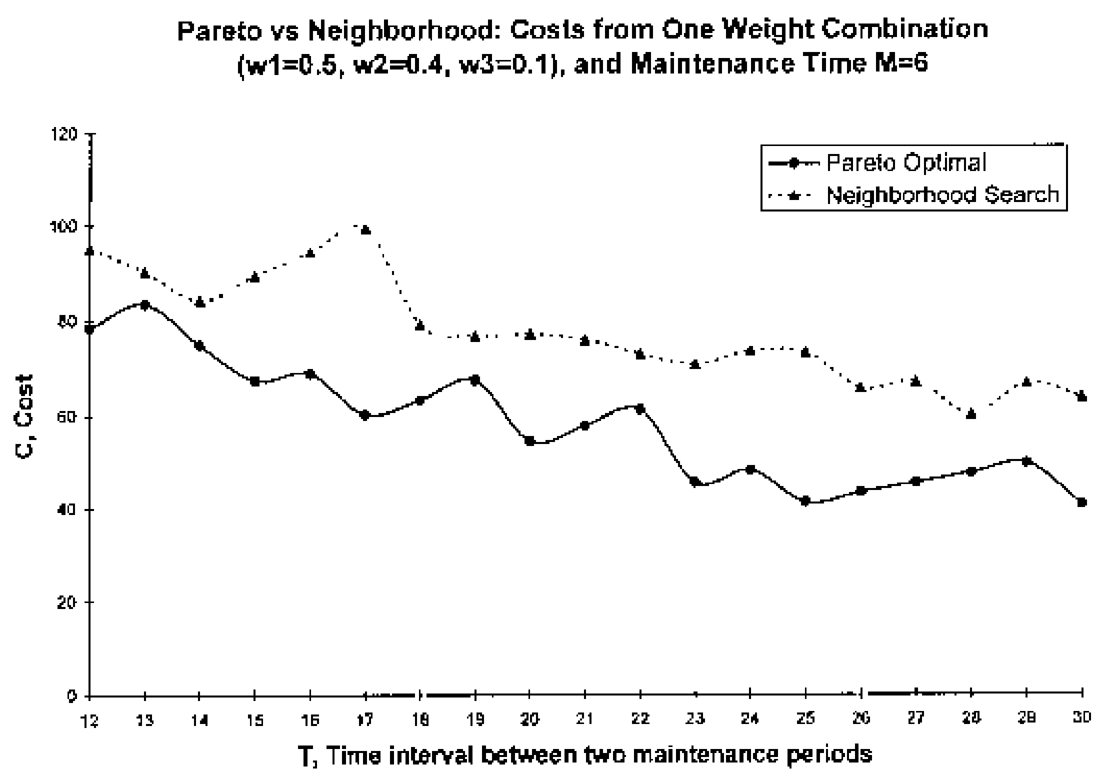

Figure 3.4 Pareto vs Neighborhood: Costs from One Weight Combination

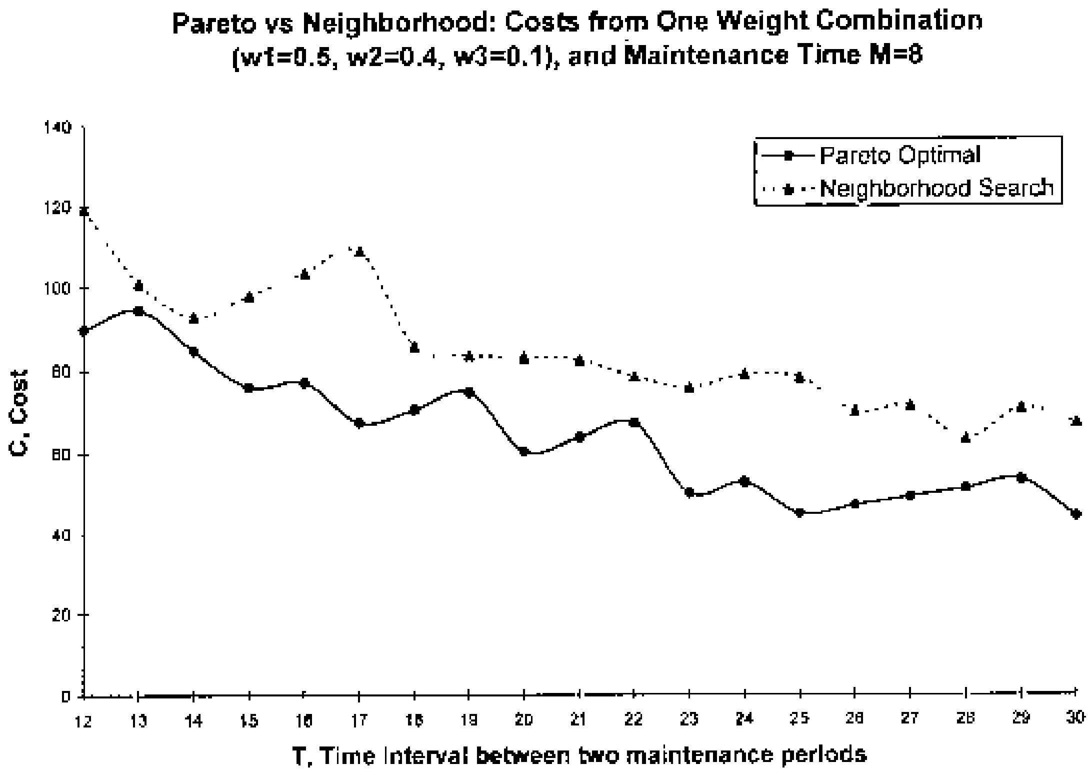

Figure 3.5 Pareto vs Neighborhood: Costs from One Weight Combination

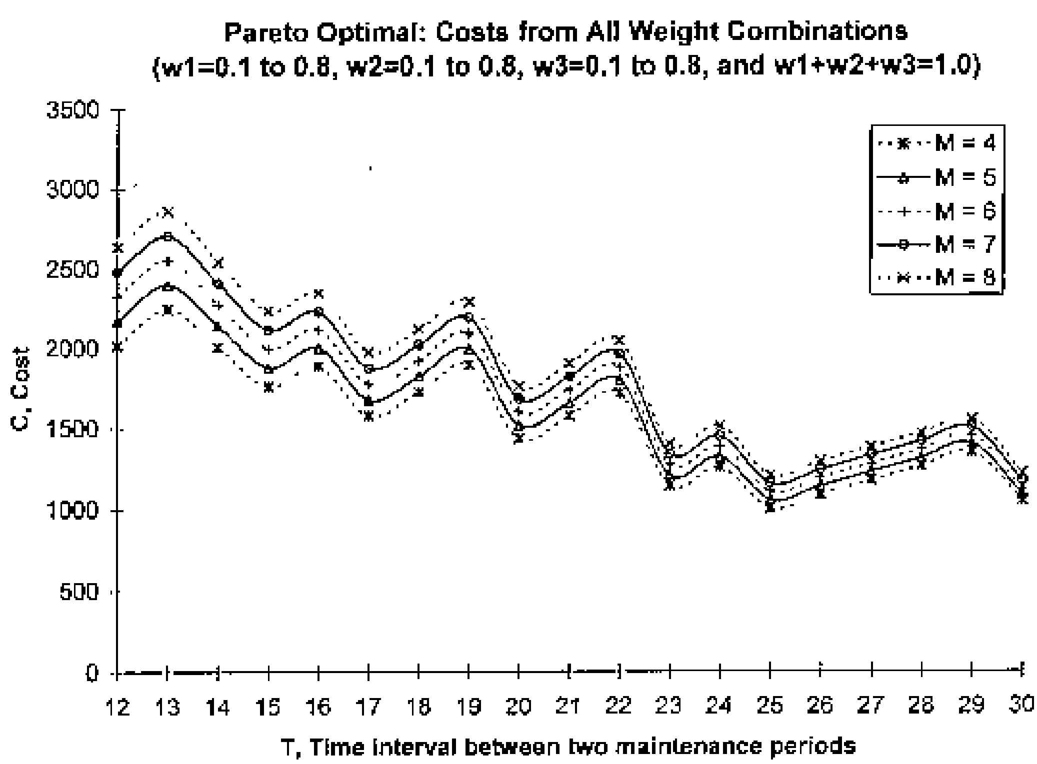

Figure 3.6 Pareto Optimal: Costs from All Weight Combinations

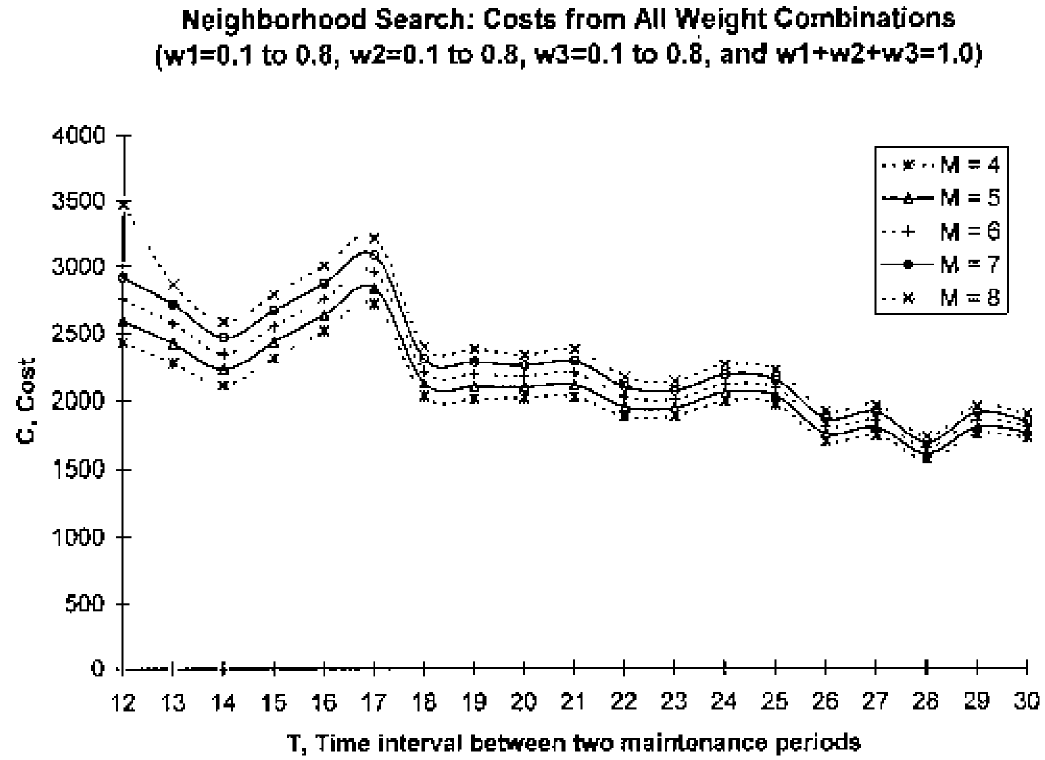

Figure 3.7 Neighborhood Search: Costs from All Weight Combinations

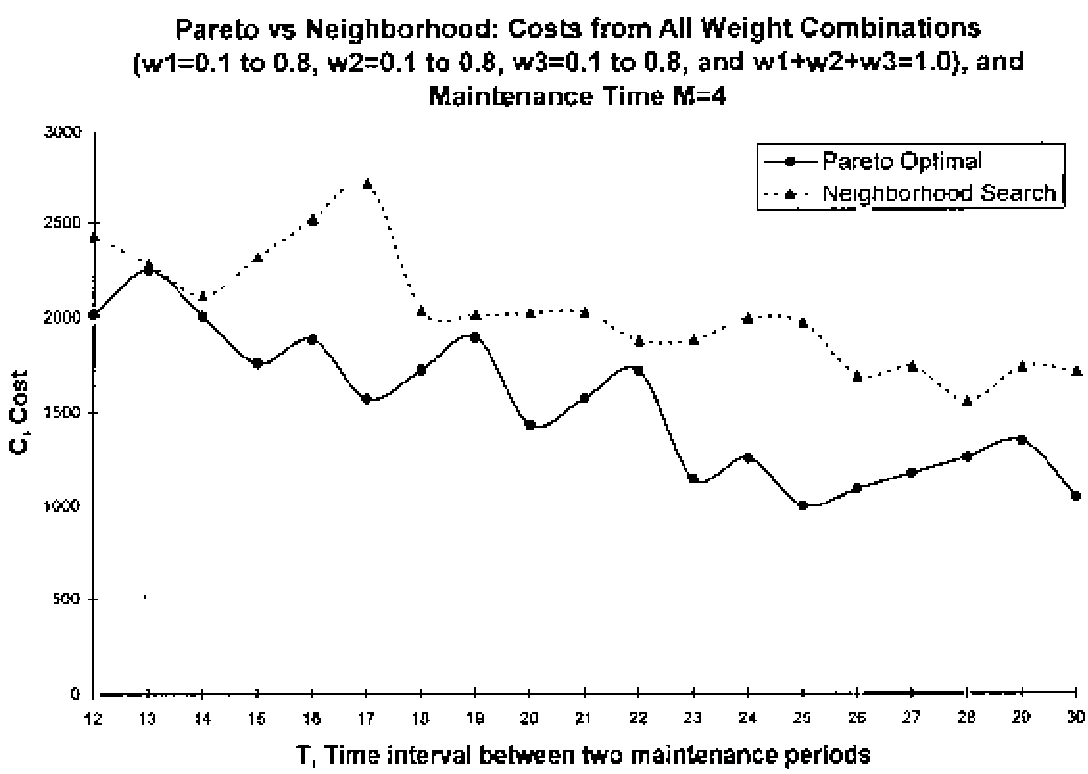

Figure 3.8 Pareto vs Neighborhood: Costs from all Weight combinations.

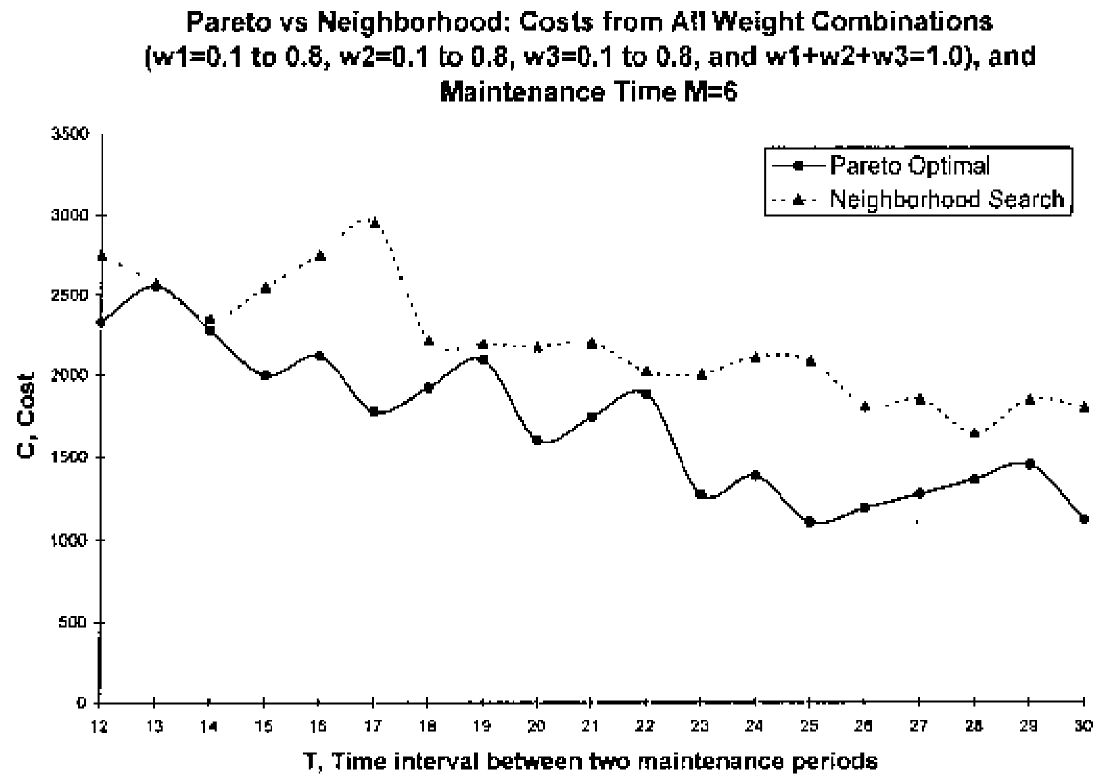

Figure 3.9 Pareto vs Neighborhood: Costs from all Weight combinations.

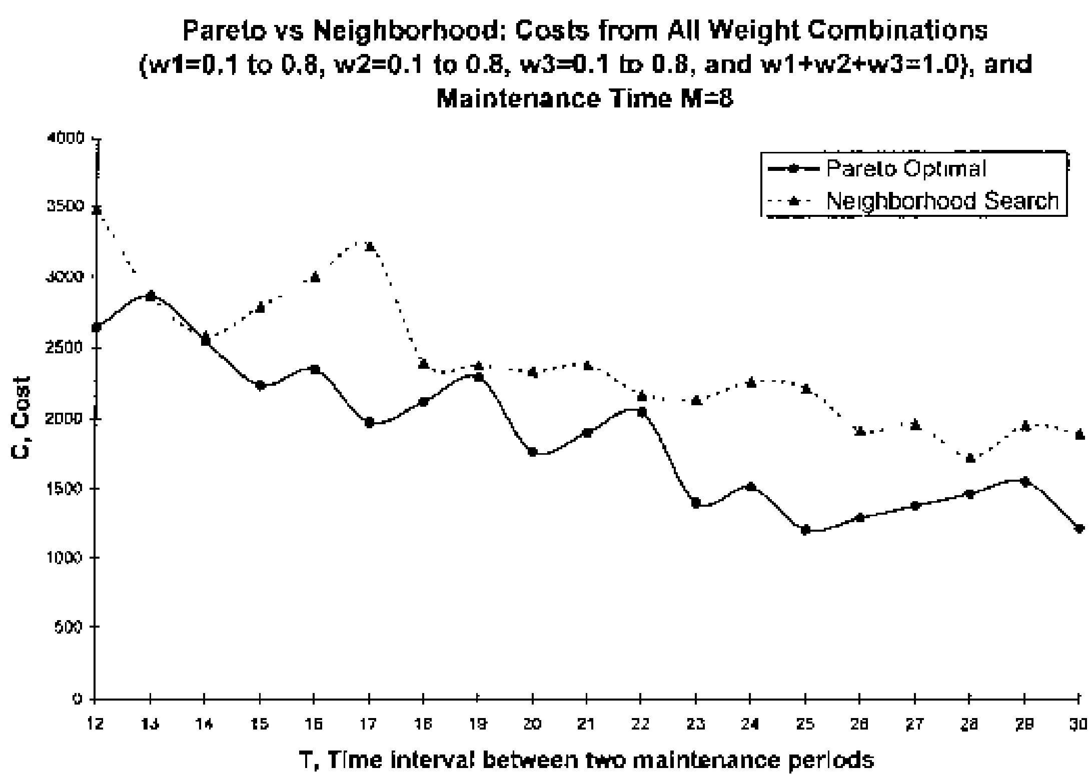

Figure 3.10 Pareto vs Neighborhood: Costs from all Weight combinations.

Various maintenance plans give more flexibility to the scheduler (or decision-maker) to make a decision according to the preference and available maintenance alternatives. Moreover, to transform multiple objectives into a single objective optimization problem, a weighted combination is considered. The weights may be time or situation dependent and sum of the weights must be equal to 1. Typically, a scheduler may not know the exact weights and may want to perform a parametric analysis to get a feeling for the trade-offs. In this work, all possible weight combinations of three objectives are performed to calculate the weighted function. These possible combinations for each schedule of Pareto-optimal set are also presented. The reason of presenting all the possible weight-combinations is that the importance level of each objective can be different according to the scheduler. These results are summarized in Appendix A. Appendix A provides cost of Pareto-optimal schedules which is dependent on total completion time, maximum lateness, and machine idle time for each combination of T and M for the all possible weight combinations. Table 3.29 only provides Pareto-optimal schedules with one possible weight combination (i.e., $w_1 = 0.5$, $w_2 = 0.4$, $w_3 = 0.1$), while Appendix A provides information on the all possible weight combinations of three objectives $(\overline{F}^*, L_{max}^*, I^*)$. Also the sum of the costs of each Pareto-optimal schedule for all the weight combinations is calculated in order to give an overall result of certain Pareto-optimal schedule. A schedule with the minimum sum of the costs is the best schedule within the set of Pareto-optimal schedules for a certain maintenance plan. Table 3.33 presents the sum of the costs of each Pareto-optimal schedule for all the weight combinations according to a certain maintenance plan. It also provides the Pareto-optimal schedule which gives the minimum cost for each maintenance plan. A decision maker can decide which Pareto-optimal schedule and which combination of weights he/she wants to use according to an available maintenance plan (i.e., T and M values). It can be concluded that the objective $c(\overline{F}^*, L_{max}^*, I^*)$ is depended on T and M, and this shows the importance of a good maintenance plan. The minimum cost is 1002.00 for T=25 and for M=4.

Table 3.33 Summary of performance measures for all different alternative parameters

T	M	SPT/EDD	SPT/EDD	S[1]	S[2]	S[3]	S[4]
12	4	2709.00	2014.00	2457.00	2457.00	2517.00	2709.00
	5	2860.00	2170.00	2632.00	2632.00	2656.00	2860.00
	6	3011.00	2326.00	2807.00	2807.00	2807.00	3011.00
	7	3162.00	2482.00	2982.00	2982.00	2982.00	3162.00
	8	3313.00	2638.00	3157.00	3157.00	3157.00	3313.00
13	4	2473.00	2264.00	2245.00	2245.00	2269.00	2473.00
	5	2603.00	2419.00	2399.00	2399.00	2399.00	2603.00
	6	2733.00	2574.00	2553.00	2553.00	2553.00	2733.00
	7	2863.00	2729.00	2707.00	2707.00	2707.00	2863.00
	8	2993.00	2884.00	2861.00	2861.00	2861.00	2993.00
14	4	2208.00	2527.00	2507.00	2004.00	2004.00	2208.00
	5	2319.00	2682.00	2661.00	2139.00	2139.00	2319.00
	6	2430.00	2837.00	2815.00	2274.00	2274.00	2430.00
	7	2541.00	2992.00	2969.00	2409.00	2409.00	2541.00
	8	2652.00	3147.00	3123.00	2544.00	2544.00	2652.00
15	4	2415.00	1758.00	1758.00	2235.00	2235.00	2415.00
	5	2526.00	1877.00	1877.00	2370.00	2370.00	2526.00
	6	2637.00	1996.00	1996.00	2505.00	2505.00	2637.00
	7	2748.00	2115.00	2115.00	2640.00	2640.00	2748.00
	8	2859.00	2234.00	2234.00	2775.00	2775.00	2859.00
16	4	2041.00	1961.00	1925.00	1885.00	1885.00	2041.00
	5	2132.00	2080.00	2042.00	2000.00	2000.00	2132.00
	6	2223.00	2199.00	2159.00	2115.00	2115.00	2223.00
	7	2314.00	2318.00	2276.00	2230.00	2230.00	2314.00
	8	2405.00	2437.00	2393.00	2345.00	2345.00	2405.00
17	4	1684.00	2164.00	1597.00	1573.00	2084.00	1684.00
	5	1759.00	2283.00	1698.00	1673.00	2199.00	1759.00
	6	1834.00	2402.00	1799.00	1773.00	2314.00	1834.00
	7	1909.00	2521.00	1900.00	1873.00	2429.00	1909.00
	8	1984.00	2640.00	2001.00	1973.00	2544.00	1984.00
18	4	1831.00	1725.00	1723.00	1725.00	1723.00	1831.00
	5	1906.00	1824.00	1822.00	1824.00	1822.00	1906.00
	6	1981.00	1923.00	1921.00	1923.00	1921.00	1981.00
	7	2056.00	2022.00	2020.00	2022.00	2020.00	2056.00
	8	2131.00	2121.00	2119.00	2121.00	2119.00	2131.00
19	4	1978.00	1896.00	1894.00	1896.00	1894.00	1978.00
	5	2053.00	1995.00	1993.00	1995.00	1993.00	2053.00
	6	2128.00	2094.00	2092.00	2094.00	2092.00	2128.00
	7	2203.00	2193.00	2191.00	2193.00	2191.00	2203.00
	8	2290.00	2292.00	2290.00	2292.00	2290.00	2290.00
20	4	2125.00	1434.00	2065.00	2067.00	2065.00	2125.00
	5	2200.00	1516.00	2164.00	2166.00	2164.00	2200.00
	6	2275.00	1598.00	2263.00	2265.00	2263.00	2275.00
	7	2362.00	1680.00	2362.00	2364.00	2362.00	2362.00
	8	2461.00	1762.00	2461.00	2463.00	2461.00	2461.00
21	4	1719.00	1576.00	1667.00	1574.00	1612.00	1719.00
	5	1777.00	1658.00	1740.00	1656.00	1670.00	1777.00
	6	1835.00	1740.00	1813.00	1738.00	1740.00	1835.00

T	M	SPT/EDD	SPT/EDD	S[1]	S[2]	S[3]	S[4]
	7	1893.00	1822.00	1898.00	1820.00	1822.00	1893.00
	8	1951.00	1904.00	1983.00	1902.00	1904.00	1951.00
22	4	1837.00	1718.00	1718.00	1716.00	1730.00	1837.00
	5	1895.00	1800.00	1800.00	1798.00	1800.00	1895.00
	6	1953.00	1882.00	1882.00	1880.00	1882.00	1953.00
	7	2011.00	1964.00	1964.00	1962.00	1964.00	2011.00
	8	2069.00	2046.00	2046.00	2044.00	2046.00	2069.00
23	4	1453.00	1860.00	1835.00	1142.00	1224.00	1453.00
	5	1506.00	1942.00	1916.00	1207.00	1265.00	1506.00
	6	1559.00	2024.00	1997.00	1272.00	1306.00	1559.00
	7	1612.00	2106.00	2078.00	1337.00	1347.00	1612.00
	8	1665.00	2188.00	2159.00	1402.00	1400.00	1665.00
24	4	1554.00	1686.00	1660.00	1255.00	1313.00	1554.00
	5	1607.00	1755.00	1728.00	1320.00	1354.00	1607.00
	6	1660.00	1824.00	1796.00	1385.00	1395.00	1660.00
	7	1713.00	1893.00	1864.00	1450.00	1448.00	1713.00
	8	1766.00	1962.00	1932.00	1515.00	1513.00	1766.00
25	4	1655.00	1429.00	**1002.00**	1368.00	1402.00	1655.00
	5	1708.00	1496.00	1053.00	1433.00	1443.00	1708.00
	6	1761.00	1563.00	1104.00	1498.00	1496.00	1761.00
	7	1814.00	1630.00	1155.00	1563.00	1561.00	1814.00
	8	1867.00	1697.00	1206.00	1628.00	1626.00	1867.00
26	4	1756.00	1088.00	1089.00	1481.00	1491.00	1756.00
	5	1809.00	1139.00	1140.00	1546.00	1544.00	1809.00
	6	1862.00	1190.00	1191.00	1611.00	1609.00	1862.00
	7	1915.00	1241.00	1242.00	1676.00	1674.00	1915.00
	8	1968.00	1292.00	1293.00	1741.00	1739.00	1968.00
27	4	1466.00	1175.00	1176.00	1265.00	1359.00	1466.00
	5	1505.00	1226.00	1227.00	1304.00	1398.00	1505.00
	6	1544.00	1277.00	1278.00	1343.00	1437.00	1544.00
	7	1583.00	1328.00	1329.00	1382.00	1476.00	1583.00
	8	1622.00	1379.00	1380.00	1421.00	1515.00	1622.00
28	4	1541.00	1262.00	1263.00	1340.00	1434.00	1541.00
	5	1580.00	1313.00	1314.00	1379.00	1473.00	1580.00
	6	1619.00	1364.00	1365.00	1418.00	1512.00	1619.00
	7	1658.00	1415.00	1416.00	1457.00	1551.00	1658.00
	8	1697.00	1466.00	1467.00	1496.00	1590.00	1697.00
29	4	1616.00	1349.00	1350.00	1415.00	1509.00	1616.00
	5	1655.00	1400.00	1401.00	1454.00	1548.00	1655.00
	6	1694.00	1451.00	1452.00	1493.00	1587.00	1694.00
	7	1733.00	1502.00	1503.00	1532.00	1626.00	1733.00
	8	1772.00	1553.00	1554.00	1571.00	1665.00	1772.00
30	4	1535.00	1054.00	1053.00	1049.00	1428.00	1535.00
	5	1572.00	1103.00	1089.00	1085.00	1465.00	1572.00
	6	1609.00	1152.00	1125.00	1121.00	1502.00	1609.00
	7	1646.00	1201.00	1173.00	1169.00	1539.00	1646.00
	8	1683.00	1250.00	1221.00	1217.00	1576.00	1683.00

* Minimum sum of the cost for each maintenance plan

3.9 Conclusion

A multi-criterion non-preemptive scheduling that reduces the total cost of the problem is considered in this study. Three criterions are considered; reduction of flow time, maximum tardiness, and machine idle time in a periodically maintained single machine problem. The trade-offs between the flow time and maximum tardiness is comparatively simple, but the trade-off between minimum flow time, maximum tardiness and machine idle time is a complex problem. In this study a new kind of approach that allows the use of weighted aggregation of the criterions is presented. The new approach started with an initially obtained set of Pareto-optimal schedule for flow time and maximum tardiness minimization problem. It then introduces machine idle time and maintenance time in each of these initially found sequences. Once the rescheduling of machine maintenance and idleness period of machine is completed, it then calculates the new values of flow time, maximum tardiness and machine idle time. All possible weight combinations for the criterions are computed. The search for the minimum total cost among all the Pareto-optimal schedules with the assigned weights on criterions is obtained. Finally, a promising sequence is chosen that gives the minimum total cost for a particular set of weights on the criterions.

A modified Pareto-optimal algorithm for such technique has been devised and several properties associated with problem have also been investigated. An algorithm for neighborhood search technique has been proposed to provide the near-optimal solution for the problem. The performance of the modified Pareto-optimal algorithm has been evaluated by comparing its solution with the solutions derived by the neighborhood search heuristic. Results have shown that the modified Pareto-optimal algorithm provides a better solution than the neighborhood search heuristic, and this shows the efficiency of the modified Pareto-optimal algorithm

Chapter 4
Distribution

4.1 Introduction

Supply-chain management seeks to synchronize a firm's processes and those of its suppliers to match the flow of materials, services, and information with customer demand. Supply-chain management has strategic implications because the supply system can be used to achieve important competitive priorities. It also involves the coordination of key processes in the firm such as order placement, order fulfillment, and purchasing, which are supported by marketing, finance, engineering, information systems, operations and logistics.

Successful supply-chain management requires a high degree of functional and organizational integration. The interconnected set of linkages between suppliers of materials and services that spans the transformation of raw materials into products and services and delivers them to a firm's customers is known as the supply-chain. The value of supply-chain management becomes apparent when the complexity of the supply-chain is recognized. The performance of numerous suppliers determines the inward flow of materials. The performance of the firm's marketing, production, and distribution processes determines the outward flow of products. Traditionally, organizations have divided the responsibility for managing the flow of materials and services among three departments: purchasing, production, and distribution.

Distribution is the management of the flow of materials from manufacturers to customers and from warehouses to retailers, involving the storage and transportation of products. It may also be responsible for finished goods inventories and the selection of transportation service providers. Typically, firms are willing to undergo the rigors of developing integrated supply-chain progress through a series of phases. The starting point for most firms, external suppliers and customers are considered to be independent of the firm. Relations with this entities are formal, and there is little sharing of operating information and costs. Internally, purchasing, production, and distribution act independently, each optimizing its own activities without considering other entities. Traditionally, it is assumed that a parameter needs to be optimized through right operations management technique. However, there is no basis as to why a particular parameter is selected as the objective function. This research provides an idea that AHP which is a technique of MCDM (Multi Criteria Decision Making) technique can be used to justify selection of the right parameter as the objective function of an optimization technique.

After determining where the demand for goods and services is greatest, management must select a location for the facility that will supply that demand. For warehousing and distribution operations, transportation costs and proximity to markets are extremely important. With a warehouse nearby, many firms can hold inventory closer to the customer, thus reducing delivery time, transportation cost and promoting sales.

4.2 Multi Criteria Decision Making

In many real world situations, there are many, often conflicting, objectives. For instance, if there are multiple potential suppliers requiring evaluation with conflicting criteria, such as quality of material, timely delivery, price, quickness of delivery, managing sudden ordering, etc., then it requires a solution [65, 66]. Or, in selecting the right communication system, several conflicting criteria, such as speed of communication, cost, reliability of transaction, maintainability, etc. becomes important, which requires a combination of qualitative and quantitative solution [67]. As another instance, a multi criteria solution is required when a selecting the right manufacturing system or material handling system out of many available ones [68]. In an advertising campaign, there might be a number of different market segments to reach. In fire station problem, there might be two types of objectives: minimizing response time and minimizing service cost. The models discussed here, however, only allow one objective. How can they be adapted to handle multiple objectives? This requires Multi Criteria Decision making (MCDM) [69].

However, there are a number of fundamental problems when there are multiple objectives. For instance, in case where there are a number of decision makers. each with a preference ordering over a number of alternatives. The goal is to choose the ``fair'' alternative that aggregates the preferences of the decision makers. This is an example of multiple criteria decision making (each decision makers represents one criteria), and it is required to balance those objectives in a fair way. The field of study that addresses these problems is called MCDM, and is filled with pessimistic results [65].

These issues of aggregating views about alternatives are difficult even with a single decision maker (or a group trying to reach consensus). Imagine trying to locate an "obnoxious facility", like a waste disposal plant. There are many factors that go into such a decision. These might include distance from highly populated areas, transportation costs, land costs, geological stability, and so on. Is there any organized way that one might think about determining the relative importance of these factors and then go about comparing alternative sites? One technique that is used is the *Analytic Hierarchy Process (AHP)*, which uses very simple calculations to try to put numerical values on factors and alternatives [70, 71].

Finally, a logical question follows as to how these models be used in more complicated situations, where the choice is not just a number of alternatives, but rather an entire decision set, say represented by a linear program. Obviously, a linear programming approach to such situations will at least theoretically provide better solutions. But it has been proved in many situations that MCDM, more specifically AHP, can offset the benefits of more fine-tuned optimality over possibility of getting a solution in a realistic time period [72].

4.3 Basic Concepts of Analytic Hierarchy Process (AHP)

Developed by Thomas Saaty, AHP provides a proven, effective means to deal with complex decision making and can assist with identifying and weighting selection criteria, analyzing the data collected for the criteria and expediting the decision-making process [70-72]. A large number of situations, with varieties of variables, have been analyzed using AHP method [73-74].

AHP helps capture both subjective and objective evaluation measures, providing a useful mechanism for checking the consistency of the evaluation measures and alternatives suggested by the team thus reducing bias in decision making. Combined with meeting automation, organizations can minimize common pitfalls of team decision making process, such as lack of focus. planning, participation or ownership, which ultimately are costly distractions that can prevent teams from making the right choice.

The first step is for the team to decompose the goal into its constituent parts, progressing from the general to the specific. In its simplest form, this structure comprises a goal, criteria and alternative levels. Each set of alternatives would then be further divided into an appropriate level of detail, recognizing that the more criteria included, the less important each individual criterion may become.

Next, a relative weight is assigned to each one. Each criterion has a local (immediate) and global priority. The sum of all the criteria beneath a given parent criterion in each tier of the model must equal one. Its global priority shows its relative importance within the overall model.

Finally, after the criteria are weighted and the information is collected, put the information into the model. Scoring is on a relative basis, not an absolute basis, comparing one choice to another. Relative scores for each choice are computed within each leaf of the hierarchy. Scores are then synthesized through the model, yielding a composite score for each choice at every tier, as well as an overall score.

Theoretical Details of AHP

Analytic hierarchy is a framework for solving a problem. The analytic hierarchy process is a systematic procedure for representing the elements of any problem. It organizes the basic rationality by breaking down a problem into its smaller constituents and then calls for pair-wise comparison judgments, to develop priorities in each level.

The analytic hierarchy process provides a comprehensive framework to cope with intuitive, rational, and irrational factors in making judgments at the same time. It is a method of integrating perceptions and purposes into an overall synthesis. The analytic hierarchy process does not require that judgments be consistent or even transitive. The degree of consistency (or inconsistency) of the judgment is revealed at the end of the analytic hierarchy process.

People making comparisons use their feelings and judgment. Both vary in intensity. To distinguish among different intensities, the scale of absolute numbers in the table is useful.

Table 4.1 Measurement scale

Intensity of relative importance	Explanation
1 (equal importance)	Two activities contribute equally to the objective
3 (slight importance of one over another)	Experience and judgment slightly favor one activity over another
5 (essential or strong importance)	Experience and judgment strongly favor one activity over another
7 (demonstrated importance)	An activity is strongly favored and its dominance is demonstrated in practice
9 (absolute importance)	The evidence favoring one activity over another is of the highest possible order of affirmation
2, 4, 6, 8 (intermediate values between the two adjacent judgments)	When compromise is needed
Reciprocals of above nonzero numbers (if an activity has one of the above numbers assigned to it when compared with second activity, the second activity has the reciprocal value when compared to the first)	

The analytic hierarchy process can be decomposed into the following steps. Particular steps may be emphasized more in some situations than in others. Also as noted, interaction is generally useful for stimulation and for representing different points of view.

1. Define the problem and determine what knowledge is sought.
2. Structure the hierarchy from the top (the objectives from a broad perspective) through the intermediate levels (criteria on which subsequent levels depend) to the lowest level (which usually is a list of the alternatives).
3. Construct a set of pair-wise comparison matrices for each of the lower levels, one matrix for each element in the level immediately above. An element in the higher level is said to be a governing element for those in the lower level since it contributes to it or affects it. In a complete simple hierarchy, every element in the lower level affects every element in the upper level. The elements in the lower level are then compared to each other, based on their effect on the governing element above. This yields a square matrix of judgments. The pair-wise comparisons are done in terms of which element dominates the other. These judgments are then expressed as integers according to the judgment values in the table. If element A dominates element B, then the whole number integer is entered in row A, column B, and the reciprocal (fraction) is entered in row B, column A.
4. There are $n(n-1)/2$ judgments required to develop the set of matrices in step 3, where n is the number of elements in the lower level.
5. Having collected all the pair-wise comparison data and entered the reciprocals together with n unit entries down the main diagonal, the eigenvalue problem $Aw = \lambda_{max} w$ is solved and consistency is tested, using the departure of λ_{max} from n (see below).
6. Steps 3, 4, and 5 are performed for all levels and clusters in the hierarchy.
7. Hierarchal composition is now used to weigh the eigenvectors by the weights of the criteria, and the sum is taken over all weighted eigenvector entries corresponding to those in the lower level of the hierarchy.

8. The consistency ratio of the entire hierarchy is found by multiplying each consistency index by the priority of the corresponding criterion and adding them together. The result is then divided by the same type of expression, using the random consistency index corresponding to the dimensions of each matrix weighted by the priorities as before. The consistency ratio should be about 10% or less to be acceptable. If not, the quality of the judgments should be improved, perhaps by revising the manner in which questions are asked in making the pair-wise comparisons. If this should fail to improve consistency, it is likely that the problem should be more accurately structured; that is, similar elements should be grouped under more meaningful criteria. A return to step 2 would be required, although only the problematic parts of the hierarchy may need revision.

The main advantage of this method is its ability to handle a complex problem to prepare a hierarchy of choice and reasons of choices through decomposition and synthesis. It can compare different alternatives and attributes using a scale of relative importance.

The numerical results of attributes are presented to the decision maker to assign relative importance according to a predefined scale. Now a judgment matrix is prepared. It is an ($n \times n$) matrix. From the judgment matrix, normalized weights are calculated as follows.

$$\begin{bmatrix} 1 & a_{12} & \cdots & a_{1k} & \cdots & a_{1n} \\ a_{21} & 1 & \cdots & a_{2k} & \cdots & a_{2n} \\ & & & & & \\ a_{k1} & a_{k2} & \cdots & 1 & \cdots & a_{kn} \\ & & & & & \\ a_{n1} & a_{n2} & \cdots & a_{nk} & \cdots & 1 \end{bmatrix} \xrightarrow{\text{Geometric mean}} \begin{bmatrix} b_1 \\ b_2 \\ \\ b_k \\ \\ b_n \end{bmatrix} \xrightarrow{\text{Normalized weights}} \begin{bmatrix} x_1 \\ x_2 \\ \\ x_k \\ \\ x_n \end{bmatrix}$$

where, i and j are the alternatives or attributes to be compared. a_{ij} is a value which represents comparison between alternatives / attributes i and j.

The above judgment matrix may be consistent if $a_{ij} \, . \, a_{jk} = a_{ik}$ for all values of i, j, k.

In the above matrix, sum of all elements in a column is

$$y_k = \sum_{i=1}^{i=n} a_{ij},$$

where $k = 1, 2, \ldots n$ and $j = 1, 2, \ldots, n$.

Geometric mean is calculated from the elements of rows as follows

$$b_k = [(a_{k1}) \,.\, (a_{k2}) \ldots (a_{kn})]^{1/n},$$

where $k = 1, 2, \ldots n$.

Normalized weights are calculated as follows

$$X_k = \frac{b_k}{\sum_{k=1}^{k=n} b_k}.$$

Saaty's measure of consistency is done in terms of consistency index (C.I.)

$$\text{C.I} = \frac{\lambda_{\max} - n}{n-1},$$

where $\lambda_{\max} = y_1 x_1 + y_2 x_2 + \cdots + y_k x_k + \cdots + y_n x_n = \sum_{k=1}^{k=n} y_k x_k$

= largest Eigen value of matrix of order n.

Now, some randomly generated consistency index (R.I.) values are as follows:

n	1	2	3	4	5	6	7	8	9	10
R.I.	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.49

Acceptability of alternative or attribute is measured in terms of Consistency Ratio (C.R.).

$$\text{C.R} = \frac{C.I.}{R.I.}$$

If C.R. $\leq$ 10%, then the alternative or attribute is considerable; otherwise, the alternative or attribute is rejected. The over-all consistency may also be measured to justify the validity of selection.

Use of AHP in this Research

It has been applied in complex material planning system. For instance, many organizations keep thousands of items in their warehouses, which at times may be in excess of 50% of all the company's expenses. Each item typically possesses its own unique characteristics, since these are typically sourced from different suppliers. Under these circumstances, it may not be rational or economical to deal with each item via a generic material control system (either push or pull system). A multi-criteria approach that utilizes the Analytic Hierarchy Process (AHP) has been reported in an occasion. The paper proposes a modified AHP, such that it is able to classify the materials and components for different Material Planning and Control Systems (MPCS), i.e. Kanban, MRP, hybrid, and Re-Order Point (ROP) Systems. This modified AHP is better at rising to the challenge of diversity of material characteristics in deriving an optimal decision for MPCS system selection [75]. This research aims at utilizing this concept in evaluating a different situation of material planning, where the right parameter needs to be selected through AHP. Traditionally, it is assumed that a parameter needs to be optimized through right operations management technique. However, there is no basis as to why a particular parameter is selected as the objective function. This research provides an idea that AHP can be used to justify selection of the right parameter as the objective function of an optimization technique.

4.4 Problem Description

Manufacturing firms rarely sell directly to the ultimate customer. Some buyers are manufacturing firms that buy products and services and incorporate them into their own output. Other buyers are wholesalers, retailers and distribution firms who buy the products and then distribute them further down the chain towards the ultimate customers.

What difference does it make whether the firms acts as the buyer from suppliers or a suppliers to other buyers? Buyers talk about such things as schedules, lot sizes, costs, lead times, and just-in-time delivery. Firms often take this as a given when finding suppliers who comply with their demands. Schedules sent to the firm by their customers may not fit their schedules. The just-in-time deliveries that the firms demand from their vendors may not be compatible with, for example, their job-shop production.

The principles of MRP can also be applied to distribution inventories, or stocks of items held at retailers and distribution centers. Consider the distribution system of which the top level represents retail stores at various locations through the country. The middle levels are regional distribution centers that replenish retail store inventories on request. The bottom level consists of one or more plants that supply the distribution centers.

The distribution planning is an inventory control and scheduling technique that applies MRP principles to distribution inventories. An inventory record is maintained for each item at each location. Use of distribution planning requires an integrated information system. If the manufacturers operates its own distribution centers and retail stores, called fixed quantity model or self distribution, gathering demand information and relaying it back to the plants is easy. If the manufacturer does not own the distribution centers and retail stores then it is called fixed time period model or contacted distribution. In this research work three models are considered.

1) Fixed -quantity model or Self distribution model (M_1),

2) Fixed- time period model or Contracted distribution model (M_2),

3) Partly self and partly contracted distribution or Mixed model (M_3).

The basic distinction is that fixed-order quantity models are "event triggered" and fixed-time period models are "time triggered." That is, a fixed-order quantity model initiates an order when the event of reaching a specified reorder level occurs. This event may take place at any time, depending on the demand for the items considered, i.e. it is under firm's control. In contrast, the fixed-time period model is limited to placing orders at the end of a predetermined period; only the passage of time triggers the model. To use the fixed-order quantity model which places an order when the remaining inventory drops to a predetermined order point, the inventory remaining must be continually monitored. Thus, the fixed-order quantity model is a perpetual system, which requires that every time a withdrawal from inventory or an addition to inventory is made, records must be updated to ensure that the reorder point has or has not been reached. In a fixed-time period model counting takes place only at the review period.

In this research work it has been assumed that there are four criteria that are being used to evaluate distribution model. Four criteria are management effort, cost, integration, reliability. Further, it has been assumed that there are three distribution models (M_1, M_2, M_3).

Management effort: The idea is to apply a total system approach to managing the flow of information, materials, and services from raw material suppliers through factories and warehouses to the end customer. Recent trends such as outsourcing and mass customization are forcing companies to find flexible ways to meet customer demand. The focus is on optimizing those core activities to maximize the speed of response to changes in customer expectations.

For many years, few companies regarded the operating processes of a firm as a source of competitive advantage. The goals of the firm relating to operations were cost reduction and improved labor utilization. Decisions were made on narrow, tactical grounds. This was the domain of the technically oriented engineering specialists. Little attention was paid to how the processes, which deliver the goods and services of the firm, fit with its strategy. To regain a competitive position, western managers realized that major change was required. Operations had to become an integral part of the corporate strategy. This corporate strategy had to be responsive to the needs of the firm's customers. Companies learned how different customers had different priorities. The old idea that cost minimization was always the goal was shattered. A new field called operations strategy emerged.

Operations strategy offers a new perspective about operations problems, as well as a new set of concepts and techniques. The new perspective relates to the context within which decisions are made. This context considers the needs of customer together with the overall strategy of the firm. A company that is considered to be world class recognizes that its ability to compete in the market place depends on developing an operations strategy that is properly aligned with its mission of serving the customer.

Cost: Within every industry, there is usually a segment of the market that buys strictly on the basis of low cost. To successfully compete in this niche, a firm must be the low-cost producer, but even doing this does not always guarantee profitability and success.

Products sold strictly on the basis of cost are typically commodity like in nature. In other words, customers cannot distinguish the products of one firm from those of other, as a result, customers use cost as the primary determinant for making a purchase.

However, this segment of the market is frequently very large, and many companies are lured by the potential for significant profits, which they associate with the large unit volumes of product. As a consequence, competition in this segment is fierce and so is the failure rate. After all, there can only be one low cost producer, which usually establishes the selling price in the market.

Integration: Successful supply-chain management requires a high degree of functional and organizational integration. Such integration does not happen overnight. The firm initiates internal integration by creating a materials management department. Materials management is concerned with decisions about purchasing materials and services, inventories, production levels, staffing patterns, schedules, and distribution. The focus is on the integration of those aspects of the supply-chain directly under the firm's control to create an internal supply-chain. Firms in this phase utilize a seamless information and materials control system from distribution to purchasing, integrating marketing, finance, accounting, and operations. The internal supply-chain is extended to embrace suppliers and customers, thereby linking it to the external supply-chain, which is not under the direct control of the firm. The firm must change its focus from a product or service orientation to a customer orientation.

Reliability: Another dimension of quality related to product design is reliability, which refers to the probability that the product will be functional when used. Products often consist of a number of components that all must be operative for the product to perform as intended. Suppose that a product has a number of subsystems, each with its own reliability measure. The reliability of each subsystem contributes to the quality of the total system. Distribution reliability relates to the ability of the firm to supply the product to the customer on or before a promised delivery due date.

4.5 Computational Results

There are four criteria that are being used to evaluate the models are management effort, cost, reliability, and integration. Further, assume that models M_1, M_2, M_3 are being considered. The measurement scale and hierarchy for this application are shown. For analysis purpose, primary data and information have been collected from several national and international logistics companies operating in Bangladesh.

The firm must now develop a set of pair-wise comparisons to define the importance of the criteria. If the firm believes that cost is equally to moderately more important than reliability, a value of 2 expresses this judgment. If reliability is moderately more important service, a value of 3 is appropriate.

However, as previously mentioned, judgments are not always perfectly consistent. Suppose that, for example, cost is judged moderately to strongly more important than management effort, so a value of 4 is appropriate. Continuing with this process, the decision maker had decided that cost is moderately more important than integration i.e. a value of 2. These six judgments complete the pair-wise comparisons that are needed at this stage; this information is entered in a pair-wise comparison matrix shown in Exhibit. The other entries in the matrix are along the diagonal and reciprocals of the six judgments as previously discussed.

Measurement Scale

People making comparisons use their feelings and judgment. Both vary in intensity. To distinguish among different intensities, the scale of absolute numbers in Table 1.1 is useful.

It is also called "Scale of relative importance".

Model Selection Hierarchy

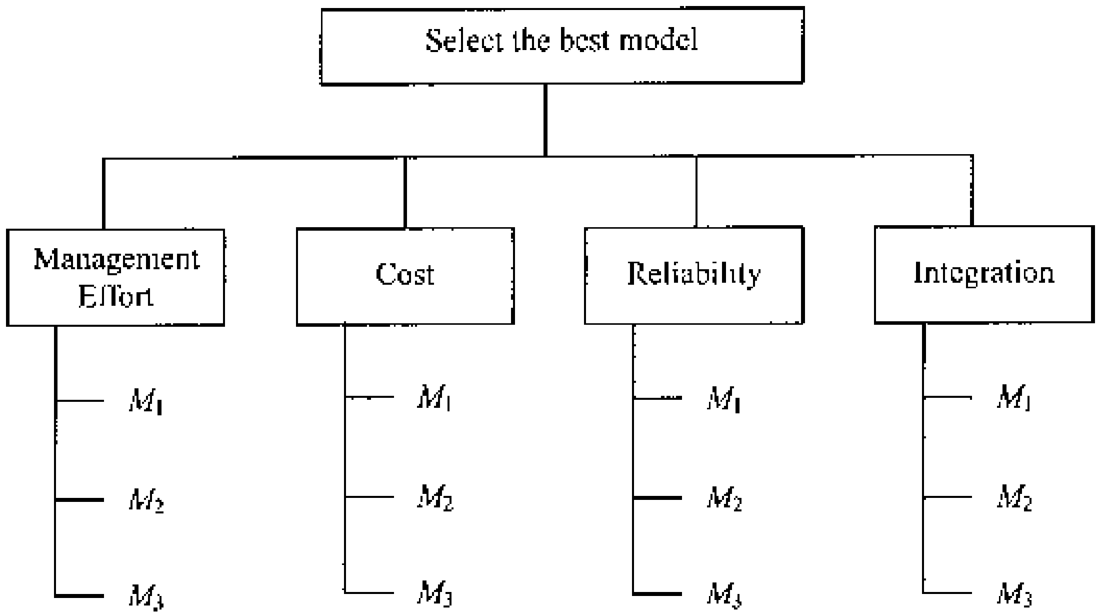

Figure 4.1 Model Selection Hierarchy used for Multi-attribute Evaluation.

On the basis of calculated results and above theoretical discussions, judgment matrices are prepared. The "scale of relative importance" is used for pair-wise comparison. On the basis of expert opinion, the following judgment matrices are prepared at each level of hierarchy.

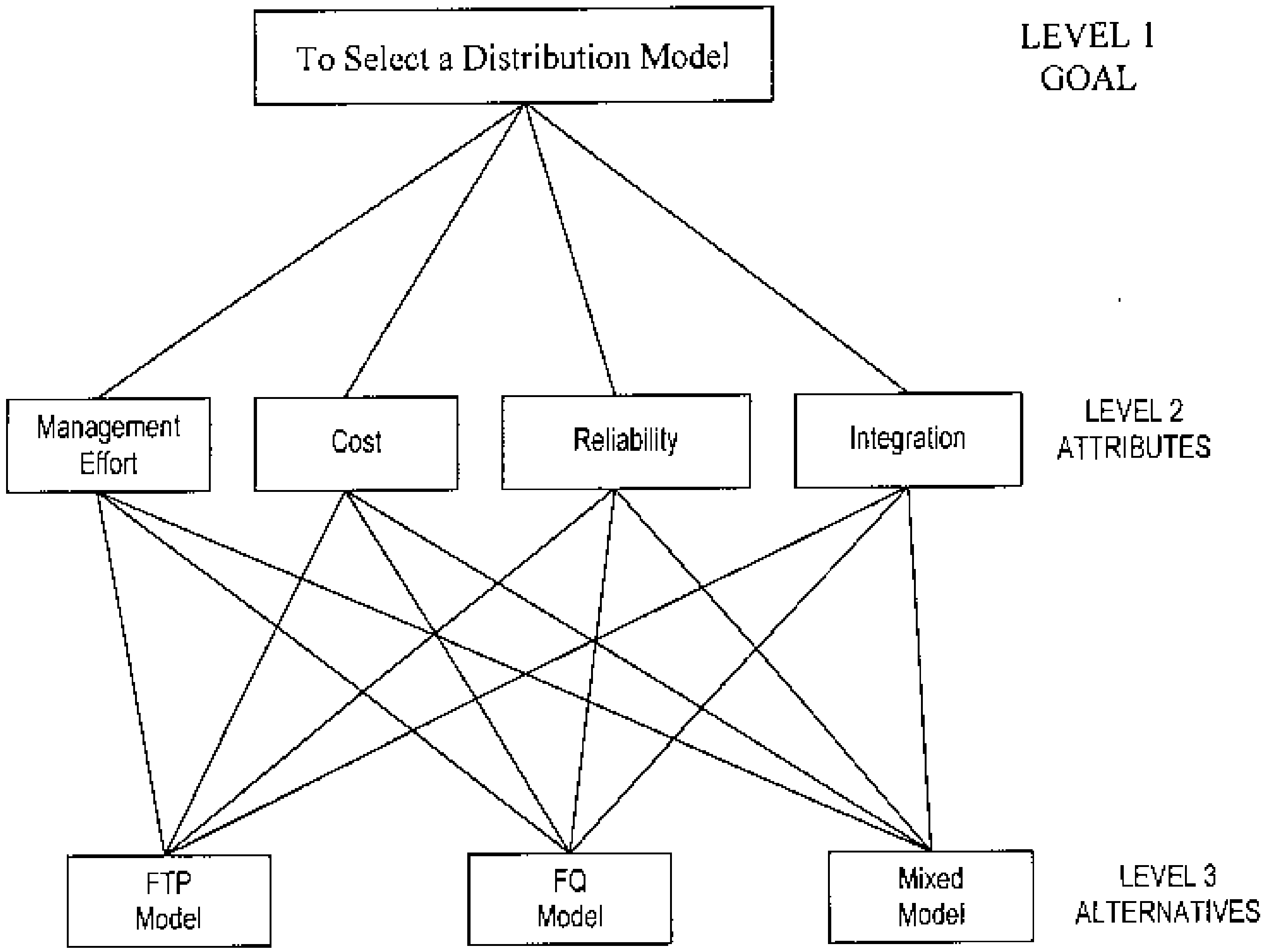

Figure 4.2 Hierarchy used for Multi-attribute Evaluation

Pair-Wise comparison Matrix and Computations: Evaluation criteria

Attributes	Effort	Cost	Reliability	Integration
Effort	1.00	0.25	0.50	0.33
Cost	4 00	1 00	3.00	2.00
Reliability	2 00	0.33	1.00	0 50
Integration	3 00	0.50	2.00	1.00
y_i	10 00	2.08	6.50	3.83

Geometric mean, b	Normalized weights, x
0.45180	0 09529506
2 21336	0.46684856
0.75984	0.16026656
1.31607	0.27758982
4 74107	

λ_{max}	4.03138	
N	4	
C . I .	0 01046	
R .I .	0.9	For n= 4
C .R	1.1622%	

Since C .R . < 10 % . So acceptable.

Model Comparisons

With respect to Management Effort

Alternatives	FTP Model	FQ Model	Mixed Model
FTP Model	1.00	4.00	3.00
FQ Model	0 25	1 00	0 50
Mixed Model	0.33	2.00	1 00
y_i	1.58	7.00	4.50

Geometric mean, b	Normalized weights, x
2 28943	0 62501
0.50000	0 13650
0.87358	0.23849
3.66301	

λ_{max}	3.01829
N	3
C . I .	0.0091474
R .I .	0.58
C R	1 57713%

Since C .R . < 10 % , So acceptable.

With respect to Cost

Alternatives	FTP Model	FQ Model	Mixed Model
FTP Model	1 00	0.25	0.50
FQ Model	4.00	1.00	2 00
Mixed Model	2.00	0.50	1 00
y_i	7 00	1 75	3.50

Geometric mean, b	Normalized weights, x
0.50000	0.14286
2.00000	0 57143
1.00000	0.28571
3.50000	

λ_{max}	3.00000
N	3
C . I .	0
R .I .	0.58
C R	0

Since C .R . < 10 % , So acceptable.

With respect to Reliability

Alternatives	FTP Model	Mixed Model	Mixed Model
FTP Model	1.00	0.33	0 50
FQ Model	3 00	1.00	2 00
Mixed Model	2 00	0.50	1.00
y_i	6.00	1 83	3.50

Geometric mean, b	Normalized weights, x
0.55032	0.16342
1 81712	0.53961
1.00000	0.29696
3.36744	

λ_{max}	3 00920
N	3
C . I .	0.0046014
R I .	0.58
C .R .	0 79334%

Since C .R . < 10 % , So acceptable.

With respect to Integration

Alternatives	FTP Model	FQ Model	Mixed Model
FTP Model	1.00	0.33	0.50
FQ Model	3.00	1.00	2.00
Mixed Model	2.00	0.50	1.00
y_i	6.00	1.83	3.50

Geometric mean, b	Normalized weights, x
0.55032	0.16342
1.81712	0.53961
1.00000	0.29696
3.36744	

λ_{max}	3.00920
N	3
C.I.	0.0046014
R.I.	0.58
C.R.	0.79334%

Since C.R. < 10 %, So acceptable.

On the basis of the above matrices, an over-all evaluation is performed using the calculated weights of the alternatives and four criteria. The composite weights of the three alternatives are calculated. On the basis of these composite weights, the alternative models are ranked. These are given in the following table.

Overall Evaluation: Comparison of model alternatives

Alternatives	Attributes and their weights					
	Effort 0.09530	Cost 0.46685	Reliability 0.16027	Integration 0.27759	Composite weights	Overall Ranking
FTP Model (M2)	0.62501	0.14286	0.16342	0.16342	0.19781	3
FQ Model (M1)	0.13650	0.57143	0.53961	0.53961	0.51605	1
Mixed Model (M3)	0.23849	0.28571	0.29696	0.29696	0.28614	2

The data in the matrix can be used to generate a good estimate of the criteria weights. The weights provide a measure of the relative importance of each criterion. The AHP allows individuals to use their own personal psychometric scale for making the required pair-wise comparisons. Measuring the consistency of one's judgments allows a cross-check on how well that scale is being followed. As long as the scale is applied consistently by each individual, the AHP can correctly process their judgments. Computations of the consistency ratio are somewhat more involved, but they are performed with a spreadsheet package such as Microsoft Excel.

The three models must be compared pair-wise for each criterion. This process is virtually identical to the procedure that was used to develop the criteria comparison matrix. The only difference is that there is a model comparison matrix for each criterion. Therefore, the decision maker compares each pair of models with respect to the management effort criterion. This is repeated for the three other criteria.

The final step of the AHP analysis is summarized in overall evaluation table. This table shows how the overall formulation scores are computed. This procedure can be explained as a simple weighted average technique. For a given model, four weights are computed, one for each of the four evaluation criteria. These four weights are multiplied by the appropriate criteria weights in meeting the goal of the hierarchy and the results of the four multiplications are added together to compute the model score. Each model score represents the estimated total benefits to be obtained from selecting this model. In this problem, according to the results obtained, the FQ model (M1) with a score of 0.51605 is ranked 1 i.e. judged to be best. Based on the solution, model M1 is selected. In this problem cost among all of the criteria is critical. So cost i.e. transportation cost should be minimized.

4.6 The Transportation Cost

The transportation problem, received this name because many of its applications involve determining how to optimally transport goods. Transportation costs play an important role in location decisions. These can stem from the movement of either raw materials or finished goods. If a facility will be the sole source or destination of shipments, the company can include the transportation costs in a locational cost-volume analysis by incorporating the transportation cost per unit being shipped into the variable cost per unit.

When a problem involves shipment of goods from multiple sending points to multiple receiving points, and a new location (sending or receiving point) is to be added to the system, the company should undertake a separate analysis of transportation. In such instances the transportation model of linear programming is very helpful. It is a special-purpose algorithm used to determine the minimum transportation cost.

4.6.1 Integrated Logistics: Needs and Variables

The conceptualization of integrated logistics can be defined as a 'unit', composed of various major functions of a supply chain system. Logistics is viewed as the competency that links an enterprise with its customers and suppliers. Information from and about customers flows through the enterprise in the form of sales activity, forecasts, and orders [76]. The information is refined into specific manufacturing and purchasing plans. As products and materials are procured, a value-added inventory flow is initiated that ultimately results in ownership transfer of finished products to customers [77]. Thus, the process is viewed in terms of two interrelated efforts, inventory flow and information flow. Prior to discussing each flow in greater detail, two observations are important. Firstly, an integrated operation is a must in hierarchical planning system, or value-chain system, or simply a supply chain system. Secondly, optimization in distribution network is necessary for not only cost minimization, but also other qualitative and quantitative variables [78].

While such integration is prerequisite to success, it is not sufficient to guarantee that a firm will achieve its performance goals. Obviously, a related issue is how to achieve the goal and how to measure the performance. Possibly, operations research, especially in the form of local search algorithm, is the only feasible solution, although it is true that global search algorithms may theoretically provide a better solution, however, at the expense of infeasibility and NP-hardness [79-80].

To be fully effective in today's competitive environment, firms must expand their integrated behavior to incorporate customers and suppliers in the hierarchically integrated system. This extension, through external integration, is referred to as value-added supply chain management system [81].

Second, the basic process is not restricted to for-profit business, nor is it unique to manufacturing firms. The need to integrate requirements and operations occurs in all businesses as well as within public sector organizations. For example, retailing or wholesaling firms typically link physical distribution and purchasing, since traditional manufacturing is not required. Nevertheless, retailers and wholesalers must complete the logistics value-added process. The same is true for all public sector organizations that manufacture products or provide other services. In fact, that is the essence of hierarchical materials planning system.

4.6.2 Materials Flow in Hierarchical Planning System

The operational management of hierarchical materials planning system has many components: materials itself, logistics to integrate materials flow, information flow and many others. This research is concentrated on physical integration issues, concerning materials and business logistics. It may be mentioned that business logistics is concerned with movement and storage of materials, finished products and associated service. Logistical operations start with the initial shipment of a material or component part from a supplier and are finalized when a manufactured or processed product is delivered to a customer. Here, optimization would mean some objectives: materials flow at the shortest possible time and information passing from one stage of planning to the other, such that certain degree of integration is achieved. This research aims both.

From the initial purchase of a material or component, the logistical process adds value by moving inventory when and where needed. Providing all goes well, a material gains value at each step of its transformation into finished inventory. In other words, an individual part has greater value after it is incorporated into a machine. Likewise, the machine has greater value once it is delivered to a buyer. This value addition should be maximum, if optimization is achieved from several dimensions, leading a multi-objective optimization, which is desired, but most of the times not achievable because of computational problems. This research solves the problem of multi-criteria optimization using linear programming and multi-criteria technique in two steps.

To support manufacturing, work-in-process inventory must be moved to support final assembly. The cost of each component and its movement becomes part of the value-added process. The final or meaningful value that is added occurs only with final ownership transfer of products to customers when and where specified [82]. For a large manufacturer, logistical operations may consist of thousands of movements, which ultimately culminate in the delivery of products to an industrial user, retailer, wholesaler, dealer, or other customer, which constitute the complex distribution network. For a large retailer. logistical operations may commence with the procurement of products for resale and may terminate with consumer pickup or delivery. For a service organization, like a hospital, logistics start with procurement and end with full support of patient surgery and recovery. The significant point is that regardless of the size and type of enterprise, integrated logistics is essential for hierarchical materials planning system and requires continuous management attention. For better understanding it is useful to divide logistical operations into three areas: physical distribution, manufacturing support, and procurement. These components constitute the center of the combined logistics operational units of an enterprise.

4.6.3 Physical Distribution

The area of physical distribution concerns the last step of distribution network operations, which involves movement of a finished product to customers in shortest possible time and minimum possible cost. In physical distribution, the customer is the final destination of a marketing channel. The availability of the product is a vital part of each channel participant's marketing effort. Even a manufacturer's agent, which typically does not own inventory, must depend on inventory availability to perform expected marketing responsibilities. Unless a proper assortment of products is efficiently delivered when and where needed, a great deal of the overall marketing effort can be jeopardized. It is through the physical distribution process that the time and space of customer service become an integral part of marketing. Thus physical distribution links a marketing channel with its customers. To support the wide variety of marketing systems that exists in a highly commercialized nation, many different physical distribution systems are utilized. All physical distribution systems have one common feature: they link manufacturers, wholesalers, and retailers into marketing channels that provide product availability as an integral aspect of the overall marketing process [83].

4.6.4 Operating Arrangements: Anticipatory versus Response-Based

The fundamental difference in anticipatory and response-based logistical arrangements is timing. Anticipatory arrangements are traditional and reflect the best practice developed during a period prior to widespread availability of information technology. In contrast, response-based arrangements reflect strategies to exploit the potential of time-based logistics. Time-based logistics provide the basis for optimization.

This question again raises another derived question regarding Anticipatory-driven value chain against Response-driven value chain. Obviously, an anticipatory-driven value chain is desired at any manufacturer's network. However, this would require market driven forecast, originating from distribution network. If this is achieved. only then a true materials planning integration is achieved. However, this would require an integrated MRP (Material

Requirements Planning) and Distribution Requirements Planning (DRP). Currently, this integration is absent. As such, total Manufacturing Resource Planning (MRPII) is not yet realized. This research provides integration between MRP and DRP at the planning level. The following table shows the variables operating at different levels for such integration.

Table 4.2 Business variables for MRP-DRP integration.

Anticipatory-driven hierarchical materials planning chain	Response-driven hierarchical materials planning chain
Manufacturing level	
Stochastic forecast	Deterministic forecast
MRP-DRP planning	MRP-DRP planning
Anticipatory inventory including stochastic safety stock	Definitive inventory with optional safety stock
Multi-item dispatching with stochastic inventory at the downstream	Multi-item dispatching with definitive inventory at the downstream
Intermediate Distribution network pipeline	
Stochastic forecast and inventory build-up as per : An integration with "Multi-item dispatching from the upper manufacturing level".	Deterministic requirement-based inventory planning, as per MRP of MRPII system
Inventory speculation as per statistical distribution pattern	Inventory postponement and flow through turn-over
Selection waves through fixed replenishment schedule	Selection waves based on requirements from MRPII system.
Profit center philosophy	Service center philosophy
Sales Point / Retailer	
Model stock (ROP, Safety stock)	Model stock (ROP)
Stochastic demand based replenishment	Scheduled replenishment

Table 4.2 illustrates contrasting priorities and practices that managers can be expected to employ with logistics-related activities at each stage of the supply chain. Even a casual review of the detailed paradigms illustrates the stark differences between the two operating arrangements, especially during planning integration.

Anticipatory practices were developed during a time period when business was primarily conducted on a transactional basis. Because information was not shared freely and technology was not available to facilitate such sharing, firms tended to operate on the basis of long-term forecasts, which is highly stochastic in nature. It must be noted and remembered that the longer the (materials) planning period, the more stochastic the plan is. Thus, the operational goal becomes to build and push inventory with higher degree of uncertainty to the next level in the channel. Because of high cost and risk associated with anticipatory practices, the prevailing relationship between trading partners was typically adversarial. Each party to the transaction needed to look out and deal with uncertainty for its own self-interest.

Response-based arrangements stress cooperation and information sharing. Because of channel-wide data concerning requirements, timely point-of-sale experience can be substituted for total reliance on forecasts. When all members in a marketing channel synchronize their operations, opportunities exist to reduce total supply chain inventory and eliminate duplicate practices that increase cost without generating customer value. However, this would require optimization and integration in the overall materials planning system. This research aims at that purpose.

The reality of today's best practice logistics is that it does not reflect the extreme of either an anticipatory or a response-based arrangement. Many well-established beliefs and practices tend to preserve conformance to anticipatory paradigms. Perhaps the greatest barrier to adopting response-based arrangements is the need for publicly held corporations to appropriately project sales volume to financial indices. Financial indices act as the base-line economic accountability factor, which means that financial goals must be reflected in operating plans and forecasts. Such goals often encourage promotional strategies to "load the channel" in order to create timely sales volume. The financial burden to "deload" the channel in order to create a response-based environment is never timely. This deloading occurs, for example, every year in many retail stores right after celebration-based sales-hikes (e.g. Christmas, Eid festivals, etc). Stores promote heavily to sell their remaining stock before the end-of-the-year inventory is counted to help reduce the expense of taking inventory and to lower inventory cost. This overflow scenario is opposite to normally prevailing backlog situation in many stores downstream.

A second barrier to implementing response-based operations is the fact that it is easier to manage on an adversarial relation on power-dominated basis than to develop and leverage cooperative relationships. Cooperative relationship requires strong synchronized supply chain network. Most business managers simply do not have training or experience for instituting cooperative arrangements designed to share both benefits and risks. While logistics managers report a high degree of belief in the long-term potential for response-based alliances, they report considerable frustration in how to get the job done.

For the foreseeable future it appears that most firms will be simultaneously involved in various combinations of anticipatory and response-based logistical arrangements. The trend toward increased involvement in response-based relationships with specific customers and suppliers appears to be well established and will continue to expand. This need for firms to participate in a variety of different delivery arrangements has placed new performance demands on logistical strategy.

4.7 Transportation Economies

From the preceding discussion, it is clear that warehouses enter a logistical system only when a differential advantage in service or cost results from their inclusion between manufacturing and customers. From the viewpoint of transportation economies, cost advantage is accomplished by using the warehouse to achieve maximum consolidation of freight [84]. The next discussion illustrates the economics of transportation consolidation that justify establishment of a warehouse, in comparison to direct shipment without intermediary warehouse. Then the chapter focuses on transportation cost minimization across a network of warehouses.

Cost-Based Warehouse Justification

The basic economic principle justifying establishment of a warehouse is transportation consolidation. A manufacturer typically sells products over a broad geographical market area. If customer orders tend to be small, then the potential to consolidate may provide economic justification for establishing a warehouse.

Transportation Cost Minimization

It is a matter of question whether adding a warehouse in the distribution channel helps minimizing cost. As a general rule, warehouses would be added to the logistical system in situations, where –

$$\sum \frac{P_{\bar{v}} + T_{\bar{v}}}{N_{\bar{x}}} + W_{\bar{x}} + L_{\bar{x}} \quad \leq \quad \sum P_{\bar{x}} + T_{\bar{x}} \; ,$$

where

$P_{\bar{v}}$ = Processing cost of volume shipment

$T_{\bar{v}}$ = Transportation cost of volume shipment

$W_{\bar{x}}$ = Warehousing cost of average shipment

$L_{\bar{x}}$ = Local delivery of average shipment

$N_{\bar{x}}$ = Number of average shipments per volume shipment

$P_{\bar{x}}$ = Processing cost of average shipment

$T_{\bar{x}}$ = Direct freight cost of average shipment

The only limitation to this generalization is that sufficient shipment volume must be available to cover the fixed cost of each warehouse facility. As long as the combined cost of warehousing and local delivery is equal to or less than the combined cost of shipping direct to customers, the establishment and operation of additional warehouse facilities would be economically justified.

The generalized relationship of transportation cost and consolidation location is illustrated in Figure 4.1. Total transportation cost will decrease as consolidation locations are added to the logistical network. In actual operation, consolidation locations can be transportation break bulk or cross-dock facilities. It is not necessary to stock inventory to achieve the lowest transportation cost. The reduction in transport cost results from consolidated volume shipments to the break bulk location, coupled with short-haul small shipments to final destination. The cost of shipping small orders direct from manufacturing to customers is at the extreme upper left of the cost curve illustrated **in Figure 4-1.** At the low point near the middle of the transportation cost curve, the number of facilities required to achieve maximum consolidation is indicated; and thus, the lowest transportation cost is identified.

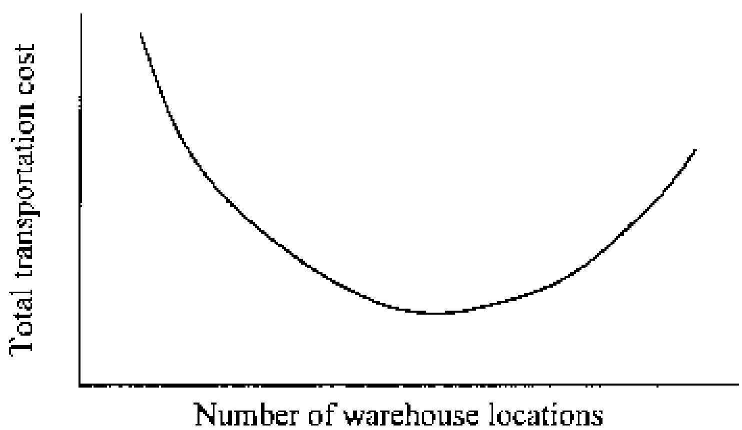

Figure 4.3 Transportation cost as a function of warehouse locations.

If facilities are expanded beyond the maximum consolidation point, total cost will increase, because the inbound volume capable of being consolidated to each facility decreases. The increased frequency of smaller inbound shipments results in a higher rate per hundred-weight shipped into the facility. In other words, the frequency of small inbound shipments increases and total transportation cost begins to increase.

Inventory Economics

Inventory level and velocity are directly related to the location structure of a logistical system. The framework for planning inventory deployment is the performance cycle. Although one element of the performance cycle is transportation, which provides spatial closure, the key factor in inventory economics is time. The forward deployment of inventory in a logistical system improves service response time. Such deployment also increases the overall system inventory requirements, resulting in greater costs and risk. In the following discussion, the impact of inventory on service response capability is initially presented, followed by a review of the impact of increasing the number of warehouses on total system inventory requirements.

Service-Based Warehouse Justification

The use of warehouses can be a vital part of the logistics strategy of a firm engaged in national distribution. To achieve essential economy of scale, firms are often required to sell over broad geographical areas. These manufacturing economics of scale often compel firms to locate plants where low production costs can be realized.

The dynamics of spatial competition enter an industry when products begin to gain customer acceptance in other than prime markets or near manufacturing locations. The enterprise may find it desirable to deploy inventory to support marketing. In highly competitive industries, the policy may be to locate a warehouse in a particular market area even if operation of the facility increases total cost. The availability of a local inventory offers the potential to provide high levels of customer service. For customers, this means faster replenishment and an overall reduction of inventory. Thus, the enterprise that commits to establishing a warehouse may be viewed as having a differential advantage.

The inventory required to support a warehouse consists of transit, base, and safety stock. This research considers the various inventory components, including MPS-type finished goods (base inventory), pipeline (transit) inventory, distribution inventory, etc. and describes how each relates to average inventory level.

Adding warehouses to a logistical system increases the number of performance cycles. The impact on transit inventory and safety stock can be significant. In contrast, the impact on base stock by adding inventory is not significant. The base stock level within a logistical system is determined by manufacturing and transportation lot sizes, which do not change as a function of the number of warehouses [85]. The combination of maintenance and ordering cost, adjusted to take into consideration volume transportation rates and purchase discounts, determines the replenishment EOQ and the resultant base stock. In just-in- time procurement situations, base stock is determined by the discrete order quantity required to support the planned manufacturing run or assembly. In either situation, the base stock determination is independent of the number or warehouses included in the logistical system.

Transit inventory is important to logistical system design because it requires capital commitment. As more performance cycles are added to a logistical network, the expected result is that existing cycles will experience a reduction in transit inventory. This reduction occurs because the total transit days in the system are reduced. It should be noted that the second warehouse does not create additional performance cycles on the physical distribution side of the logistics flow. However, on the inbound side, each product stocked in the new warehouse requires a replenishment source. Assuming a full product line at each warehouse, the number of performance cycles required to replenish the system will increase each time a new warehouse is added [86].

Despite the increased need for inventory replenishment, the average in-transit inventory for the total system drops as new warehouses are added because of a reduction in days required to service customers. Thus, even if multiple plant-to-warehouse replenishment cycles were added to the logistical system. the average transit time reduces because of the reduction in total replenishment days.

In summary, the addition of facilities will generally have the net effect of reducing total in-transit days and, thus, inventory level. This result will vary in accordance with the particulars of each situation. Each network of locations must be carefully analyzed to determine the exact impact on average transit inventory. The key to understanding the impact of increasing warehouses on transit inventory is to remember that total transit days are reduced even though the number of required performance cycles increases. A qualification is that while an increase in the number of performance cycles typically reduces transit days, it may also increase overall lead time uncertainty. As the number of performance cycles is increased, the possibility of breakdowns leading to potential service failures also increases.. This potential impact is treated under safety stock.

From the viewpoint of safety stock, the expected result of adding warehouses will be an increase in average system inventory. The impact of sales and performance-cycle uncertainty on inventory must be evaluated using two independent frequency distributions. The purpose of Safety stock is to protect against unplanned stock-out during inventory replenishment. Thus, if safety stock is predicted to increase as a function of adding warehouses, then the overall system uncertainty must also be increasing.

The addition of warehouses to the logistical system impacts uncertainty in two ways. First, since performance-cycle days are reduced, the variability in sales during replenishment and the variability in the cycle are both reduced. Therefore, reducing the length of the performance cycle relieves to some degree the need for safety stock to protect against variability.

The second impact of adding locations has a direct and significant effect on average inventory. Each new performance cycle added to the system creates the need for additional safety stock. The introduction of an additional warehouse to service a specific market area reduces the applicable size of the demand database used to determine safety stock requirements. In effect; the size of the market area serviced by a given facility is reduced without a corresponding reduction in uncertainty [87]. For example, when the demand of several markets is aggregated to a single warehouse, the variability of demand is averaged across markets. This allows peaks in demand in one market to be offset by low demand in another. In essence, the use of probability allows the idle stock of one market to be used to meet safety stock requirements of other markets.

The impact of adding warehouses on system safety stock is really vital in complete supply chain management. The important point to understand is that the increase in safety stock results from an inability to aggregate the uncertainty across a large market area. As a consequence, separate safety stocks must accommodate all local demand variation.

Inventory Cost Minimization

The overall impact on average inventory of increasing the number of warehouses in a logistical system is of vital importance. A reduction in average transit inventory is obvious. The assumption is that a linear relationship exists between average transit inventory and the number of warehouses in the network.

The actual inventory increases at a decreasing rate since the net increase for each facility is limited (the added safety stock required to accommodate uncertainty is related only to demand assigned to that warehouse less the reduction 'in safety stock required for less lead time uncertainty resulting from a shorter replenishment cycle). Thus, the incremental inventory required to maintain customer service performance diminishes for each new warehouse location added to the system. The average inventory represents the combined impact of safety stock and transit inventory. The significant observation is that the safety stock dominates the impact of transit inventory reduction. For the overall system, the average inventory is the safety stock plus half of the order quantity plus transit inventory. Thus, given the same demand and customer service goals, total inventory increases at a decreasing rate as the number of warehouses used in a logistical system increases.

Least Total Cost Design

As noted earlier, the identification of the least-total-cost system design is the goal of logistical integration. The basic total cost for the overall logistical system is composed of minimum holding and ordering cost, as well as transit and safety stock. As a result, average inventory commitment increases with each additional warehouse. For the overall system, the lowest total cost network is a function of locations. In fact, a trade-off relation exists among number of warehouses, amount of inventory and overall distribution cost.

The identification of the least-total-cost design of warehouses in the network may be illustrated by a trade-off between cost-generating activities. The minimal total-cost point for the system is not at the point of least cost for either transportation or inventory. This is the hallmark of integrated logistical analysis. In actual practice, a great many problems must be overcome to effectively examine total cost. Foremost among them is that many assumptions must be made to operationalize the logistical system analysis. A second concern is the fact that a two-dimensional analysis, although may provide a less trade-off, such system does not encompass the complexity of total cost integration. Each of the critical assumptions and associated implementational problems are matter of concern.

Some Assumptions and Limitations

This research assumes an average projected level of sales volume across a planning horizon. Transportation requirements are represented by one average-size shipment. In actual operations, neither of these simplifying assumptions would be valid. First, the nature of logistical network design is not a short-term planning problem. When facility decisions are involved, the planning horizon extends across several years and must accommodate a range of different annual sales projections. Second, actual shipment and order sizes will vary substantially around an average. In fact, the assumption that shipments must be serviced through a warehouse must be relaxed to accommodate high-volume customer-direct truckload or container distribution. A realistic approach to planning must incorporate a range of shipment sizes supported by alternative logistical methods to satisfy customer service requirements [89]. In actual operation, alternative modes of transportation are employed, as necessary, to upgrade the speed of deli very

Significant cost trade-offs exist between inventory and transportation. Inventory cost as a function of the number of warehouses is directly related to the desired level of inventory availability. If no safety stock is maintained in the system, the total inventory requirement is limited to base and transit stock. Under a no-safety- stock situation, the total least cost for the system would be at or near the point of lowest transportation cost. Thus, assumptions made with respect to the desired inventory availability and fill rate are essential to trade-off analysis and have a significant impact on the least-total-cost design solution.

The locational selection aspect of logistical network planning is far more complex than simply deciding how many facilities to choose from a single array of locations. A firm engaged in nationwide logistics has wide latitude in choice of where to locate warehouses. In a large market, there may be as high as fifty regions within which one or more distribution warehouses could be located. Assuming that the total allowable warehouses for a logistical system cannot exceed fifty and that locations are limited to a maximum of one in each region, there are 1.1259 x 1015 combinations of warehouses to be evaluated in the selection of a least-total-cost network.

To overcome some of the above noted simplifying assumptions. variations in shipment size and transportation alternatives need to be introduced. Extending the analysis to a more complete treatment of variables typically demands the use of computer planning models and techniques. Application of linear programming may provide an optimal point for a trade-off. Such refinement requires linkage of a full range of variables [90]. At least three critical ones to be considered are shipment size, transportation mode, and location alternatives. The constants are level of inventory availability, performance- cycle duration, and the specific warehouse locations being evaluated.

In constructing a more comprehensive analysis, shipment size can be grouped in terms of frequency of occurrence and transportation mode economically justified handling each shipment size within the specified performance-cycle time constraints. For each shipment size, a total-cost relationship can be identified. The result is a two-dimensional analysis for each shipment size and appropriate transportation mode. Next, the individual two-dimensional profiles can be linked by joining the points of least cost to make a planning curve. In a technical sense, this is an envelope curve that joins the low total-cost points of individual shipment size-transport mode relationships.

A compromise is required to select the final warehouse network. Initially, the time duration of the performance cycle and inventory availability assumptions should be held constant. The service availability and performance-cycle duration serve as parameters to help isolate an initial least-cost approximation. At a later point in strategy formulation, these parameters can be relaxed and subjected to sensitivity analysis. The fit of the least-cost planning curve requires marginal cost analysis for each shipment size transportation mode combination for the stipulated network.

4.8 Problem Description

The transportation problem involves finding the lowest-cost plan for distributing stocks of goods or supplies from multiple origins to multiple destinations that demand the goods. For instance, a firm might have some factories, all of which are capable of producing identical units of the same products, and some warehouses that stock or demand those products. The transportation model can be used to determine how to allocate the supplies available from the various factories to the warehouses that stock the demand of those goods, in such a way that total shipping cost is minimized (i.e. the optimal shipping plan).

The shipping (supply) points can be factories, warehouses, departments, or any other place from which goods are sent. Destinations can be factories, warehouses, departments, or any other points that receive goods. To describe the general model for the transportation problem, it is needed to use terms that are considerably less specific than those for the components of the prototype examples. In particular, the general transportation problem is concerned with distributing any commodity from any group of supply centers, called sources, to any group of receiving centers, called destinations, in such a way as to minimize the total distribution cost. The model for a transportation problem makes the following assumption about supplies and demands.

1. Each source has a fixed supply of units, where this entire supply must be distributed to the destinations. Let s_i denote the number of units being supplied by source i, for $i = 1, 2, \ldots, m$. Similarly, each destination has a fixed demand for units, where this entire demand must be received from the source. Let d_j denote the number of units being received by destination j, for $j = 1, 2, \ldots, n$.

2. A transportation problem will have feasible solutions if and only if

$$\sum_{i=1}^{m} s_i = \sum_{j=1}^{n} d_j \ .$$

3. The cost of distributing units from any particular source to any particular destination is directly proportional to the number of units distributed. Therefore, this cost is just the unit cost of distribution times the number of units distributed. Let c_{ij} denote this unit cost for source I and destination j.

The only data needed for a transportation problem model are the supplies, demands, and unit costs. These are the parameters of the model. All these parameters can be summarized conveniently in a single parameter table as shown below.

Table 4.3 Parameter table for the transportation problem

Source	Cost per unit distributed				Supply
	Destination				
	1	2	...	n	
1	c_{11}	c_{12}	...	c_{1n}	s_1
2	c_{21}	c_{22}	...	c_{2n}	s_2
:		:		:	:
M	c_{m1}	c_{m1}	...	c_{mn}	s_m
Demand	d_1	d_2		d_n	

The problem fits the model for a transportation problem if it can be described completely in terms of a parameter table like table and it satisfies the assumptions mentioned above. The objective is to minimize the total cost of distributing the units. All the parameters of the model are included in this parameter table. Therefore, formulating a problem as a transportation problem only requires filling out a parameter table in the format of table.

Let Z be the total distribution cost and x_{ij} $(i = 1,2, \cdots, m, \; j = 1,2, \cdots, n)$ be the number of units to be distributed from source i to destination j, the linear programming formulation of this problem is

Minimize $$Z = \sum_{i=1}^{m} \sum_{j=1}^{n} c_{ij} x_{ij},$$

Subject to

$$\sum_{j=1}^{n} x_{ij} = s_i \qquad \text{for } i = 1,2, \cdots, m,$$

$$\sum_{i=1}^{m} x_{ij} = d_j \qquad \text{for } j = 1,2, \cdots, n, \text{ and}$$

$$x_{ij} \geq 0, \qquad \text{for all i and j.}$$

4.9 Computational Results

The product of this research problem is a fixed chair of twelve models manufactured in a local renowned furniture company. The product is manufactured at three workcenters (Dhaka, Bogra, and Chittagong) and then shipped by truck to nine distributing warehouses (Gazipur, Narayangang, Tangail, Rajshahi, Kustia, Khulna, Comilla, Cox-Bazar, Feni). Because the shipping costs are a major expense, management is initiating a study to reduce them as much as possible. An estimate has been made of the output from each workcenter, and each warehouse has been allocated a certain amount from the total supply of products. This information (in units of truckloads), along with the shipping cost per truckload for each workcenter-warehouse combination, is given in table. Thus, there are a total of 320 truckloads to be shipped. The problem is now to determine which plan for assigning these shipments to the various workcenter-warehouse combinations would minimize the total shipping cost.

The problem is actually a linear programming problem of the transportation problem type. To formulate the model, let Z denote total shipping cost, and let x_{ij} $(i = 1, 2, 3; j = 1, 2, 3, 4,$

5, 6, 7, 8, 9) be the number of truckloads to be shipped from workcenters i to warehouse j. Thus the objective is to choose the values of these decision variables (x_{ij}) so as to

$$\text{Minimize} \quad Z = 1000x_{11} + 800x_{12} + 2000x_{13} + 5000x_{14} + 4000x_{15} + 7000x_{16} + 3000x_{17} +$$
$$8000x_{18} + 4000x_{19} + 4500x_{21} + 5500x_{22} + 3000x_{23} + 1000x_{24} + 3000x_{25} +$$
$$5000x_{26} + 6000x_{27} + 12000x_{28} + 6500x_{29} + 6000x_{31} + 5000x_{32} + 6500x_{33}$$
$$10000x_{34} + 9000x_{35} + 12000x_{36} + 3000x_{37} + 1000x_{38} + 2000x_{39}$$

Subject to constraint

$$x_{11} + x_{12} + x_{13} + x_{14} + x_{15} + x_{16} + x_{17} + x_{18} + x_{19} = 120$$
$$x_{21} + x_{22} + x_{23} + x_{24} + x_{25} + x_{26} + x_{27} + x_{28} + x_{29} = 125$$
$$x_{31} + x_{32} + x_{33} + x_{34} + x_{35} + x_{36} + x_{37} + x_{38} + x_{39} = 75$$
$$x_{11} + x_{21} + x_{31} = 20$$
$$x_{12} + x_{22} + x_{32} = 40$$
$$x_{13} + x_{23} + x_{33} = 20$$
$$x_{14} + x_{24} + x_{24} = 55$$
$$x_{15} + x_{25} + x_{35} = 50$$
$$x_{16} + x_{26} + x_{36} = 45$$
$$x_{17} + x_{27} + x_{37} = 20$$
$$x_{18} + x_{28} + x_{38} = 50$$
$$x_{19} + x_{29} + x_{39} = 20$$

Table 4.4 Parameter table for the transportation problem

Source	Destination									Supply
	Gazipur	Narayan gang	Tangail	Rajshahi	Kustia	Khulna	Comilla	Cox-Bazar	Feni	
	Unit cost Per Truck load(TL) in Tk.									
Dhaka	1000	800	2000	5000	4000	7000	3000	8000	4000	120
Bogra	4500	5500	3000	1000	3000	5000	6000	12000	6500	125
Chittagong	6000	5000	6500	10000	9000	12000	3000	1000	2000	75
Demand (TL)	20	40	20	55	50	45	20	50	20	

Table 4.5 Solution table for the transportation problem

Source	Destination									Total		Supply
	Gazipur	Narayan gang	Tangail	Rajshahi	Kustia	Khulna	Comilla	Cox-Bazar	Feni			
	Shipment Quantities (Truck loads)											
Dhaka	20	40	20	0	25	0	15	0	0	120	=	120
Bogra	0	0	0	55	25	45	0	0	0	125	=	125
Chittagong	0	0	0	0	0	0	5	50	20	75	=	75
Total	20	40	20	55	50	45	20	50	20			
	=	=	=	=	=	=	=	=	=			
Demand (TL)	20	40	20	55	50	45	20	50	20	Tk 697,000		

Applications of the transportation problems tend to require a very large number of constraints and variables, so a straightforward computer application of the simplex method may require an exorbitant computational effort. Therefore, it is important to become sufficiently familiar with this special type of problems that one can recognize them when they arise and apply the proper computational procedure.

A major part of the study revolved around formulating and solving transportation problems for individual product categories. For each option regarding the plants to keep open, etc., solving the corresponding transportation problem for a product category shows what the distribution cost would be for shipping the product category from those plants to the distribution centers and customer zones.

Any problem fits the model for a transportation problem if it can be described completely in terms of a parameter table like table 4.3 and it satisfies both the requirements assumption and the cost assumption. The objective is to minimize the total cost of distributing the units. All the parameters of the model are included in the parameter table 4.4.

To formulate and solve a transportation problem using Excel Solver, two separate tables need to be entered on a spreadsheet. The first one is the parameter table. All the parameters of the model are included in the parameter table 4.4. The second is the solution table 4.5, containing the quantities to distribute from each source to each destination. Spreadsheet software, such as Excel Solver, is a popular tool for analyzing and solving linear programming problems. The main feature of the linear programming model, including all its parameter, can be easily entered onto a spreadsheet. However, spreadsheet software can do much more than just display data. In addition, the Excel Solver can quickly apply the simplex method to find an optimal solution for the model. For transportation problems where every s_i and d_j have an integer value, all the basic variables (allocations) in every basic feasible solution (including an optimal one) also have integer values. The solution procedure deals only with basic feasible solutions, so it automatically will obtain an integer solution for this case. The optimal total cost and distribution quantities have been shown in the solution table 4.5.

4.10 Conclusions

Distribution is the management of the flow of materials from manufacturers to customers and from warehouses to retailers, involving the storage and transportation of products. It may also be responsible for finished goods inventories and the selection of transportation service providers. This research provides an idea that AHP which is a technique of MCDM

(Multi Criteria Decision Making) technique can be used to justify selection of the right parameter as the objective function of an optimization technique

The AHP can also accommodate uncertain and subjective information, and allows the application of experience, insight, and intuition in a logical manner. This forces the decision maker to seriously consider and justify the relevance of the criteria. The AHP allows individuals to use their own personal psychometric scale for making the required pair-wise comparisons. In this research work, according to the results obtained, the FQ model (M1) with a score of 0.51605 is ranked 1 i.e. judged to be best. In this problem cost among all of the criteria is critical. So cost i.e. transportation cost should be minimized.

The transportation problem involves finding the lowest-cost plan for distributing stocks of goods or supplies from multiple origins to multiple destinations that demand the goods. For instance, a firm has some factories, all of which are capable of producing identical units of the same products, and some warehouses that stock or demand those products. The transportation model can be used to determine how to allocate the supplies available from the various factories to the warehouses that stock the demand of those goods, in such a way that total shipping cost is minimized (i.e. the optimal shipping plan). The problem is now to determine which plan for assigning these shipments to the various workcenter-warehouse combinations would minimize the total shipping cost. The problem is actually a linear programming problem of the transportation problem type. Spreadsheet software, such as Excel Solver. is a popular tool for analyzing and solving linear programming problems. The solution procedure deals only with basic feasible solutions, so it automatically obtains an integer solution for this case. The optimal total cost and distribution quantities have been shown in the solution table 4.5.

Chapter 5
Conclusions and Recommendations

5.1 Summary of Findings and Conclusions

It is the age of coordinated manufacturing and distribution. The manufacturing industries are now facing a time of intense international competition, which will only become more severe in the days to come. For manufacturing companies, the danger lies in lower cost-higher quality producers taking an increasing share of both domestic and foreign markets. The opportunity lies in new technology that can enable a company to improve both productivity and quality, and obtain a competitive edge.

The new technology can be divided into two categories: (1) the automation of production activities using computer-aided design and manufacturing, robotics, or flexible manufacturing systems and (2) computer-based production and inventory control. Computer-based production and inventory control embodies powerful tools for the use of new and better planning and control concepts and techniques

The research work focuses on production planning and distribution system of total supply chain. In this research work the production planning and distribution system of a product (chair) of a furniture company have been optimized.

Lot-Sizing

Internal materials planning or Production planning is an activity that considers the best use of production resources in order to satisfy production goals (satisfying production requirements and anticipating sales opportunities) over a certain period named the planning horizon. Production planning typically encompasses three time ranges for decision making:

long-term, medium-term and short-term. In long-term planning usually the focus is on anticipating aggregate needs. Medium-term planning often involves making decisions on material requirements planning and establishing production quantities or lot sizing over the planning period, so as to optimize some performance criteria such as minimizing overall costs, while meeting demand requirements and satisfying existing capacity restrictions. In short-term planning, decisions usually involve day-to-day scheduling of operations such as job sequencing or control in a workshop.

Lot sizing is one of the most important and also one of the most difficult problems in production planning. Lot sizing decisions give rise to the problem of identifying when and how much of a product to produce such that setup, production and holding costs are minimized. Making the right decisions in lot sizing will affect directly the system performance and its productivity, which are important for a manufacturing firm's ability to compete in the market. Therefore, developing and improving solution procedures for lot sizing problems is very important. Due to their importance in industry and mathematical complexity, deterministic, dynamic demand lot-sizing problems are frequently studied. This research work develops specialized formulations and solution procedures for each particular lot-sizing problem class. This work synthesizes the research on this important problem class updating the survey to consider recent modeling and algorithmic advancements. This work complements the recent reviews on the multi-item single level capacitated lot-sizing problem [15] to provide a complete picture of state-of-the-art research in anyone conducting research in the deterministic dynamic demand capacitated lot-sizing field.

Considering the comparison study of Maes and Van Wassenhove [14] and other points as discussed in literature study the Dixon and Silver heuristic has been considered for further improvements in the present work. The heuristic was extended to include two very important parameters such as, (i) plant or machine set up time and (ii) maximum limit of production lot-size from a machine. From analysis and results, the present work has demonstrated that feasible solutions could be obtained with competitive computer usage. The consideration of set up time also led to increase in inventory holding cost. This increase in cost could be attributed to increased inventory held for meeting demand of the later period. Available machine time, inventory holding cost were found to be highly sensitive to the change in setup time. However, setup cost was not found to be significantly influenced by the setup time.

Effect of the limitation on the lot-size is dependent on the extent of reduction of the lot-size. It is obvious that the smaller the allowable lot-size, the greater will be the number of setup which will eventually lead to more splitted items. This in turn led to the increase number of required setups.

Costs due to implementation of this restriction on lot-size went up quite significantly. Further decrease in lot-size would obviously result in higher costs. But at the lower range of allowable lot-size, there has been a trend of slight increase in setup costs.

The applicability of these problems arises commonly in operations such as forging and casting and in industries which consist of a single production process, or where all production process can be considered as a single operation, such as some medical or chemical industries.

Production Scheduling

In short-term planning, decisions usually involve day-to-day scheduling of operations such as job sequencing or control in a workshop. Most real-world scheduling problems are naturally multi-criterion. There are several approaches that deal with the multi-objective problems. Traditionally, the most common way is to combine the multiple criterions into a single scalar value by using weighted aggregating functions according to the preferences set by the scheduler (or decision-makers) and then to find a compromise solution that reflects these preferences However, in many real scenarios involving multi-criterion scheduling problems, it is preferable to present a set of promising solutions to the decision-makers so that the most adequate schedule can be chosen. This has increased the interest in investigating the application of Pareto-optimization techniques to multi-criterion scheduling problems. A Pareto-optimal algorithm is developed in this paper for a scheduling problem on a single machine with periodic maintenance and non-preemptive jobs. In literature, most of the scheduling problems address only one objective function, while in the real world, such problems are always associated with more than one objective. In this work, both multi-objective functions and multi-maintenance periods are considered for the machine scheduling problem. A multi-criterion non-preemptive scheduling that reduces the total cost of the problem is considered in this study. Three criterions are considered: reduction of flow time, maximum tardiness, and machine idle time in a periodically maintained single machine problem. The trade-off between minimum flow time, maximum tardiness and machine idle time is a complex problem. The objective of the model addressed in this work is to minimize the weighted function of the total job flow time, the maximum tardiness, and the machine idle time in a single machine problem with periodic maintenance and non-preemptive jobs. An algorithm is developed to solve this multiple criterion problem and to construct the pareto-set. In this study a new kind of approach that allows the use of weighted aggregation of the criterions is presented. All possible weight combinations for the criterions are computed. The search for the minimum total cost among all the Pareto-optimal schedules with the assigned weights on criterions is obtained. Finally, a promising sequence is chosen that gives the minimum total cost for a particular set of weights on the criterions. The parametric analysis of the trade-offs of all solutions with all possible weighted combination of the criterions is analyzed.

A neighborhood search heuristic is also developed to provide the near-optimal solution for the problem. Results are provided to explore the best schedule among all the Pareto-optimal sets and to compare the result of the modified Pareto-optimal algorithm with the result of the neighborhood search heuristic. The performance of the modified Pareto-optimal algorithm has been evaluated by comparing its solution with the solutions derived by the neighborhood search heuristic. Results have shown that the modified Pareto-optimal algorithm provides a better solution than the neighborhood search heuristic, and this shows the efficiency of the modified Pareto-optimal algorithm. Direct application of this study may be applied to the industries where performance of machine maintenance is a routine work and worthwhile as well. Chemical processing equipments, boilers, furnaces, mechanical machineries etc. are the examples of such implications.

Distribution Planning

Distribution is the management of the flow of materials from manufacturers to customers and from warehouses to retailers, involving the storage and transportation of products. It may also be responsible for finished goods inventories and the selection of transportation service providers. After determining where the demand for goods and services is greatest, management must select a location for the facility that will supply that demand. For warehousing and distribution operations, transportation costs and proximity to markets are extremely important. With a warehouse nearby, many firms can hold inventory closer to the customer, thus reducing delivery time, transportation cost and promoting sales. The transportation problem, received this name because many of its applications involve determining how to optimally transport goods. When a problem involves shipment of goods from multiple sending points to multiple receiving points, and a new location (sending or receiving point) is to be added to the system, the company should undertake a separate analysis of transportation. In this work the transportation model of linear programming has been used. It is a special-purpose algorithm used to determine the minimum transportation cost.

Applications of the transportation problems tend to require a very large number of constraints and variables, so a straightforward computer application of the simplex method requires an exorbitant computational effort. For each option regarding the plants solving the corresponding transportation problem for a product category shows what the distribution cost would be for shipping the product category from those plants to the distribution centers and customer zones. The optimal total cost and distribution quantities have been shown in the solution table of distribution chapter.

5.2 Recommendations

Successful supply-chain management requires a high degree of functional and organizational integration. The interconnected set of linkages between suppliers of materials and services that spans the transformation of raw materials into products and services and delivers them to a firm's customers is known as the supply-chain. The value of supply-chain management becomes apparent when the complexity of the supply-chain is recognized. The performance of numerous suppliers determines the inward flow of materials. The performance of the firm's marketing, production, and distribution processes determines the outward flow of products. Traditionally, organizations have divided the responsibility for managing the flow of materials and services among three departments: purchasing, production, and distribution. In this research work integration of internal production planning and distribution has been considered. Purchasing can be included as a future work.

In case of aggregate planning and lot sizing though some practical and real-life situations have been incorporated in the Dixon-Silver model, there are plenty of scope of improvement of the model. Following recommendations can be made for further development:

1. The Dixon-Silver model was extended through inclusion of setup time and placing limitation on the maximum allowable lot-size. In the present work these two conditions were considered separately. Further work can be performed combining the two situations to develop a uniform model.

2. A restriction of the heuristic lies with number of production stages. Single production stage has been considered in the present work. Development of a heuristic for multiple production stages could be a significant contribution.

3. Setup costs and setup time have been considered independently. Realistically larger setup time would lead to increased setup costs. Linking of these two parameters in the heuristic would be clearly a more realistic approach.

4. Back-logging was not considered in this model. Heuristic with back-logging could be developed as further work

5. Other promising research areas are available. While genetic algorithms, tabu search and capacitated network flow models are successfully applied to solve other lot-size problems, their potential to solve CLSP is unknown. Research examining sensitivity analysis of dynamic lot-sizing heuristics within the context of CLSP is also worthwhile. Finally, extending the CLSP problem representation to capture the impact of equipment downtime on capacity during item changeover and multiple product families are important research areas.

In case of scheduling, although some practical and real-life situations have been incorporated in the Pareto-Optimal algorithm and neighborhood search method, there are plenty of scope of improvement in the model. Following recommendations can be made for further development:

1. The performance of the modified Pareto-optimal algorithm has been evaluated by comparing its solution with the solutions derived by the neighborhood search heuristic.

The performance of the modified Pareto-optimal algorithm can be compared with other local search methods.

2. There are many sequencing rules that can be applied to the jobs through the machines in a job shop according to the preferences. Two of those basic sequencing rules, Shortest Processing Time (SPT) and Earliest Due Date (EDD) have been adopted in the modified Pareto-optimal algorithm. Additional priority rule, such as Critical Ratio can also be adopted in future.
3. In the modified Pareto-optimal algorithm single production stage has been considered Pareto-optimal algorithm can be developed for multiple production stages.

In case of distribution system beside the Transportation method other linear programming methods can be applied for optimization.

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Appendix A

Table A.1 Performance of schedules at different weights and maintenance alternatives.

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
12	4	0.1	0.1	0 8	47.775	33 583	45.675	45.675	46 175	47 775
		0 1	0 2	0 7	54 975	38 283	50 775	50 775	51.775	54 975
		0 1	0 3	0.6	62.175	42 983	55 875	55.875	57.375	62 175
		0.1	0.4	0 5	69.375	47 683	60.975	60 975	62.975	69 375
		0 1	0 5	0 4	76 575	52.383	66 075	66 075	68.575	76 575
		0 1	0 6	0 3	83 775	57.083	71 175	71 175	74.175	83.775
		0.1	0 7	0 2	90 975	61.783	76.275	76 275	79.775	90 975
		0.1	0 8	0 1	98 175	66 483	81.375	81 375	85 375	98 175
		0 2	0.1	0 7	52 350	38.467	50.250	50.250	50.750	52 350
		0 2	0 2	0.6	59 550	43.167	55 350	55.350	56 350	59 550
		0 2	0 3	0.5	66 750	47.867	60 450	60 450	61 950	66 750
		0 2	0 4	0.4	73.950	52.567	65 550	65.550	67.550	73 950
		0 2	0.5	0 3	81.150	57 267	70 650	70 650	73.150	81.150
		0 2	0 6	0.2	88.350	61 967	75 750	75.750	78.750	88 350
		0 2	0.7	0 1	95.550	66 667	80 850	80 850	84 350	95 550
		0 3	0 1	0.6	56 925	43 350	54 825	54.825	55 325	56.925
		0 3	0 2	0 5	64 125	48 050	59.925	59.925	60 925	64 125
		0 3	0.3	0 4	71 325	52 750	65.025	65.025	66 525	71 325
		0 3	0.4	0 3	78 525	57 450	70.125	70.125	72 125	78 525
		0 3	0 5	0 2	85.725	62.150	75 225	75.225	77 725	85 725
		0 3	0 6	0.1	92.925	66.850	80 325	80 325	83 325	92 925 ·
		0 4	0 1	0 5	61.500	48.233	59.400	59 400	59 900	61 500
		0 4	0 2	0 4	68.700	52.933	64.500	64 500	65 500	68.700
		0 4	0 3	0 3	75.900	57.633	69.600	69 600	71 100	75 900
		0 4	0 4	0 2	83 100	62 333	74.700	74 700	76 700	83 100
		0.4	0 5	0 1	90 300	67 033	79.800	79.800	82.300	90 300
		0 5	0 1	0 4	66.075	53 117	63.975	63 975	64 475	66 075
		0 5	0 2	0.3	73 275	57.817	69 075	69 075	70 075	73.275
		0 5	0 3	0.2	80 475	62 517	74 175	74 175	75 675	80 475
		0 5	0 4	0.1	87.675	67.217	79.275	79 275	81 275	87 675
		0 6	0 1	0 3	70 650	58 000	68.550	68.550	69 050	70 650
		0 6	0 2	0 2	77.850	62.700	73 650	73 650	74 650	77 850
		0 6	0 3	0 1	85 050	67 400	78 750	78 750	80 250	85 050
		0 7	0.1	0.2	75 225	62 883	73 125	73 125	73 625	75.225
		0.7	0.2	0 1	82 425	67 583	78 225	78 225	79 225	82.425
		0.8	0.1	0 1	79 800	67 767	77 700	77 700	78 200	79 800
		SUM			2709 00	2014.00	2457.00	2457 00	2517 00	2709.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
12	5	0.1	0.1	0.8	49.033	34.883	47.133	47.133	47.333	49.033
		0.1	0.2	0.7	57.033	40.483	53.233	53.233	53.633	57.033
		0.1	0.3	0.6	65.033	46.083	59.333	59.333	59.933	65.033
		0.1	0.4	0.5	73.033	51.683	65.433	65.433	66.233	73.033
		0.1	0.5	0.4	81.033	57.283	71.533	71.533	72.533	81.033
		0.1	0.6	0.3	89.033	62.883	77.633	77.633	78.833	89.033
		0.1	0.7	0.2	97.033	68.483	83.733	83.733	85.133	97.033
		0.1	0.8	0.1	105.033	74.083	89.833	89.833	91.433	105.033
		0.2	0.1	0.7	54.067	40.167	52.167	52.167	52.367	54.067
		0.2	0.2	0.6	62.067	45.767	58.267	58.267	58.667	62.067
		0.2	0.3	0.5	70.067	51.367	64.367	64.367	64.967	70.067
		0.2	0.4	0.4	78.067	56.967	70.467	70.467	71.267	78.067
		0.2	0.5	0.3	86.067	62.567	76.567	76.567	77.567	86.067
		0.2	0.6	0.2	94.067	68.167	82.667	82.667	83.867	94.067
		0.2	0.7	0.1	102.067	73.767	88.767	88.767	90.167	102.067
		0.3	0.1	0.6	59.100	45.450	57.200	57.200	57.400	59.100
		0.3	0.2	0.5	67.100	51.050	63.300	63.300	63.700	67.100
		0.3	0.3	0.4	75.100	56.650	69.400	69.400	70.000	75.100
		0.3	0.4	0.3	83.100	62.250	75.500	75.500	76.300	83.100
		0.3	0.5	0.2	91.100	67.850	81.600	81.600	82.600	91.100
		0.3	0.6	0.1	99.100	73.450	87.700	87.700	88.900	99.100
		0.4	0.1	0.5	64.133	50.733	62.233	62.233	62.433	64.133
		0.4	0.2	0.4	72.133	56.333	68.333	68.333	68.733	72.133
		0.4	0.3	0.3	80.133	61.933	74.433	74.433	75.033	80.133
		0.4	0.4	0.2	88.133	67.533	80.533	80.533	81.333	88.133
		0.4	0.5	0.1	96.133	73.133	86.633	86.633	87.633	96.133
		0.5	0.1	0.4	69.167	56.017	67.267	67.267	67.467	69.167
		0.5	0.2	0.3	77.167	61.617	73.367	73.367	73.767	77.167
		0.5	0.3	0.2	85.167	67.217	79.467	79.467	80.067	85.167
		0.5	0.4	0.1	93.167	72.817	85.567	85.567	86.367	93.167
		0.6	0.1	0.3	74.200	61.300	72.300	72.300	72.500	74.200
		0.6	0.2	0.2	82.200	66.900	78.400	78.400	78.800	82.200
		0.6	0.3	0.1	90.200	72.500	84.500	84.500	85.100	90.200
		0.7	0.1	0.2	79.233	66.583	77.333	77.333	77.533	79.233
		0.7	0.2	0.1	87.233	72.183	83.433	83.433	83.833	87.233
		0.8	0.1	0.1	84.267	71.867	82.367	82.367	82.567	84.267
SUM					2860.00	2170.00	2632.00	2632.00	2656.00	2860.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
12	6	0.1	0.1	0.8	50.292	36.183	48.592	48.592	48.592	50.292
		0.1	0.2	0.7	59.092	42.683	55.692	55.692	55.692	59.092
		0.1	0.3	0.6	67.892	49.183	62.792	62.792	62.792	67.892
		0.1	0.4	0.5	76.692	55.683	69.892	69.892	69.892	76.692
		0.1	0.5	0.4	85.492	62.183	76.992	76.992	76.992	85.492
		0.1	0.6	0.3	94.292	68.683	84.092	84.092	84.092	94.292
		0.1	0.7	0.2	103.092	75.183	91.192	91.192	91.192	103.092
		0.1	0.8	0.1	111.892	81.683	98.292	98.292	98.292	111.892
		0.2	0.1	0.7	55.783	41.867	54.083	54.083	54.083	55.783
		0.2	0.2	0.6	64.583	48.367	61.183	61.183	61.183	64.583
		0.2	0.3	0.5	73.383	54.867	68.283	68.283	68.283	73.383
		0.2	0.4	0.4	82.183	61.367	75.383	75.383	75.383	82.183
		0.2	0.5	0.3	90.983	67.867	82.483	82.483	82.483	90.983
		0.2	0.6	0.2	99.783	74.367	89.583	89.583	89.583	99.783
		0.2	0.7	0.1	108.583	80.867	96.683	96.683	96.683	108.583
		0.3	0.1	0.6	61.275	47.550	59.575	59.575	59.575	61.275
		0.3	0.2	0.5	70.075	54.050	66.675	66.675	66.675	70.075
		0.3	0.3	0.4	78.875	60.550	73.775	73.775	73.775	78.875
		0.3	0.4	0.3	87.675	67.050	80.875	80.875	80.875	87.675
		0.3	0.5	0.2	96.475	73.550	87.975	87.975	87.975	96.475
		0.3	0.6	0.1	105.275	80.050	95.075	95.075	95.075	105.275
		0.4	0.1	0.5	66.767	53.233	65.067	65.067	65.067	66.767
		0.4	0.2	0.4	75.567	59.733	72.167	72.167	72.167	75.567
		0.4	0.3	0.3	84.367	66.233	79.267	79.267	79.267	84.367
		0.4	0.4	0.2	93.167	72.733	86.367	86.367	86.367	93.167
		0.4	0.5	0.1	101.967	79.233	93.467	93.467	93.467	101.967
		0.5	0.1	0.4	72.258	58.917	70.558	70.558	70.558	72.258
		0.5	0.2	0.3	81.058	65.417	77.658	77.658	77.658	81.058
		0.5	0.3	0.2	89.858	71.917	84.758	84.758	84.758	89.858
		0.5	0.4	0.1	98.658	78.417	91.858	91.858	91.858	98.658
		0.6	0.1	0.3	77.750	64.600	76.050	76.050	76.050	77.750
		0.6	0.2	0.2	86.550	71.100	83.150	83.150	83.150	86.550
		0.6	0.3	0.1	95.350	77.600	90.250	90.250	90.250	95.350
		0.7	0.1	0.2	83.242	70.283	81.542	81.542	81.542	83.242
		0.7	0.2	0.1	92.042	76.783	88.642	88.642	88.642	92.042
		0.8	0.1	0.1	88.733	75.967	87.033	87.033	87.033	88.733
SUM					3011.00	2326.00	2807.00	2807.00	2807.00	3011.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
12	7	0.1	0.1	0.8	51.550	37.483	50.050	50.050	50.050	51.550
		0.1	0.2	0.7	61.150	44.883	58.150	58.150	58.150	61.150
		0.1	0.3	0.6	70.750	52.283	66.250	66.250	66.250	70.750
		0.1	0.4	0.5	80.350	59.683	74.350	74.350	74.350	80.350
		0.1	0.5	0.4	89.950	67.083	82.450	82.450	82.450	89.950
		0.1	0.6	0.3	99.550	74.483	90.550	90.550	90.550	99.550
		0.1	0.7	0.2	109.150	81.883	98.650	98.650	98.650	109.150
		0.1	0.8	0.1	118.750	89.283	106.750	106.750	106.750	118.750
		0.2	0.1	0.7	57.500	43.567	56.000	56.000	56.000	57.500
		0.2	0.2	0.6	67.100	50.967	64.100	64.100	64.100	67.100
		0.2	0.3	0.5	76.700	58.367	72.200	72.200	72.200	76.700
		0.2	0.4	0.4	86.300	65.767	80.300	80.300	80.300	86.300
		0.2	0.5	0.3	95.900	73.167	88.400	88.400	88.400	95.900
		0.2	0.6	0.2	105.500	80.567	96.500	96.500	96.500	105.500
		0.2	0.7	0.1	115.100	87.967	104.600	104.600	104.600	115.100
		0.3	0.1	0.6	63.450	49.650	61.950	61.950	61.950	63.450
		0.3	0.2	0.5	73.050	57.050	70.050	70.050	70.050	73.050
		0.3	0.3	0.4	82.650	64.450	78.150	78.150	78.150	82.650
		0.3	0.4	0.3	92.250	71.850	86.250	86.250	86.250	92.250
		0.3	0.5	0.2	101.850	79.250	94.350	94.350	94.350	101.850
		0.3	0.6	0.1	111.450	86.650	102.450	102.450	102.450	111.450
		0.4	0.1	0.5	69.400	55.733	67.900	67.900	67.900	69.400
		0.4	0.2	0.4	79.000	63.133	76.000	76.000	76.000	79.000
		0.4	0.3	0.3	88.600	70.533	84.100	84.100	84.100	88.600
		0.4	0.4	0.2	98.200	77.933	92.200	92.200	92.200	98.200
		0.4	0.5	0.1	107.800	85.333	100.300	100.300	100.300	107.800
		0.5	0.1	0.4	75.350	61.817	73.850	73.850	73.850	75.350
		0.5	0.2	0.3	84.950	69.217	81.950	81.950	81.950	84.950
		0.5	0.3	0.2	94.550	76.617	90.050	90.050	90.050	94.550
		0.5	0.4	0.1	104.150	84.017	98.150	98.150	98.150	104.150
		0.6	0.1	0.3	81.300	67.900	79.800	79.800	79.800	81.300
		0.6	0.2	0.2	90.900	75.300	87.900	87.900	87.900	90.900
		0.6	0.3	0.1	100.500	82.700	96.000	96.000	96.000	100.500
		0.7	0.1	0.2	87.250	73.983	85.750	85.750	85.750	87.250
		0.7	0.2	0.1	96.850	81.383	93.850	93.850	93.850	96.850
		0.8	0.1	0.1	93.200	80.067	91.700	91.700	91.700	93.200
SUM					3162.00	2482.00	2982.00	2982.00	2982.00	3162.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
12	8	0.1	0.1	0.8	52.808	38.783	51.508	51.508	51.508	52.808
		0.1	0.2	0.7	63.208	47.083	60.608	60.608	60.608	63.208
		0.1	0.3	0.6	73.608	55.383	69.708	69.708	69.708	73.608
		0.1	0.4	0.5	84.008	63.683	78.808	78.808	78.808	84.008
		0.1	0.5	0.4	94.408	71.983	87.908	87.908	87.908	94.408
		0.1	0.6	0.3	104.808	80.283	97.008	97.008	97.008	104.808
		0.1	0.7	0.2	115.208	88.583	106.108	106.108	106.108	115.208
		0.1	0.8	0.1	125.608	96.883	115.208	115.208	115.208	125.608
		0.2	0.1	0.7	59.217	45.267	57.917	57.917	57.917	59.217
		0.2	0.2	0.6	69.617	53.567	67.017	67.017	67.017	69.617
		0.2	0.3	0.5	80.017	61.867	76.117	76.117	76.117	80.017
		0.2	0.4	0.4	90.417	70.167	85.217	85.217	85.217	90.417
		0.2	0.5	0.3	100.817	78.467	94.317	94.317	94.317	100.817
		0.2	0.6	0.2	111.217	86.767	103.417	103.417	103.417	111.217
		0.2	0.7	0.1	121.617	95.067	112.517	112.517	112.517	121.617
		0.3	0.1	0.6	65.625	51.750	64.325	64.325	64.325	65.625
		0.3	0.2	0.5	76.025	60.050	73.425	73.425	73.425	76.025
		0.3	0.3	0.4	86.425	68.350	82.525	82.525	82.525	86.425
		0.3	0.4	0.3	96.825	76.650	91.625	91.625	91.625	96.825
		0.3	0.5	0.2	107.225	84.950	100.725	100.725	100.725	107.225
		0.3	0.6	0.1	117.625	93.250	109.825	109.825	109.825	117.625
		0.4	0.1	0.5	72.033	58.233	70.733	70.733	70.733	72.033
		0.4	0.2	0.4	82.433	66.533	79.833	79.833	79.833	82.433
		0.4	0.3	0.3	92.833	74.833	88.933	88.933	88.933	92.833
		0.4	0.4	0.2	103.233	83.133	98.033	98.033	98.033	103.233
		0.4	0.5	0.1	113.633	91.433	107.133	107.133	107.133	113.633
		0.5	0.1	0.4	78.442	64.717	77.142	77.142	77.142	78.442
		0.5	0.2	0.3	88.842	73.017	86.242	86.242	86.242	88.842
		0.5	0.3	0.2	99.242	81.317	95.342	95.342	95.342	99.242
		0.5	0.4	0.1	109.642	89.617	104.442	104.442	104.442	109.642
		0.6	0.1	0.3	84.850	71.200	83.550	83.550	83.550	84.850
		0.6	0.2	0.2	95.250	79.500	92.650	92.650	92.650	95.250
		0.6	0.3	0.1	105.650	87.800	101.750	101.750	101.750	105.650
		0.7	0.1	0.2	91.258	77.683	89.958	89.958	89.958	91.258
		0.7	0.2	0.1	101.658	85.983	99.058	99.058	99.058	101.658
		0.8	0.1	0.1	97.667	84.167	96.367	96.367	96.367	97.667
		SUM			3313.00	2638.00	3157.00	3157.00	3157.00	3313.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
13	4	0.1	0.1	0.8	43.708	41.967	41.808	41.808	42.008	43.708
		0.1	0.2	0.7	50.308	46.667	46.508	46.508	46.908	50.308
		0.1	0.3	0.6	56.908	51.367	51.208	51.208	51.808	56.908
		0.1	0.4	0.5	63.508	56.067	55.908	55.908	56.708	63.508
		0.1	0.5	0.4	70.108	60.767	60.608	60.608	61.608	70.108
		0.1	0.6	0.3	76.708	65.467	65.308	65.308	66.508	76.708
		0.1	0.7	0.2	83.308	70.167	70.008	70.008	71.408	83.308
		0.1	0.8	0.1	89.908	74.867	74.708	74.708	76.308	89.908
		0.2	0.1	0.7	47.817	46.233	45.917	45.917	46.117	47.817
		0.2	0.2	0.6	54.417	50.933	50.617	50.617	51.017	54.417
		0.2	0.3	0.5	61.017	55.633	55.317	55.317	55.917	61.017
		0.2	0.4	0.4	67.617	60.333	60.017	60.017	60.817	67.617
		0.2	0.5	0.3	74.217	65.033	64.717	64.717	65.717	74.217
		0.2	0.6	0.2	80.817	69.733	69.417	69.417	70.617	80.817
		0.2	0.7	0.1	87.417	74.433	74.117	74.117	75.517	87.417
		0.3	0.1	0.6	51.925	50.500	50.025	50.025	50.225	51.925
		0.3	0.2	0.5	58.525	55.200	54.725	54.725	55.125	58.525
		0.3	0.3	0.4	65.125	59.900	59.425	59.425	60.025	65.125
		0.3	0.4	0.3	71.725	64.600	64.125	64.125	64.925	71.725
		0.3	0.5	0.2	78.325	69.300	68.825	68.825	69.825	78.325
		0.3	0.6	0.1	84.925	74.000	73.525	73.525	74.725	84.925
		0.4	0.1	0.5	56.033	54.767	54.133	54.133	54.333	56.033
		0.4	0.2	0.4	62.633	59.467	58.833	58.833	59.233	62.633
		0.4	0.3	0.3	69.233	64.167	63.533	63.533	64.133	69.233
		0.4	0.4	0.2	75.833	68.867	68.233	68.233	69.033	75.833
		0.4	0.5	0.1	82.433	73.567	72.933	72.933	73.933	82.433
		0.5	0.1	0.4	60.142	59.033	58.242	58.242	58.442	60.142
		0.5	0.2	0.3	66.742	63.733	62.942	62.942	63.342	66.742
		0.5	0.3	0.2	73.342	68.433	67.642	67.642	68.242	73.342
		0.5	0.4	0.1	79.942	73.133	72.342	72.342	73.142	79.942
		0.6	0.1	0.3	64.250	63.300	62.350	62.350	62.550	64.250
		0.6	0.2	0.2	70.850	68.000	67.050	67.050	67.450	70.850
		0.6	0.3	0.1	77.450	72.700	71.750	71.750	72.350	77.450
		0.7	0.1	0.2	68.358	67.567	66.458	66.458	66.658	68.358
		0.7	0.2	0.1	74.958	72.267	71.158	71.158	71.558	74.958
		0.8	0.1	0.1	72.467	71.833	70.567	70.567	70.767	72.467
		SUM			2473.00	2264.00	2245.00	2245.00	2269.00	2473.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
13	5	0.1	0.1	0.8	44.792	43.258	43.092	43.092	43.092	44.792
		0.1	0.2	0.7	52.092	48.858	48.692	48.692	48.692	52.092
		0.1	0.3	0.6	59.392	54.458	54.292	54.292	54.292	59.392
		0.1	0.4	0.5	66.692	60.058	59.892	59.892	59.892	66.692
		0.1	0.5	0.4	73.992	65.658	65.492	65.492	65.492	73.992
		0.1	0.6	0.3	81.292	71.258	71.092	71.092	71.092	81.292
		0.1	0.7	0.2	88.592	76.858	76.692	76.692	76.692	88.592
		0.1	0.8	0.1	95.892	82.458	82.292	82.292	82.292	95.892
		0.2	0.1	0.7	49.283	47.917	47.583	47.583	47.583	49.283
		0.2	0.2	0.6	56.583	53.517	53.183	53.183	53.183	56.583
		0.2	0.3	0.5	63.883	59.117	58.783	58.783	58.783	63.883
		0.2	0.4	0.4	71.183	64.717	64.383	64.383	64.383	71.183
		0.2	0.5	0.3	78.483	70.317	69.983	69.983	69.983	78.483
		0.2	0.6	0.2	85.783	75.917	75.583	75.583	75.583	85.783
		0.2	0.7	0.1	93.083	81.517	81.183	81.183	81.183	93.083
		0.3	0.1	0.6	53.775	52.575	52.075	52.075	52.075	53.775
		0.3	0.2	0.5	61.075	58.175	57.675	57.675	57.675	61.075
		0.3	0.3	0.4	68.375	63.775	63.275	63.275	63.275	68.375
		0.3	0.4	0.3	75.675	69.375	68.875	68.875	68.875	75.675
		0.3	0.5	0.2	82.975	74.975	74.475	74.475	74.475	82.975
		0.3	0.6	0.1	90.275	80.575	80.075	80.075	80.075	90.275
		0.4	0.1	0.5	58.267	57.233	56.567	56.567	56.567	58.267
		0.4	0.2	0.4	65.567	62.833	62.167	62.167	62.167	65.567
		0.4	0.3	0.3	72.867	68.433	67.767	67.767	67.767	72.867
		0.4	0.4	0.2	80.167	74.033	73.367	73.367	73.367	80.167
		0.4	0.5	0.1	87.467	79.633	78.967	78.967	78.967	87.467
		0.5	0.1	0.4	62.758	61.892	61.058	61.058	61.058	62.758
		0.5	0.2	0.3	70.058	67.492	66.658	66.658	66.658	70.058
		0.5	0.3	0.2	77.358	73.092	72.258	72.258	72.258	77.358
		0.5	0.4	0.1	84.658	78.692	77.858	77.858	77.858	84.658
		0.6	0.1	0.3	67.250	66.550	65.550	65.550	65.550	67.250
		0.6	0.2	0.2	74.550	72.150	71.150	71.150	71.150	74.550
		0.6	0.3	0.1	81.850	77.750	76.750	76.750	76.750	81.850
		0.7	0.1	0.2	71.742	71.208	70.042	70.042	70.042	71.742
		0.7	0.2	0.1	79.042	76.808	75.642	75.642	75.642	79.042
		0.8	0.1	0.1	76.233	75.867	74.533	74.533	74.533	76.233
		SUM			2603.00	2419.00	2399.00	2399.00	2399.00	2603.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
13	6	0.1	0.1	0.8	45.875	44.550	44.375	44.375	44.375	45.875
		0.1	0.2	0.7	53.875	51.050	50.875	50.875	50.875	53.875
		0.1	0.3	0.6	61.875	57.550	57.375	57.375	57.375	61.875
		0.1	0.4	0.5	69.875	64.050	63.875	63.875	63.875	69.875
		0.1	0.5	0.4	77.875	70.550	70.375	70.375	70.375	77.875
		0.1	0.6	0.3	85.875	77.050	76.875	76.875	76.875	85.875
		0.1	0.7	0.2	93.875	83.550	83.375	83.375	83.375	93.875
		0.1	0.8	0.1	101.875	90.050	89.875	89.875	89.875	101.875
		0.2	0.1	0.7	50.750	49.600	49.250	49.250	49.250	50.750
		0.2	0.2	0.6	58.750	56.100	55.750	55.750	55.750	58.750
		0.2	0.3	0.5	66.750	62.600	62.250	62.250	62.250	66.750
		0.2	0.4	0.4	74.750	69.100	68.750	68.750	68.750	74.750
		0.2	0.5	0.3	82.750	75.600	75.250	75.250	75.250	82.750
		0.2	0.6	0.2	90.750	82.100	81.750	81.750	81.750	90.750
		0.2	0.7	0.1	98.750	88.600	88.250	88.250	88.250	98.750
		0.3	0.1	0.6	55.625	54.650	54.125	54.125	54.125	55.625
		0.3	0.2	0.5	63.625	61.150	60.625	60.625	60.625	63.625
		0.3	0.3	0.4	71.625	67.650	67.125	67.125	67.125	71.625
		0.3	0.4	0.3	79.625	74.150	73.625	73.625	73.625	79.625
		0.3	0.5	0.2	87.625	80.650	80.125	80.125	80.125	87.625
		0.3	0.6	0.1	95.625	87.150	86.625	86.625	86.625	95.625
		0.4	0.1	0.5	60.500	59.700	59.000	59.000	59.000	60.500
		0.4	0.2	0.4	68.500	66.200	65.500	65.500	65.500	68.500
		0.4	0.3	0.3	76.500	72.700	72.000	72.000	72.000	76.500
		0.4	0.4	0.2	84.500	79.200	78.500	78.500	78.500	84.500
		0.4	0.5	0.1	92.500	85.700	85.000	85.000	85.000	92.500
		0.5	0.1	0.4	65.375	64.750	63.875	63.875	63.875	65.375
		0.5	0.2	0.3	73.375	71.250	70.375	70.375	70.375	73.375
		0.5	0.3	0.2	81.375	77.750	76.875	76.875	76.875	81.375
		0.5	0.4	0.1	89.375	84.250	83.375	83.375	83.375	89.375
		0.6	0.1	0.3	70.250	69.800	68.750	68.750	68.750	70.250
		0.6	0.2	0.2	78.250	76.300	75.250	75.250	75.250	78.250
		0.6	0.3	0.1	86.250	82.800	81.750	81.750	81.750	86.250
		0.7	0.1	0.2	75.125	74.850	73.625	73.625	73.625	75.125
		0.7	0.2	0.1	83.125	81.350	80.125	80.125	80.125	83.125
		0.8	0.1	0.1	80.000	79.900	78.500	78.500	78.500	80.000
		SUM			2733.00	2574.00	2553.00	2553.00	2553.00	2733.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
13	7	0.1	0.1	0.8	46.958	45.842	45.658	45.658	45.658	46.958
		0.1	0.2	0.7	55.658	53.242	53.058	53.058	53.058	55.658
		0.1	0.3	0.6	64.358	60.642	60.458	60.458	60.458	64.358
		0.1	0.4	0.5	73.058	68.042	67.858	67.858	67.858	73.058
		0.1	0.5	0.4	81.758	75.442	75.258	75.258	75.258	81.758
		0.1	0.6	0.3	90.458	82.842	82.658	82.658	82.658	90.458
		0.1	0.7	0.2	99.158	90.242	90.058	90.058	90.058	99.158
		0.1	0.8	0.1	107.858	97.642	97.458	97.458	97.458	107.858
		0.2	0.1	0.7	52.217	51.283	50.917	50.917	50.917	52.217
		0.2	0.2	0.6	60.917	58.683	58.317	58.317	58.317	60.917
		0.2	0.3	0.5	69.617	66.083	65.717	65.717	65.717	69.617
		0.2	0.4	0.4	78.317	73.483	73.117	73.117	73.117	78.317
		0.2	0.5	0.3	87.017	80.883	80.517	80.517	80.517	87.017
		0.2	0.6	0.2	95.717	88.283	87.917	87.917	87.917	95.717
		0.2	0.7	0.1	104.417	95.683	95.317	95.317	95.317	104.417
		0.3	0.1	0.6	57.475	56.725	56.175	56.175	56.175	57.475
		0.3	0.2	0.5	66.175	64.125	63.575	63.575	63.575	66.175
		0.3	0.3	0.4	74.875	71.525	70.975	70.975	70.975	74.875
		0.3	0.4	0.3	83.575	78.925	78.375	78.375	78.375	83.575
		0.3	0.5	0.2	92.275	86.325	85.775	85.775	85.775	92.275
		0.3	0.6	0.1	100.975	93.725	93.175	93.175	93.175	100.975
		0.4	0.1	0.5	62.733	62.167	61.433	61.433	61.433	62.733
		0.4	0.2	0.4	71.433	69.567	68.833	68.833	68.833	71.433
		0.4	0.3	0.3	80.133	76.967	76.233	76.233	76.233	80.133
		0.4	0.4	0.2	88.833	84.367	83.633	83.633	83.633	88.833
		0.4	0.5	0.1	97.533	91.767	91.033	91.033	91.033	97.533
		0.5	0.1	0.4	67.992	67.608	66.692	66.692	66.692	67.992
		0.5	0.2	0.3	76.692	75.008	74.092	74.092	74.092	76.692
		0.5	0.3	0.2	85.392	82.408	81.492	81.492	81.492	85.392
		0.5	0.4	0.1	94.092	89.808	88.892	88.892	88.892	94.092
		0.6	0.1	0.3	73.250	73.050	71.950	71.950	71.950	73.250
		0.6	0.2	0.2	81.950	80.450	79.350	79.350	79.350	81.950
		0.6	0.3	0.1	90.650	87.850	86.750	86.750	86.750	90.650
		0.7	0.1	0.2	78.508	78.492	77.208	77.208	77.208	78.508
		0.7	0.2	0.1	87.208	85.892	84.608	84.608	84.608	87.208
		0.8	0.1	0.1	83.767	83.933	82.467	82.467	82.467	83.767
		SUM			2863.00	2729.00	2707.00	2707.00	2707.00	2863.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
13	8	0.1	0.1	0.8	48.042	47.133	46.942	46.942	46.942	48.042
		0.1	0.2	0.7	57.442	55.433	55.242	55.242	55.242	57.442
		0.1	0.3	0.6	66.842	63.733	63.542	63.542	63.542	66.842
		0.1	0.4	0.5	76.242	72.033	71.842	71.842	71.842	76.242
		0.1	0.5	0.4	85.642	80.333	80.142	80.142	80.142	85.642
		0.1	0.6	0.3	95.042	88.633	88.442	88.442	88.442	95.042
		0.1	0.7	0.2	104.442	96.933	96.742	96.742	96.742	104.442
		0.1	0.8	0.1	113.842	105.233	105.042	105.042	105.042	113.842
		0.2	0.1	0.7	53.683	52.967	52.583	52.583	52.583	53.683
		0.2	0.2	0.6	63.083	61.267	60.883	60.883	60.883	63.083
		0.2	0.3	0.5	72.483	69.567	69.183	69.183	69.183	72.483
		0.2	0.4	0.4	81.883	77.867	77.483	77.483	77.483	81.883
		0.2	0.5	0.3	91.283	86.167	85.783	85.783	85.783	91.283
		0.2	0.6	0.2	100.683	94.467	94.083	94.083	94.083	100.683
		0.2	0.7	0.1	110.083	102.767	102.383	102.383	102.383	110.083
		0.3	0.1	0.6	59.325	58.800	58.225	58.225	58.225	59.325
		0.3	0.2	0.5	68.725	67.100	66.525	66.525	66.525	68.725
		0.3	0.3	0.4	78.125	75.400	74.825	74.825	74.825	78.125
		0.3	0.4	0.3	87.525	83.700	83.125	83.125	83.125	87.525
		0.3	0.5	0.2	96.925	92.000	91.425	91.425	91.425	96.925
		0.3	0.6	0.1	106.325	100.300	99.725	99.725	99.725	106.325
		0.4	0.1	0.5	64.967	64.633	63.867	63.867	63.867	64.967
		0.4	0.2	0.4	74.367	72.933	72.167	72.167	72.167	74.367
		0.4	0.3	0.3	83.767	81.233	80.467	80.467	80.467	83.767
		0.4	0.4	0.2	93.167	89.533	88.767	88.767	88.767	93.167
		0.4	0.5	0.1	102.567	97.833	97.067	97.067	97.067	102.567
		0.5	0.1	0.4	70.608	70.467	69.508	69.508	69.508	70.608
		0.5	0.2	0.3	80.008	78.767	77.808	77.808	77.808	80.008
		0.5	0.3	0.2	89.408	87.067	86.108	86.108	86.108	89.408
		0.5	0.4	0.1	98.808	95.367	94.408	94.408	94.408	98.808
		0.6	0.1	0.3	76.250	76.300	75.150	75.150	75.150	76.250
		0.6	0.2	0.2	85.650	84.600	83.450	83.450	83.450	85.650
		0.6	0.3	0.1	95.050	92.900	91.750	91.750	91.750	95.050
		0.7	0.1	0.2	81.892	82.133	80.792	80.792	80.792	81.892
		0.7	0.2	0.1	91.292	90.433	89.092	89.092	89.092	91.292
		0.8	0.1	0.1	87.533	87.967	86.433	86.433	86.433	87.533
		SUM			2993.00	2884.00	2861.00	2861.00	2861.00	2993.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
14	4	0.1	0.1	0.8	38.000	50.458	50.292	36.300	36.300	38.000
		0.1	0.2	0.7	44.000	55.158	54.992	40.600	40.600	44.000
		0.1	0.3	0.6	50.000	59.858	59.692	44.900	44.900	50.000
		0.1	0.4	0.5	56.000	64.558	64.392	49.200	49.200	56.000
		0.1	0.5	0.4	62.000	69.258	69.092	53.500	53.500	62.000
		0.1	0.6	0.3	68.000	73.958	73.792	57.800	57.800	68.000
		0.1	0.7	0.2	74.000	78.658	78.492	62.100	62.100	74.000
		0.1	0.8	0.1	80.000	83.358	83.192	66.400	66.400	80.000
		0.2	0.1	0.7	42.000	54.217	53.883	40.300	40.300	42.000
		0.2	0.2	0.6	48.000	58.917	58.583	44.600	44.600	48.000
		0.2	0.3	0.5	54.000	63.617	63.283	48.900	48.900	54.000
		0.2	0.4	0.4	60.000	68.317	67.983	53.200	53.200	60.000
		0.2	0.5	0.3	66.000	73.017	72.683	57.500	57.500	66.000
		0.2	0.6	0.2	72.000	77.717	77.383	61.800	61.800	72.000
		0.2	0.7	0.1	78.000	82.417	82.083	66.100	66.100	78.000
		0.3	0.1	0.6	46.000	57.975	57.475	44.300	44.300	46.000
		0.3	0.2	0.5	52.000	62.675	62.175	48.600	48.600	52.000
		0.3	0.3	0.4	58.000	67.375	66.875	52.900	52.900	58.000
		0.3	0.4	0.3	64.000	72.075	71.575	57.200	57.200	64.000
		0.3	0.5	0.2	70.000	76.775	76.275	61.500	61.500	70.000
		0.3	0.6	0.1	76.000	81.475	80.975	65.800	65.800	76.000
		0.4	0.1	0.5	50.000	61.733	61.067	48.300	48.300	50.000
		0.4	0.2	0.4	56.000	66.433	65.767	52.600	52.600	56.000
		0.4	0.3	0.3	62.000	71.133	70.467	56.900	56.900	62.000
		0.4	0.4	0.2	68.000	75.833	75.167	61.200	61.200	68.000
		0.4	0.5	0.1	74.000	80.533	79.867	65.500	65.500	74.000
		0.5	0.1	0.4	54.000	65.492	64.658	52.300	52.300	54.000
		0.5	0.2	0.3	60.000	70.192	69.358	56.600	56.600	60.000
		0.5	0.3	0.2	66.000	74.892	74.058	60.900	60.900	66.000
		0.5	0.4	0.1	72.000	79.592	78.758	65.200	65.200	72.000
		0.6	0.1	0.3	58.000	69.250	68.250	56.300	56.300	58.000
		0.6	0.2	0.2	64.000	73.950	72.950	60.600	60.600	64.000
		0.6	0.3	0.1	70.000	78.650	77.650	64.900	64.900	70.000
		0.7	0.1	0.2	62.000	73.008	71.842	60.300	60.300	62.000
		0.7	0.2	0.1	68.000	77.708	76.542	64.600	64.600	68.000
		0.8	0.1	0.1	66.000	76.767	75.433	64.300	64.300	66.000
		SUM			2208.00	2527.00	2507.00	2004.00	2004.00	2208.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
14	5	0.1	0.1	0.8	38.925	51.760	51.575	37.425	37.425	38.925
		0.1	0.2	0.7	45.525	57.350	57.175	42.525	42.525	45.525
		0.1	0.3	0.6	52.125	62.950	62.775	47.625	47.625	52.125
		0.1	0.4	0.5	58.725	68.550	68.375	52.725	52.725	58.725
		0.1	0.5	0.4	65.325	74.150	73.975	57.825	57.825	65.325
		0.1	0.6	0.3	71.925	79.750	79.575	62.925	62.925	71.925
		0.1	0.7	0.2	78.525	85.350	85.175	68.025	68.025	78.525
		0.1	0.8	0.1	85.125	90.950	90.775	73.125	73.125	85.125
		0.2	0.1	0.7	43.250	55.900	55.550	41.750	41.750	43.250
		0.2	0.2	0.6	49.850	61.500	61.150	46.850	46.850	49.850
		0.2	0.3	0.5	56.450	67.100	66.750	51.950	51.950	56.450
		0.2	0.4	0.4	63.050	72.700	72.350	57.050	57.050	63.050
		0.2	0.5	0.3	69.650	78.300	77.950	62.150	62.150	69.650
		0.2	0.6	0.2	76.250	83.900	83.550	67.250	67.250	76.250
		0.2	0.7	0.1	82.850	89.500	89.150	72.350	72.350	82.850
		0.3	0.1	0.6	47.575	60.050	59.525	46.075	46.075	47.575
		0.3	0.2	0.5	54.175	65.650	65.125	51.175	51.175	54.175
		0.3	0.3	0.4	60.775	71.250	70.725	56.275	56.275	60.775
		0.3	0.4	0.3	67.375	76.850	76.325	61.375	61.375	67.375
		0.3	0.5	0.2	73.975	82.450	81.925	66.475	66.475	73.975
		0.3	0.6	0.1	80.575	88.050	87.525	71.575	71.575	80.575
		0.4	0.1	0.5	51.900	64.200	63.500	50.400	50.400	51.900
		0.4	0.2	0.4	58.500	69.800	69.100	55.500	55.500	58.500
		0.4	0.3	0.3	65.100	75.400	74.700	60.600	60.600	65.100
		0.4	0.4	0.2	71.700	81.000	80.300	65.700	65.700	71.700
		0.4	0.5	0.1	78.300	86.600	85.900	70.800	70.800	78.300
		0.5	0.1	0.4	56.225	68.350	67.475	54.725	54.725	56.225
		0.5	0.2	0.3	62.825	73.950	73.075	59.825	59.825	62.825
		0.5	0.3	0.2	69.425	79.550	78.675	64.925	64.925	69.425
		0.5	0.4	0.1	76.025	85.150	84.275	70.025	70.025	76.025
		0.6	0.1	0.3	60.550	72.500	71.450	59.050	59.050	60.550
		0.6	0.2	0.2	67.150	78.100	77.050	64.150	64.150	67.150
		0.6	0.3	0.1	73.750	83.700	82.650	69.250	69.250	73.750
		0.7	0.1	0.2	64.875	76.650	75.425	63.375	63.375	64.875
		0.7	0.2	0.1	71.475	82.250	81.025	68.475	68.475	71.475
		0.8	0.1	0.1	69.200	80.800	79.400	67.700	67.700	69.200
		SUM			2319.00	2682.00	2661.00	2139.00	2139.00	2319.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
14	6	0.1	0.1	0.8	39.850	53.042	52.858	38.550	38.550	39.850
		0.1	0.2	0.7	47.050	59.542	59.358	44.450	44.450	47.050
		0.1	0.3	0.6	54.250	66.042	65.858	50.350	50.350	54.250
		0.1	0.4	0.5	61.450	72.542	72.358	56.250	56.250	61.450
		0.1	0.5	0.4	68.650	79.042	78.858	62.150	62.150	68.650
		0.1	0.6	0.3	75.850	85.542	85.358	68.050	68.050	75.850
		0.1	0.7	0.2	83.050	92.042	91.858	73.950	73.950	83.050
		0.1	0.8	0.1	90.250	98.542	98.358	79.850	79.850	90.250
		0.2	0.1	0.7	44.500	57.583	57.217	43.200	43.200	44.500
		0.2	0.2	0.6	51.700	64.083	63.717	49.100	49.100	51.700
		0.2	0.3	0.5	58.900	70.583	70.217	55.000	55.000	58.900
		0.2	0.4	0.4	66.100	77.083	76.717	60.900	60.900	66.100
		0.2	0.5	0.3	73.300	83.583	83.217	66.800	66.800	73.300
		0.2	0.6	0.2	80.500	90.083	89.717	72.700	72.700	80.500
		0.2	0.7	0.1	87.700	96.583	96.217	78.600	78.600	87.700
		0.3	0.1	0.6	49.150	62.125	61.575	47.850	47.850	49.150
		0.3	0.2	0.5	56.350	68.625	68.075	53.750	53.750	56.350
		0.3	0.3	0.4	63.550	75.125	74.575	59.650	59.650	63.550
		0.3	0.4	0.3	70.750	81.625	81.075	65.550	65.550	70.750
		0.3	0.5	0.2	77.950	88.125	87.575	71.450	71.450	77.950
		0.3	0.6	0.1	85.150	94.625	94.075	77.350	77.350	85.150
		0.4	0.1	0.5	53.800	66.667	65.933	52.500	52.500	53.800
		0.4	0.2	0.4	61.000	73.167	72.433	58.400	58.400	61.000
		0.4	0.3	0.3	68.200	79.667	78.933	64.300	64.300	68.200
		0.4	0.4	0.2	75.400	86.167	85.433	70.200	70.200	75.400
		0.4	0.5	0.1	82.600	92.667	91.933	76.100	76.100	82.600
		0.5	0.1	0.4	58.450	71.208	70.292	57.150	57.150	58.450
		0.5	0.2	0.3	65.650	77.708	76.792	63.050	63.050	65.650
		0.5	0.3	0.2	72.850	84.208	83.292	68.950	68.950	72.850
		0.5	0.4	0.1	80.050	90.708	89.792	74.850	74.850	80.050
		0.6	0.1	0.3	63.100	75.750	74.650	61.800	61.800	63.100
		0.6	0.2	0.2	70.300	82.250	81.150	67.700	67.700	70.300
		0.6	0.3	0.1	77.500	88.750	87.650	73.600	73.600	77.500
		0.7	0.1	0.2	67.750	80.292	79.008	66.450	66.450	67.750
		0.7	0.2	0.1	74.950	86.792	85.508	72.350	72.350	74.950
		0.8	0.1	0.1	72.400	84.833	83.367	71.100	71.100	72.400
		SUM			2430.00	2837.00	2815.00	2274.00	2274.00	2430.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
14	7	0.1	0.1	0.8	40.775	54.333	54.142	39.675	39.675	40.775
		0.1	0.2	0.7	48.575	61.733	61.542	46.375	46.375	48.575
		0.1	0.3	0.6	56.375	69.133	68.942	53.075	53.075	56.375
		0.1	0.4	0.5	64.175	76.533	76.342	59.775	59.775	64.175
		0.1	0.5	0.4	71.975	83.933	83.742	66.475	66.475	71.975
		0.1	0.6	0.3	79.775	91.333	91.142	73.175	73.175	79.775
		0.1	0.7	0.2	87.575	98.733	98.542	79.875	79.875	87.575
		0.1	0.8	0.1	95.375	106.133	105.942	86.575	86.575	95.375
		0.2	0.1	0.7	45.750	59.267	58.883	44.650	44.650	45.750
		0.2	0.2	0.6	53.550	66.667	66.283	51.350	51.350	53.550
		0.2	0.3	0.5	61.350	74.067	73.683	58.050	58.050	61.350
		0.2	0.4	0.4	69.150	81.467	81.083	64.750	64.750	69.150
		0.2	0.5	0.3	76.950	88.867	88.483	71.450	71.450	76.950
		0.2	0.6	0.2	84.750	96.267	95.883	78.150	78.150	84.750
		0.2	0.7	0.1	92.550	103.667	103.283	84.850	84.850	92.550
		0.3	0.1	0.6	50.725	64.200	63.625	49.625	49.625	50.725
		0.3	0.2	0.5	58.525	71.600	71.025	56.325	56.325	58.525
		0.3	0.3	0.4	66.325	79.000	78.425	63.025	63.025	66.325
		0.3	0.4	0.3	74.125	86.400	85.825	69.725	69.725	74.125
		0.3	0.5	0.2	81.925	93.800	93.225	76.425	76.425	81.925
		0.3	0.6	0.1	89.725	101.200	100.625	83.125	83.125	89.725
		0.4	0.1	0.5	55.700	69.133	68.367	54.600	54.600	55.700
		0.4	0.2	0.4	63.500	76.533	75.767	61.300	61.300	63.500
		0.4	0.3	0.3	71.300	83.933	83.167	68.000	68.000	71.300
		0.4	0.4	0.2	79.100	91.333	90.567	74.700	74.700	79.100
		0.4	0.5	0.1	86.900	98.733	97.967	81.400	81.400	86.900
		0.5	0.1	0.4	60.675	74.067	73.108	59.575	59.575	60.675
		0.5	0.2	0.3	68.475	81.467	80.508	66.275	66.275	68.475
		0.5	0.3	0.2	76.275	88.867	87.908	72.975	72.975	76.275
		0.5	0.4	0.1	84.075	96.267	95.308	79.675	79.675	84.075
		0.6	0.1	0.3	65.650	79.000	77.850	64.550	64.550	65.650
		0.6	0.2	0.2	73.450	86.400	85.250	71.250	71.250	73.450
		0.6	0.3	0.1	81.250	93.800	92.650	77.950	77.950	81.250
		0.7	0.1	0.2	70.625	83.933	82.592	69.525	69.525	70.625
		0.7	0.2	0.1	78.425	91.333	89.992	76.225	76.225	78.425
		0.8	0.1	0.1	75.600	88.867	87.333	74.500	74.500	75.600
		SUM			2541.00	2992.00	2969.00	2409.00	2409.00	2541.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
14	8	0.1	0.1	0.8	41.700	55.625	55.425	40.800	40.800	41.700
		0.1	0.2	0.7	50.100	63.925	63.725	48.300	48.300	50.100
		0.1	0.3	0.6	58.500	72.225	72.025	55.800	55.800	58.500
		0.1	0.4	0.5	66.900	80.525	80.325	63.300	63.300	66.900
		0.1	0.5	0.4	75.300	88.825	88.625	70.800	70.800	75.300
		0.1	0.6	0.3	83.700	97.125	96.925	78.300	78.300	83.700
		0.1	0.7	0.2	92.100	105.425	105.225	85.800	85.800	92.100
		0.1	0.8	0.1	100.500	113.725	113.525	93.300	93.300	100.500
		0.2	0.1	0.7	47.000	60.950	60.550	46.100	46.100	47.000
		0.2	0.2	0.6	55.400	69.250	68.850	53.600	53.600	55.400
		0.2	0.3	0.5	63.800	77.550	77.150	61.100	61.100	63.800
		0.2	0.4	0.4	72.200	85.850	85.450	68.600	68.600	72.200
		0.2	0.5	0.3	80.600	94.150	93.750	76.100	76.100	80.600
		0.2	0.6	0.2	89.000	102.450	102.050	83.600	83.600	89.000
		0.2	0.7	0.1	97.400	110.750	110.350	91.100	91.100	97.400
		0.3	0.1	0.6	52.300	66.275	65.675	51.400	51.400	52.300
		0.3	0.2	0.5	60.700	74.575	73.975	58.900	58.900	60.700
		0.3	0.3	0.4	69.100	82.875	82.275	66.400	66.400	69.100
		0.3	0.4	0.3	77.500	91.175	90.575	73.900	73.900	77.500
		0.3	0.5	0.2	85.900	99.475	98.875	81.400	81.400	85.900
		0.3	0.6	0.1	94.300	107.775	107.175	88.900	88.900	94.300
		0.4	0.1	0.5	57.600	71.600	70.800	56.700	56.700	57.600
		0.4	0.2	0.4	66.000	79.900	79.100	64.200	64.200	66.000
		0.4	0.3	0.3	74.400	88.200	87.400	71.700	71.700	74.400
		0.4	0.4	0.2	82.800	96.500	95.700	79.200	79.200	82.800
		0.4	0.5	0.1	91.200	104.800	104.000	86.700	86.700	91.200
		0.5	0.1	0.4	62.900	76.925	75.925	62.000	62.000	62.900
		0.5	0.2	0.3	71.300	85.225	84.225	69.500	69.500	71.300
		0.5	0.3	0.2	79.700	93.525	92.525	77.000	77.000	79.700
		0.5	0.4	0.1	88.100	101.825	100.825	84.500	84.500	88.100
		0.6	0.1	0.3	68.200	82.250	81.050	67.300	67.300	68.200
		0.6	0.2	0.2	76.600	90.550	89.350	74.800	74.800	76.600
		0.6	0.3	0.1	85.000	98.850	97.650	82.300	82.300	85.000
		0.7	0.1	0.2	73.500	87.575	86.175	72.600	72.600	73.500
		0.7	0.2	0.1	81.900	95.875	94.475	80.100	80.100	81.900
		0.8	0.1	0.1	78.800	92.900	91.300	77.900	77.900	78.800
		SUM			2652.00	3147.00	3123.00	2544.00	2544.00	2652.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
15	4	0 1	0.1	0.8	45 325	29 350	29 350	43 825	43 825	45 325
		0.1	0 2	0 7	51 125	33 250	33 250	48.125	48 125	51 125
		0 1	0 3	0.6	56 925	37 150	37.150	52.425	52 425	56.925
		0.1	0 4	0 5	62 725	41.050	41 050	56.725	56 725	62 725
		0.1	0.5	0 4	68 525	44.950	44 950	61 025	61.025	68 525
		0 1	0.6	0 3	74 325	48.850	48 850	65.325	65.325	74 325
		0.1	0.7	0 2	80 125	52.750	52.750	69 625	69.625	80 125
		0 1	0.8	0.1	85 925	56 650	56.650	73.925	73 925	85.925
		0 2	0 1	0 7	48.850	33 800	33 800	47 350	47 350	48 850
		0.2	0 2	0 6	54.650	37.700	37 700	51.650	51.650	54 650
		0.2	0.3	0 5	60 450	41 600	41.600	55 950	55 950	60.450
		0 2	0 4	0.4	66 250	45 500	45.500	60 250	60.250	66.250
		0 2	0.5	0.3	72 050	49 400	49.400	64 550	64.550	72.050
		0 2	0 6	0.2	77.850	53 300	53 300	68.850	68.850	77 850
		0 2	0 7	0.1	83 650	57 200	57.200	73.150	73.150	83 650
		0.3	0.1	0 6	52 375	38 250	38.250	50 875	50 875	52.375
		0 3	0 2	0 5	58 175	42.150	42 150	55 175	55 175	58.175
		0 3	0 3	0.4	63.975	46 050	46 050	59.475	59.475	63 975
		0.3	0 4	0 3	69 775	49.950	49.950	63 775	63 775	69.775
		0 3	0 5	0 2	75 575	53 850	53 850	68 075	68.075	75 575
		0 3	0.6	0.1	81.375	57.750	57.750	72.375	72 375	81.375
		0 4	0 1	0.5	55.900	42 700	42.700	54.400	54 400	55.900
		0.4	0.2	0 4	61.700	46 600	46 600	58.700	58 700	61.700
		0 4	0.3	0 3	67.500	50 500	50 500	63.000	63 000	67.500
		0 4	0.4	0 2	73 300	54.400	54 400	67 300	67.300	73 300
		0.4	0.5	0.1	79 100	58 300	58.300	71.600	71 600	79 100
		0.5	0.1	0 4	59 425	47.150	47.150	57.925	57 925	59 425
		0 5	0 2	0.3	65 225	51.050	51.050	62 225	62.225	65 225
		0 5	0 3	0.2	71.025	54.950	54 950	66 525	66 525	71.025
		0 5	0 4	0.1	76 825	58 850	58.850	70 825	70 825	76.825
		0 6	0 1	0 3	62.950	51.600	51.600	61 450	61 450	62.950
		0 6	0 2	0 2	68 750	55.500	55.500	65 750	65.750	68.750
		0 6	0.3	0 1	74 550	59 400	59 400	70 050	70 050	74.550
		0 7	0 1	0 2	66 475	56 050	56 050	64 975	64 975	66 475
		0 7	0 2	0 1	72 275	59.950	59.950	69 275	69.275	72.275
		0 8	0 1	0.1	70 000	60.500	60 500	68.500	68 500	70.000
		SUM			2415.00	1758 00	1758.00	2235 00	2235 00	2415 00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
15	5	0.1	0.1	0 8	46 250	30 342	30.342	44 950	44 950	46 250
		0 1	0 2	0 7	52 650	34.942	34 942	50 050	50.050	52 650
		0.1	0 3	0 6	59 050	39 542	39.542	55 150	55 150	59 050
		0 1	0 4	0.5	65.450	44 142	44 142	60 250	60.250	65 450
		0 1	0 5	0 4	71 850	48.742	48 742	65 350	65 350	71.850
		0.1	0 6	0 3	78 250	53 342	53 342	70 450	70 450	78 250
		0.1	0 7	0 2	84 650	57 942	57.942	75 550	75 550	84 650
		0 1	0 8	0 1	91 050	62.542	62 542	80 650	80 650	91.050
		0.2	0.1	0 7	50 100	35 083	35 083	48 800	48.800	50 100
		0 2	0 2	0 6	56 500	39.683	39 683	53.900	53 900	56 500
		0 2	0.3	0.5	62.900	44 283	44 283	59 000	59.000	62 900
		0 2	0 4	0 4	69 300	48.883	48.883	64.100	64.100	69 300
		0 2	0 5	0 3	75.700	53 483	53 483	69 200	69.200	75.700
		0 2	0 6	0.2	82.100	58 083	58 083	74.300	74.300	82 100
		0 2	0 7	0 1	88 500	62 683	62.683	79 400	79 400	88 500
		0 3	0 1	0 6	53 950	39 825	39.825	52.650	52.650	53 950
		0 3	0.2	0 5	60 350	44 425	44 425	57.750	57.750	60 350
		0.3	0 3	0 4	66 750	49 025	49 025	62.850	62.850	66 750
		0 3	0 4	0 3	73 150	53 625	53 625	67 950	67.950	73.150
		0 3	0 5	0 2	79.550	58 225	58 225	73 050	73 050	79.550
		0 3	0 6	0.1	85.950	62 825	62 825	78 150	78.150	85.950
		0 4	0 1	0 5	57.800	44 567	44 567	56 500	56.500	57.800
		0 4	0 2	0.4	64.200	49 167	49 167	61 600	61.600	64 200
		0 4	0 3	0 3	70 600	53 767	53.767	66 700	66.700	70 600
		0 4	0 4	0 2	77 000	58.367	58 367	71 800	71 800	77 000
		0 4	0 5	0 1	83 400	62 967	62 967	76 900	76.900	83 400
		0 5	0 1	0 4	61 650	49.308	49.308	60 350	60.350	61 650
		0 5	0 2	0 3	68.050	53.908	53 908	65 450	65.450	68.050
		0 5	0 3	0.2	74.450	58 508	58 508	70 550	70 550	74 450
		0 5	0 4	0 1	80 850	63.108	63 108	75 650	75 650	80.850
		0 6	0 1	0 3	65 500	54 050	54 050	64 200	64 200	65.500
		0 6	0 2	0 2	71 900	58 650	58.650	69.300	69 300	71 900
		0 6	0 3	0 1	78 300	63 250	63.250	74.400	74.400	78 300
		0 7	0 1	0 2	69 350	58 792	58.792	68 050	68 050	69 350
		0 7	0.2	0.1	75.750	63 392	63 392	73.150	73.150	75.750
		0 8	0 1	0 1	73.200	63 533	63 533	71 900	71.900	73 200
		SUM			2526 00	1877.00	1877.00	2370 00	2370 00	2526 00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
15	6	0.1	0.1	0.8	47.175	31.333	31.333	46.075	46.075	47.175
		0.1	0.2	0.7	54.175	36.633	36.633	51.975	51.975	54.175
		0.1	0.3	0.6	61.175	41.933	41.933	57.875	57.875	61.175
		0.1	0.4	0.5	68.175	47.233	47.233	63.775	63.775	68.175
		0.1	0.5	0.4	75.175	52.533	52.533	69.675	69.675	75.175
		0.1	0.6	0.3	82.175	57.833	57.833	75.575	75.575	82.175
		0.1	0.7	0.2	89.175	63.133	63.133	81.475	81.475	89.175
		0.1	0.8	0.1	96.175	68.433	68.433	87.375	87.375	96.175
		0.2	0.1	0.7	51.350	36.367	36.367	50.250	50.250	51.350
		0.2	0.2	0.6	58.350	41.667	41.667	56.150	56.150	58.350
		0.2	0.3	0.5	65.350	46.967	46.967	62.050	62.050	65.350
		0.2	0.4	0.4	72.350	52.267	52.267	67.950	67.950	72.350
		0.2	0.5	0.3	79.350	57.567	57.567	73.850	73.850	79.350
		0.2	0.6	0.2	86.350	62.867	62.867	79.750	79.750	86.350
		0.2	0.7	0.1	93.350	68.167	68.167	85.650	85.650	93.350
		0.3	0.1	0.6	55.525	41.400	41.400	54.425	54.425	55.525
		0.3	0.2	0.5	62.525	46.700	46.700	60.325	60.325	62.525
		0.3	0.3	0.4	69.525	52.000	52.000	66.225	66.225	69.525
		0.3	0.4	0.3	76.525	57.300	57.300	72.125	72.125	76.525
		0.3	0.5	0.2	83.525	62.600	62.600	78.025	78.025	83.525
		0.3	0.6	0.1	90.525	67.900	67.900	83.925	83.925	90.525
		0.4	0.1	0.5	59.700	46.433	46.433	58.600	58.600	59.700
		0.4	0.2	0.4	66.700	51.733	51.733	64.500	64.500	66.700
		0.4	0.3	0.3	73.700	57.033	57.033	70.400	70.400	73.700
		0.4	0.4	0.2	80.700	62.333	62.333	76.300	76.300	80.700
		0.4	0.5	0.1	87.700	67.633	67.633	82.200	82.200	87.700
		0.5	0.1	0.4	63.875	51.467	51.467	62.775	62.775	63.875
		0.5	0.2	0.3	70.875	56.767	56.767	68.675	68.675	70.875
		0.5	0.3	0.2	77.875	62.067	62.067	74.575	74.575	77.875
		0.5	0.4	0.1	84.875	67.367	67.367	80.475	80.475	84.875
		0.6	0.1	0.3	68.050	56.500	56.500	66.950	66.950	68.050
		0.6	0.2	0.2	75.050	61.800	61.800	72.850	72.850	75.050
		0.6	0.3	0.1	82.050	67.100	67.100	78.750	78.750	82.050
		0.7	0.1	0.2	72.225	61.533	61.533	71.125	71.125	72.225
		0.7	0.2	0.1	79.225	66.833	66.833	77.025	77.025	79.225
		0.8	0.1	0.1	76.400	66.567	66.567	75.300	75.300	76.400
		SUM			2637.00	1996.00	1996.00	2505.00	2505.00	2637.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
15	7	0.1	0.1	0.8	48.100	32.325	32.325	47.200	47.200	48.100
		0.1	0.2	0.7	55.700	38.325	38.325	53.900	53.900	55.700
		0.1	0.3	0.6	63.300	44.325	44.325	60.600	60.600	63.300
		0.1	0.4	0.5	70.900	50.325	50.325	67.300	67.300	70.900
		0.1	0.5	0.4	78.500	56.325	56.325	74.000	74.000	78.500
		0.1	0.6	0.3	86.100	62.325	62.325	80.700	80.700	86.100
		0.1	0.7	0.2	93.700	68.325	68.325	87.400	87.400	93.700
		0.1	0.8	0.1	101.300	74.325	74.325	94.100	94.100	101.300
		0.2	0.1	0.7	52.600	37.650	37.650	51.700	51.700	52.600
		0.2	0.2	0.6	60.200	43.650	43.650	58.400	58.400	60.200
		0.2	0.3	0.5	67.800	49.650	49.650	65.100	65.100	67.800
		0.2	0.4	0.4	75.400	55.650	55.650	71.800	71.800	75.400
		0.2	0.5	0.3	83.000	61.650	61.650	78.500	78.500	83.000
		0.2	0.6	0.2	90.600	67.650	67.650	85.200	85.200	90.600
		0.2	0.7	0.1	98.200	73.650	73.650	91.900	91.900	98.200
		0.3	0.1	0.6	57.100	42.975	42.975	56.200	56.200	57.100
		0.3	0.2	0.5	64.700	48.975	48.975	62.900	62.900	64.700
		0.3	0.3	0.4	72.300	54.975	54.975	69.600	69.600	72.300
		0.3	0.4	0.3	79.900	60.975	60.975	76.300	76.300	79.900
		0.3	0.5	0.2	87.500	66.975	66.975	83.000	83.000	87.500
		0.3	0.6	0.1	95.100	72.975	72.975	89.700	89.700	95.100
		0.4	0.1	0.5	61.600	48.300	48.300	60.700	60.700	61.600
		0.4	0.2	0.4	69.200	54.300	54.300	67.400	67.400	69.200
		0.4	0.3	0.3	76.800	60.300	60.300	74.100	74.100	76.800
		0.4	0.4	0.2	84.400	66.300	66.300	80.800	80.800	84.400
		0.4	0.5	0.1	92.000	72.300	72.300	87.500	87.500	92.000
		0.5	0.1	0.4	66.100	53.625	53.625	65.200	65.200	66.100
		0.5	0.2	0.3	73.700	59.625	59.625	71.900	71.900	73.700
		0.5	0.3	0.2	81.300	65.625	65.625	78.600	78.600	81.300
		0.5	0.4	0.1	88.900	71.625	71.625	85.300	85.300	88.900
		0.6	0.1	0.3	70.600	58.950	58.950	69.700	69.700	70.600
		0.6	0.2	0.2	78.200	64.950	64.950	76.400	76.400	78.200
		0.6	0.3	0.1	85.800	70.950	70.950	83.100	83.100	85.800
		0.7	0.1	0.2	75.100	64.275	64.275	74.200	74.200	75.100
		0.7	0.2	0.1	82.700	70.275	70.275	80.900	80.900	82.700
		0.8	0.1	0.1	79.600	69.600	69.600	78.700	78.700	79.600
		SUM			2748.00	2115.00	2115.00	2640.00	2640.00	2748.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
15	8	0.1	0.1	0.8	49.025	33.317	33.317	48.325	48.325	49.025
		0.1	0.2	0.7	57.225	40.017	40.017	55.825	55.825	57.225
		0.1	0.3	0.6	65.425	46.717	46.717	63.325	63.325	65.425
		0.1	0.4	0.5	73.625	53.417	53.417	70.825	70.825	73.625
		0.1	0.5	0.4	81.825	60.117	60.117	78.325	78.325	81.825
		0.1	0.6	0.3	90.025	66.817	66.817	85.825	85.825	90.025
		0.1	0.7	0.2	98.225	73.517	73.517	93.325	93.325	98.225
		0.1	0.8	0.1	106.425	80.217	80.217	100.825	100.825	106.425
		0.2	0.1	0.7	53.850	38.933	38.933	53.150	53.150	53.850
		0.2	0.2	0.6	62.050	45.633	45.633	60.650	60.650	62.050
		0.2	0.3	0.5	70.250	52.333	52.333	68.150	68.150	70.250
		0.2	0.4	0.4	78.450	59.033	59.033	75.650	75.650	78.450
		0.2	0.5	0.3	86.650	65.733	65.733	83.150	83.150	86.650
		0.2	0.6	0.2	94.850	72.433	72.433	90.650	90.650	94.850
		0.2	0.7	0.1	103.050	79.133	79.133	98.150	98.150	103.050
		0.3	0.1	0.6	58.675	44.550	44.550	57.975	57.975	58.675
		0.3	0.2	0.5	66.875	51.250	51.250	65.475	65.475	66.875
		0.3	0.3	0.4	75.075	57.950	57.950	72.975	72.975	75.075
		0.3	0.4	0.3	83.275	64.650	64.650	80.475	80.475	83.275
		0.3	0.5	0.2	91.475	71.350	71.350	87.975	87.975	91.475
		0.3	0.6	0.1	99.675	78.050	78.050	95.475	95.475	99.675
		0.4	0.1	0.5	63.500	50.167	50.167	62.800	62.800	63.500
		0.4	0.2	0.4	71.700	56.867	56.867	70.300	70.300	71.700
		0.4	0.3	0.3	79.900	63.567	63.567	77.800	77.800	79.900
		0.4	0.4	0.2	88.100	70.267	70.267	85.300	85.300	88.100
		0.4	0.5	0.1	96.300	76.967	76.967	92.800	92.800	96.300
		0.5	0.1	0.4	68.325	55.783	55.783	67.625	67.625	68.325
		0.5	0.2	0.3	76.525	62.483	62.483	75.125	75.125	76.525
		0.5	0.3	0.2	84.725	69.183	69.183	82.625	82.625	84.725
		0.5	0.4	0.1	92.925	75.883	75.883	90.125	90.125	92.925
		0.6	0.1	0.3	73.150	61.400	61.400	72.450	72.450	73.150
		0.6	0.2	0.2	81.350	68.100	68.100	79.950	79.950	81.350
		0.6	0.3	0.1	89.550	74.800	74.800	87.450	87.450	89.550
		0.7	0.1	0.2	77.975	67.017	67.017	77.275	77.275	77.975
		0.7	0.2	0.1	86.175	73.717	73.717	84.775	84.775	86.175
		0.8	0.1	0.1	82.800	72.633	72.633	82.100	82.100	82.800
		SUM			2859.00	2234.00	2234.00	2775.00	2775.00	2859.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
16	4	0.1	0.1	0.8	36.608	35.942	35.642	35.308	35.308	36.608
		0.1	0.2	0.7	41.808	39.842	39.542	39.208	39.208	41.808
		0.1	0.3	0.6	47.008	43.742	43.442	43.108	43.108	47.008
		0.1	0.4	0.5	52.208	47.642	47.342	47.008	47.008	52.208
		0.1	0.5	0.4	57.408	51.542	51.242	50.908	50.908	57.408
		0.1	0.6	0.3	62.608	55.442	55.142	54.808	54.808	62.608
		0.1	0.7	0.2	67.808	59.342	59.042	58.708	58.708	67.808
		0.1	0.8	0.1	73.008	63.242	62.942	62.608	62.608	73.008
		0.2	0.1	0.7	40.017	39.983	39.383	38.717	38.717	40.017
		0.2	0.2	0.6	45.217	43.883	43.283	42.617	42.617	45.217
		0.2	0.3	0.5	50.417	47.783	47.183	46.517	46.517	50.417
		0.2	0.4	0.4	55.617	51.683	51.083	50.417	50.417	55.617
		0.2	0.5	0.3	60.817	55.583	54.983	54.317	54.317	60.817
		0.2	0.6	0.2	66.017	59.483	58.883	58.217	58.217	66.017
		0.2	0.7	0.1	71.217	63.383	62.783	62.117	62.117	71.217
		0.3	0.1	0.6	43.425	44.025	43.125	42.125	42.125	43.425
		0.3	0.2	0.5	48.625	47.925	47.025	46.025	46.025	48.625
		0.3	0.3	0.4	53.825	51.825	50.925	49.925	49.925	53.825
		0.3	0.4	0.3	59.025	55.725	54.825	53.825	53.825	59.025
		0.3	0.5	0.2	64.225	59.625	58.725	57.725	57.725	64.225
		0.3	0.6	0.1	69.425	63.525	62.625	61.625	61.625	69.425
		0.4	0.1	0.5	46.833	48.067	46.867	45.533	45.533	46.833
		0.4	0.2	0.4	52.033	51.967	50.767	49.433	49.433	52.033
		0.4	0.3	0.3	57.233	55.867	54.667	53.333	53.333	57.233
		0.4	0.4	0.2	62.433	59.767	58.567	57.233	57.233	62.433
		0.4	0.5	0.1	67.633	63.667	62.467	61.133	61.133	67.633
		0.5	0.1	0.4	50.242	52.108	50.608	48.942	48.942	50.242
		0.5	0.2	0.3	55.442	56.008	54.508	52.842	52.842	55.442
		0.5	0.3	0.2	60.642	59.908	58.408	56.742	56.742	60.642
		0.5	0.4	0.1	65.842	63.808	62.308	60.642	60.642	65.842
		0.6	0.1	0.3	53.650	56.150	54.350	52.350	52.350	53.650
		0.6	0.2	0.2	58.850	60.050	58.250	56.250	56.250	58.850
		0.6	0.3	0.1	64.050	63.950	62.150	60.150	60.150	64.050
		0.7	0.1	0.2	57.058	60.192	58.092	55.758	55.758	57.058
		0.7	0.2	0.1	62.258	64.092	61.992	59.658	59.658	62.258
		0.8	0.1	0.1	60.467	64.233	61.833	59.167	59.167	60.467
		SUM			2041.00	1961.00	1926.00	1885.00	1885.00	2041.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
16	5	0.1	0.1	0.8	37.367	36.933	36.617	36.267	36.267	37.367
		0.1	0.2	0.7	43.067	41.533	41.217	40.867	40.867	43.067
		0.1	0.3	0.6	48.767	46.133	45.817	45.467	45.467	48.767
		0.1	0.4	0.5	54.467	50.733	50.417	50.067	50.067	54.467
		0.1	0.5	0.4	60.167	55.333	55.017	54.667	54.667	60.167
		0.1	0.6	0.3	65.867	59.933	59.617	59.267	59.267	65.867
		0.1	0.7	0.2	71.567	64.533	64.217	63.867	63.867	71.567
		0.1	0.8	0.1	77.267	69.133	68.817	68.467	68.467	77.267
		0.2	0.1	0.7	41.033	41.267	40.633	39.933	39.933	41.033
		0.2	0.2	0.6	46.733	45.867	45.233	44.533	44.533	46.733
		0.2	0.3	0.5	52.433	50.467	49.833	49.133	49.133	52.433
		0.2	0.4	0.4	58.133	55.067	54.433	53.733	53.733	58.133
		0.2	0.5	0.3	63.833	59.667	59.033	58.333	58.333	63.833
		0.2	0.6	0.2	69.533	64.267	63.633	62.933	62.933	69.533
		0.2	0.7	0.1	75.233	68.867	68.233	67.533	67.533	75.233
		0.3	0.1	0.6	44.700	45.600	44.650	43.600	43.600	44.700
		0.3	0.2	0.5	50.400	50.200	49.250	48.200	48.200	50.400
		0.3	0.3	0.4	56.100	54.800	53.850	52.800	52.800	56.100
		0.3	0.4	0.3	61.800	59.400	58.450	57.400	57.400	61.800
		0.3	0.5	0.2	67.500	64.000	63.050	62.000	62.000	67.500
		0.3	0.6	0.1	73.200	68.600	67.650	66.600	66.600	73.200
		0.4	0.1	0.5	48.367	49.933	48.667	47.267	47.267	48.367
		0.4	0.2	0.4	54.067	54.533	53.267	51.867	51.867	54.067
		0.4	0.3	0.3	59.767	59.133	57.867	56.467	56.467	59.767
		0.4	0.4	0.2	65.467	63.733	62.467	61.067	61.067	65.467
		0.4	0.5	0.1	71.167	68.333	67.067	65.667	65.667	71.167
		0.5	0.1	0.4	52.033	54.267	52.683	50.933	50.933	52.033
		0.5	0.2	0.3	57.733	58.867	57.283	55.533	55.533	57.733
		0.5	0.3	0.2	63.433	63.467	61.883	60.133	60.133	63.433
		0.5	0.4	0.1	69.133	68.067	66.483	64.733	64.733	69.133
		0.6	0.1	0.3	55.700	58.600	56.700	54.600	54.600	55.700
		0.6	0.2	0.2	61.400	63.200	61.300	59.200	59.200	61.400
		0.6	0.3	0.1	67.100	67.800	65.900	63.800	63.800	67.100
		0.7	0.1	0.2	59.367	62.933	60.717	58.267	58.267	59.367
		0.7	0.2	0.1	65.067	67.533	66.317	62.867	62.867	65.067
		0.8	0.1	0.1	63.033	67.267	64.733	61.933	61.933	63.033
		SUM			2132.00	2080.00	2042.00	2000.00	2000.00	2132.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
16	6	0.1	0.1	0.8	38.125	37.925	37.592	37.225	37.225	38.125
		0.1	0.2	0.7	44.325	43.225	42.892	42.525	42.525	44.325
		0.1	0.3	0.6	50.525	48.525	48.192	47.825	47.825	50.525
		0.1	0.4	0.5	56.725	53.825	53.492	53.125	53.125	56.725
		0.1	0.5	0.4	62.925	59.125	58.792	58.425	58.425	62.925
		0.1	0.6	0.3	69.125	64.425	64.092	63.725	63.725	69.125
		0.1	0.7	0.2	75.325	69.725	69.392	69.025	69.025	75.325
		0.1	0.8	0.1	81.525	75.025	74.692	74.325	74.325	81.525
		0.2	0.1	0.7	42.050	42.550	41.883	41.150	41.150	42.050
		0.2	0.2	0.6	48.250	47.850	47.183	46.450	46.450	48.250
		0.2	0.3	0.5	54.450	53.150	52.483	51.750	51.750	54.450
		0.2	0.4	0.4	60.650	58.450	57.783	57.050	57.050	60.650
		0.2	0.5	0.3	66.850	63.750	63.083	62.350	62.350	66.850
		0.2	0.6	0.2	73.050	69.050	68.383	67.650	67.650	73.050
		0.2	0.7	0.1	79.250	74.350	73.683	72.950	72.950	79.250
		0.3	0.1	0.6	45.975	47.175	46.175	45.075	45.075	45.975
		0.3	0.2	0.5	52.175	52.475	51.475	50.375	50.375	52.175
		0.3	0.3	0.4	58.375	57.775	56.775	55.675	55.675	58.375
		0.3	0.4	0.3	64.575	63.075	62.075	60.975	60.975	64.575
		0.3	0.5	0.2	70.775	68.375	67.375	66.275	66.275	70.775
		0.3	0.6	0.1	76.975	73.675	72.675	71.575	71.575	76.975
		0.4	0.1	0.5	49.900	51.800	50.467	49.000	49.000	49.900
		0.4	0.2	0.4	56.100	57.100	55.767	54.300	54.300	56.100
		0.4	0.3	0.3	62.300	62.400	61.067	59.600	59.600	62.300
		0.4	0.4	0.2	68.500	67.700	66.367	64.900	64.900	68.500
		0.4	0.5	0.1	74.700	73.000	71.667	70.200	70.200	74.700
		0.5	0.1	0.4	53.825	56.425	54.758	52.925	52.925	53.825
		0.5	0.2	0.3	60.025	61.725	60.058	58.225	58.225	60.025
		0.5	0.3	0.2	66.225	67.025	65.358	63.525	63.525	66.225
		0.5	0.4	0.1	72.425	72.325	70.658	68.825	68.825	72.425
		0.6	0.1	0.3	57.750	61.050	59.050	56.850	56.850	57.750
		0.6	0.2	0.2	63.950	66.350	64.350	62.150	62.150	63.950
		0.6	0.3	0.1	70.150	71.650	69.650	67.450	67.450	70.150
		0.7	0.1	0.2	61.675	65.675	63.342	60.775	60.775	61.675
		0.7	0.2	0.1	67.875	70.975	68.642	66.075	66.075	67.875
		0.8	0.1	0.1	65.600	70.300	67.633	64.700	64.700	65.600
		SUM			2223.00	2199.00	2159.00	2115.00	2115.00	2223.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
16	7	0.1	0.1	0.8	38.883	38.917	38.567	38.183	38.183	38.883
		0.1	0.2	0.7	45.583	44.917	44.567	44.183	44.183	45.583
		0.1	0.3	0.6	52.283	50.917	50.567	50.183	50.183	52.283
		0.1	0.4	0.5	58.983	56.917	56.567	56.183	56.183	58.983
		0.1	0.5	0.4	65.683	62.917	62.567	62.183	62.183	65.683
		0.1	0.6	0.3	72.383	68.917	68.567	68.183	68.183	72.383
		0.1	0.7	0.2	79.083	74.917	74.567	74.183	74.183	79.083
		0.1	0.8	0.1	85.783	80.917	80.567	80.183	80.183	85.783
		0.2	0.1	0.7	43.067	43.833	43.133	42.367	42.367	43.067
		0.2	0.2	0.6	49.767	49.833	49.133	48.367	48.367	49.767
		0.2	0.3	0.5	56.467	55.833	55.133	54.367	54.367	56.467
		0.2	0.4	0.4	63.167	61.833	61.133	60.367	60.367	63.167
		0.2	0.5	0.3	69.867	67.833	67.133	66.367	66.367	69.867
		0.2	0.6	0.2	76.567	73.833	73.133	72.367	72.367	76.567
		0.2	0.7	0.1	83.267	79.833	79.133	78.367	78.367	83.267
		0.3	0.1	0.6	47.250	48.750	47.700	46.550	46.550	47.250
		0.3	0.2	0.5	53.950	54.750	53.700	52.550	52.550	53.950
		0.3	0.3	0.4	60.650	60.750	59.700	58.550	58.550	60.650
		0.3	0.4	0.3	67.350	66.750	65.700	64.550	64.550	67.350
		0.3	0.5	0.2	74.050	72.750	71.700	70.550	70.550	74.050
		0.3	0.6	0.1	80.750	78.750	77.700	76.550	76.550	80.750
		0.4	0.1	0.5	51.433	53.667	52.267	50.733	50.733	51.433
		0.4	0.2	0.4	58.133	59.667	58.267	56.733	56.733	58.133
		0.4	0.3	0.3	64.833	65.667	64.267	62.733	62.733	64.833
		0.4	0.4	0.2	71.533	71.667	70.267	68.733	68.733	71.533
		0.4	0.5	0.1	78.233	77.667	76.267	74.733	74.733	78.233
		0.5	0.1	0.4	55.617	58.583	56.833	54.917	54.917	55.617
		0.5	0.2	0.3	62.317	64.583	62.833	60.917	60.917	62.317
		0.5	0.3	0.2	69.017	70.583	68.833	66.917	66.917	69.017
		0.5	0.4	0.1	75.717	76.583	74.833	72.917	72.917	75.717
		0.6	0.1	0.3	59.800	63.500	61.400	59.100	59.100	59.800
		0.6	0.2	0.2	66.500	69.500	67.400	65.100	65.100	66.500
		0.6	0.3	0.1	73.200	75.500	73.400	71.100	71.100	73.200
		0.7	0.1	0.2	63.983	68.417	65.967	63.283	63.283	63.983
		0.7	0.2	0.1	70.683	74.417	71.967	69.283	69.283	70.683
		0.8	0.1	0.1	68.167	73.333	70.533	67.467	67.467	68.167
		SUM			2314.00	2318.00	2276.00	2230.00	2230.00	2314.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
16	8	0.1	0.1	0.8	39.642	39.908	39.542	39.142	39.142	39.642
		0.1	0.2	0.7	46.842	46.608	46.242	45.842	45.842	46.842
		0.1	0.3	0.6	54.042	53.308	52.942	52.542	52.542	54.042
		0.1	0.4	0.5	61.242	60.008	59.642	59.242	59.242	61.242
		0.1	0.5	0.4	68.442	66.708	66.342	65.942	65.942	68.442
		0.1	0.6	0.3	75.642	73.408	73.042	72.642	72.642	75.642
		0.1	0.7	0.2	82.842	80.108	79.742	79.342	79.342	82.842
		0.1	0.8	0.1	90.042	86.808	86.442	86.042	86.042	90.042
		0.2	0.1	0.7	44.083	45.117	44.383	43.583	43.583	44.083
		0.2	0.2	0.6	51.283	51.817	51.083	50.283	50.283	51.283
		0.2	0.3	0.5	58.483	58.517	57.783	56.983	56.983	58.483
		0.2	0.4	0.4	65.683	65.217	64.483	63.683	63.683	65.683
		0.2	0.5	0.3	72.883	71.917	71.183	70.383	70.383	72.883
		0.2	0.6	0.2	80.083	78.617	77.883	77.083	77.083	80.083
		0.2	0.7	0.1	87.283	85.317	84.583	83.783	83.783	87.283
		0.3	0.1	0.6	48.525	50.325	49.225	48.025	48.025	48.525
		0.3	0.2	0.5	55.725	57.025	55.925	54.725	54.725	55.725
		0.3	0.3	0.4	62.925	63.725	62.625	61.425	61.425	62.925
		0.3	0.4	0.3	70.125	70.425	69.325	68.125	68.125	70.125
		0.3	0.5	0.2	77.325	77.125	76.025	74.825	74.825	77.325
		0.3	0.6	0.1	84.525	83.825	82.725	81.525	81.525	84.525
		0.4	0.1	0.5	52.967	56.533	54.067	52.467	52.467	52.967
		0.4	0.2	0.4	60.167	62.233	60.767	59.167	59.167	60.167
		0.4	0.3	0.3	67.367	68.933	67.467	65.867	65.867	67.367
		0.4	0.4	0.2	74.567	75.633	74.167	72.567	72.567	74.567
		0.4	0.5	0.1	81.767	82.333	80.867	79.267	79.267	81.767
		0.5	0.1	0.4	57.408	60.742	58.908	56.908	56.908	57.408
		0.5	0.2	0.3	64.608	67.442	65.608	63.608	63.608	64.608
		0.5	0.3	0.2	71.808	74.142	72.308	70.308	70.308	71.808
		0.5	0.4	0.1	79.008	80.842	79.008	77.008	77.008	79.008
		0.6	0.1	0.3	61.850	65.950	63.750	61.350	61.350	61.850
		0.6	0.2	0.2	69.050	72.650	70.450	68.050	68.050	69.050
		0.6	0.3	0.1	76.250	79.350	77.150	74.750	74.750	76.250
		0.7	0.1	0.2	66.292	71.158	68.592	65.792	65.792	66.292
		0.7	0.2	0.1	73.492	77.858	75.292	72.492	72.492	73.492
		0.8	0.1	0.1	70.733	76.367	73.433	70.233	70.233	70.733
		SUM			2405.00	2437.00	2393.00	2345.00	2345.00	2405.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
17	4	0.1	0.1	0.8	26.633	42.533	25.908	25.708	41.867	26.633
		0.1	0.2	0.7	31.233	46.433	29.408	29.208	45.767	31.233
		0.1	0.3	0.6	35.833	50.333	32.908	32.708	49.667	35.833
		0.1	0.4	0.5	40.433	54.233	36.408	36.208	53.567	40.433
		0.1	0.5	0.4	45.033	58.133	39.908	39.708	57.467	45.033
		0.1	0.6	0.3	49.633	62.033	43.408	43.208	61.367	49.633
		0.1	0.7	0.2	54.233	65.933	46.908	46.708	65.267	54.233
		0.1	0.8	0.1	58.833	69.833	50.408	50.208	69.167	58.833
		0.2	0.1	0.7	30.667	46.167	30.317	29.917	44.833	30.667
		0.2	0.2	0.6	35.267	50.067	33.817	33.417	48.733	35.267
		0.2	0.3	0.5	39.867	53.967	37.317	36.917	52.633	39.867
		0.2	0.4	0.4	44.467	57.867	40.817	40.417	56.533	44.467
		0.2	0.5	0.3	49.067	61.767	44.317	43.917	60.433	49.067
		0.2	0.6	0.2	53.667	65.667	47.817	47.417	64.333	53.667
		0.2	0.7	0.1	58.267	69.567	51.317	50.917	68.233	58.267
		0.3	0.1	0.6	34.700	49.800	34.725	34.125	47.800	34.700
		0.3	0.2	0.5	39.300	53.700	38.225	37.625	51.700	39.300
		0.3	0.3	0.4	43.900	57.600	41.725	41.125	55.600	43.900
		0.3	0.4	0.3	48.500	61.500	45.225	44.625	59.500	48.500
		0.3	0.5	0.2	53.100	65.400	48.725	48.125	63.400	53.100
		0.3	0.6	0.1	57.700	69.300	52.225	51.625	67.300	57.700
		0.4	0.1	0.5	38.733	53.433	39.133	38.333	50.767	38.733
		0.4	0.2	0.4	43.333	57.333	42.633	41.833	54.667	43.333
		0.4	0.3	0.3	47.933	61.233	46.133	45.333	58.567	47.933
		0.4	0.4	0.2	52.533	65.133	49.633	48.833	62.467	52.533
		0.4	0.5	0.1	57.133	69.033	53.133	52.333	66.367	57.133
		0.5	0.1	0.4	42.767	57.067	43.542	42.542	53.733	42.767
		0.5	0.2	0.3	47.367	60.967	47.042	46.042	57.633	47.367
		0.5	0.3	0.2	51.967	64.867	50.542	49.542	61.533	51.967
		0.5	0.4	0.1	56.567	68.767	54.042	53.042	65.433	56.567
		0.6	0.1	0.3	46.800	60.700	47.950	46.750	56.700	46.800
		0.6	0.2	0.2	51.400	64.600	51.450	50.250	60.600	51.400
		0.6	0.3	0.1	56.000	68.500	54.950	53.750	64.500	56.000
		0.7	0.1	0.2	50.833	64.333	52.358	50.958	59.667	50.833
		0.7	0.2	0.1	55.433	68.233	55.858	54.458	63.567	55.433
		0.8	0.1	0.1	54.867	67.967	56.767	55.167	62.633	54.867
		SUM			1684.00	2164.00	1597.00	1573.00	2084.00	1684.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
17	5	0.1	0.1	0.8	27.258	43.525	26.750	26.542	42.825	27.258
		0.1	0.2	0.7	32.258	48.125	30.850	30.642	47.425	32.258
		0.1	0.3	0.6	37.258	52.725	34.950	34.742	52.025	37.258
		0.1	0.4	0.5	42.258	57.325	39.050	38.842	56.625	42.258
		0.1	0.5	0.4	47.258	61.925	43.150	42.942	61.225	47.258
		0.1	0.6	0.3	52.258	66.525	47.250	47.042	65.825	52.258
		0.1	0.7	0.2	57.258	71.125	51.350	51.142	70.425	57.258
		0.1	0.8	0.1	62.258	75.725	55.450	55.242	75.025	62.258
		0.2	0.1	0.7	31.517	47.450	31.400	30.983	46.050	31.517
		0.2	0.2	0.6	36.517	52.050	35.500	35.083	50.650	36.517
		0.2	0.3	0.5	41.517	56.650	39.600	39.183	55.250	41.517
		0.2	0.4	0.4	46.517	61.250	43.700	43.283	59.850	46.517
		0.2	0.5	0.3	51.517	65.850	47.800	47.383	64.450	51.517
		0.2	0.6	0.2	56.517	70.450	51.900	51.483	69.050	56.517
		0.2	0.7	0.1	61.517	75.050	56.000	55.583	73.650	61.517
		0.3	0.1	0.6	35.775	51.375	36.050	35.425	49.275	35.775
		0.3	0.2	0.5	40.775	55.975	40.150	39.525	53.875	40.775
		0.3	0.3	0.4	45.775	60.575	44.250	43.625	58.475	45.775
		0.3	0.4	0.3	50.775	65.175	48.350	47.725	63.075	50.775
		0.3	0.5	0.2	55.775	69.775	52.450	51.825	67.675	55.775
		0.3	0.6	0.1	60.775	74.375	56.550	55.925	72.275	60.775
		0.4	0.1	0.5	40.033	55.300	40.700	39.867	52.500	40.033
		0.4	0.2	0.4	45.033	59.900	44.800	43.967	57.100	45.033
		0.4	0.3	0.3	50.033	64.500	48.900	48.067	61.700	50.033
		0.4	0.4	0.2	55.033	69.100	53.000	52.167	66.300	55.033
		0.4	0.5	0.1	60.033	73.700	57.100	56.267	70.900	60.033
		0.5	0.1	0.4	44.292	59.225	45.350	44.308	55.725	44.292
		0.5	0.2	0.3	49.292	63.825	49.450	48.408	60.325	49.292
		0.5	0.3	0.2	54.292	68.425	53.550	52.508	64.925	54.292
		0.5	0.4	0.1	59.292	73.025	57.650	56.608	69.525	59.292
		0.6	0.1	0.3	48.550	63.150	50.000	48.750	58.950	48.550
		0.6	0.2	0.2	53.550	67.750	54.100	52.850	63.550	53.550
		0.6	0.3	0.1	58.550	72.350	58.200	56.950	68.150	58.550
		0.7	0.1	0.2	52.808	67.075	54.650	53.192	62.175	52.808
		0.7	0.2	0.1	57.808	71.675	58.750	57.292	66.775	57.808
		0.8	0.1	0.1	57.067	71.000	59.300	57.633	65.400	57.067
		SUM			1759.00	2283.00	1698.00	1673.00	2199.00	1759.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
17	6	0.1	0.1	0.8	27.883	44.517	27.592	27.375	43.783	27.883
		0.1	0.2	0.7	33.283	49.817	32.292	32.075	49.083	33.283
		0.1	0.3	0.6	38.683	55.117	36.992	36.775	54.383	38.683
		0.1	0.4	0.5	44.083	60.417	41.692	41.475	59.683	44.083
		0.1	0.5	0.4	49.483	65.717	46.392	46.175	64.983	49.483
		0.1	0.6	0.3	54.883	71.017	51.092	50.875	70.283	54.883
		0.1	0.7	0.2	60.283	76.317	55.792	55.575	75.583	60.283
		0.1	0.8	0.1	65.683	81.617	60.492	60.275	80.883	65.683
		0.2	0.1	0.7	32.367	48.733	32.483	32.050	47.267	32.367
		0.2	0.2	0.6	37.767	54.033	37.183	36.750	52.567	37.767
		0.2	0.3	0.5	43.167	59.333	41.883	41.450	57.867	43.167
		0.2	0.4	0.4	48.567	64.633	46.583	46.150	63.167	48.567
		0.2	0.5	0.3	53.967	69.933	51.283	50.850	68.467	53.967
		0.2	0.6	0.2	59.367	75.233	55.983	55.550	73.767	59.367
		0.2	0.7	0.1	64.767	80.533	60.683	60.250	79.067	64.767
		0.3	0.1	0.6	36.850	52.950	37.375	36.725	50.750	36.850
		0.3	0.2	0.5	42.250	58.250	42.075	41.425	56.050	42.250
		0.3	0.3	0.4	47.650	63.550	46.775	46.125	61.350	47.650
		0.3	0.4	0.3	53.050	68.850	51.475	50.825	66.650	53.050
		0.3	0.5	0.2	58.450	74.150	56.175	55.525	71.950	58.450
		0.3	0.6	0.1	63.850	79.450	60.875	60.225	77.250	63.850
		0.4	0.1	0.5	41.333	57.167	42.267	41.400	54.233	41.333
		0.4	0.2	0.4	46.733	62.467	46.967	46.100	59.533	46.733
		0.4	0.3	0.3	52.133	67.767	51.667	50.800	64.833	52.133
		0.4	0.4	0.2	57.533	73.067	56.367	55.500	70.133	57.533
		0.4	0.5	0.1	62.933	78.367	61.067	60.200	75.433	62.933
		0.5	0.1	0.4	45.817	61.383	47.158	46.075	57.717	45.817
		0.5	0.2	0.3	51.217	66.683	51.858	50.775	63.017	51.217
		0.5	0.3	0.2	56.617	71.983	56.558	55.475	68.317	56.617
		0.5	0.4	0.1	62.017	77.283	61.258	60.175	73.617	62.017
		0.6	0.1	0.3	50.300	65.600	52.050	50.750	61.200	50.300
		0.6	0.2	0.2	55.700	70.900	56.750	55.450	66.500	55.700
		0.6	0.3	0.1	61.100	76.200	61.450	60.150	71.800	61.100
		0.7	0.1	0.2	54.783	69.817	56.942	55.425	64.683	54.783
		0.7	0.2	0.1	60.183	75.117	61.642	60.125	69.983	60.183
		0.8	0.1	0.1	59.267	74.033	61.833	60.100	68.167	59.267
		SUM			1834.00	2402.00	1799.00	1773.00	2314.00	1834.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
17	7	0.1	0.1	0.8	28.508	45.508	28.433	28.208	44.742	28.508
		0.1	0.2	0.7	34.308	51.508	33.733	33.508	50.742	34.308
		0.1	0.3	0.6	40.108	57.508	39.033	38.808	56.742	40.108
		0.1	0.4	0.5	45.908	63.508	44.333	44.108	62.742	45.908
		0.1	0.5	0.4	51.708	69.508	49.633	49.408	68.742	51.708
		0.1	0.6	0.3	57.508	75.508	54.933	54.708	74.742	57.508
		0.1	0.7	0.2	63.308	81.508	60.233	60.008	80.742	63.308
		0.1	0.8	0.1	69.108	87.508	65.533	65.308	86.742	69.108
		0.2	0.1	0.7	33.217	50.017	33.567	33.117	48.483	33.217
		0.2	0.2	0.6	39.017	56.017	38.867	38.417	54.483	39.017
		0.2	0.3	0.5	44.817	62.017	44.167	43.717	60.483	44.817
		0.2	0.4	0.4	50.617	68.017	49.467	49.017	66.483	50.617
		0.2	0.5	0.3	56.417	74.017	54.767	54.317	72.483	56.417
		0.2	0.6	0.2	62.217	80.017	60.067	59.617	78.483	62.217
		0.2	0.7	0.1	68.017	86.017	65.367	64.917	84.483	68.017
		0.3	0.1	0.6	37.925	54.525	38.700	38.025	52.225	37.925
		0.3	0.2	0.5	43.725	60.525	44.000	43.325	58.225	43.725
		0.3	0.3	0.4	49.525	66.525	49.300	48.625	64.225	49.525
		0.3	0.4	0.3	55.325	72.525	54.600	53.925	70.225	55.325
		0.3	0.5	0.2	61.125	78.525	59.900	59.225	76.225	61.125
		0.3	0.6	0.1	66.925	84.525	65.200	64.525	82.225	66.925
		0.4	0.1	0.5	42.633	59.033	43.833	42.933	55.967	42.633
		0.4	0.2	0.4	48.433	65.033	49.133	48.233	61.967	48.433
		0.4	0.3	0.3	54.233	71.033	54.433	53.533	67.967	54.233
		0.4	0.4	0.2	60.033	77.033	59.733	58.833	73.967	60.033
		0.4	0.5	0.1	65.833	83.033	65.033	64.133	79.967	65.833
		0.5	0.1	0.4	47.342	63.542	48.967	47.842	59.708	47.342
		0.5	0.2	0.3	53.142	69.542	54.267	53.142	65.708	53.142
		0.5	0.3	0.2	58.942	75.542	59.567	58.442	71.708	58.942
		0.5	0.4	0.1	64.742	81.542	64.867	63.742	77.708	64.742
		0.6	0.1	0.3	52.050	68.050	54.100	52.750	63.450	52.050
		0.6	0.2	0.2	57.850	74.050	59.400	58.050	69.450	57.850
		0.6	0.3	0.1	63.650	80.050	64.700	63.350	75.450	63.650
		0.7	0.1	0.2	56.758	72.558	59.233	57.658	67.192	56.758
		0.7	0.2	0.1	62.558	78.558	64.533	62.958	73.192	62.558
		0.8	0.1	0.1	61.467	77.067	64.367	62.567	70.933	61.467
		SUM			1909.00	2521.00	1900.00	1873.00	2429.00	1909.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
17	8	0.1	0.1	0.8	29.133	46.500	29.275	29.042	45.700	29.133
		0.1	0.2	0.7	35.333	53.200	35.175	34.942	52.400	35.333
		0.1	0.3	0.6	41.533	59.900	41.075	40.842	59.100	41.533
		0.1	0.4	0.5	47.733	66.600	46.975	46.742	65.800	47.733
		0.1	0.5	0.4	53.933	73.300	52.875	52.642	72.500	53.933
		0.1	0.6	0.3	60.133	80.000	58.775	58.542	79.200	60.133
		0.1	0.7	0.2	66.333	86.700	64.675	64.442	85.900	66.333
		0.1	0.8	0.1	72.533	93.400	70.575	70.342	92.600	72.533
		0.2	0.1	0.7	34.067	51.300	34.650	34.183	49.700	34.067
		0.2	0.2	0.6	40.267	58.000	40.550	40.083	56.400	40.267
		0.2	0.3	0.5	46.467	64.700	46.450	45.983	63.100	46.467
		0.2	0.4	0.4	52.667	71.400	52.350	51.883	69.800	52.667
		0.2	0.5	0.3	58.867	78.100	58.250	57.783	76.500	58.867
		0.2	0.6	0.2	65.067	84.800	64.150	63.683	83.200	65.067
		0.2	0.7	0.1	71.267	91.500	70.050	69.583	89.900	71.267
		0.3	0.1	0.6	39.000	56.100	40.025	39.325	53.700	39.000
		0.3	0.2	0.5	45.200	62.800	45.925	45.225	60.400	45.200
		0.3	0.3	0.4	51.400	69.500	51.825	51.125	67.100	51.400
		0.3	0.4	0.3	57.600	76.200	57.725	57.025	73.800	57.600
		0.3	0.5	0.2	63.800	82.900	63.625	62.925	80.500	63.800
		0.3	0.6	0.1	70.000	89.600	69.525	68.825	87.200	70.000
		0.4	0.1	0.5	43.933	60.900	45.400	44.467	57.700	43.933
		0.4	0.2	0.4	50.133	67.600	51.300	50.367	64.400	50.133
		0.4	0.3	0.3	56.333	74.300	57.200	56.267	71.100	56.333
		0.4	0.4	0.2	62.533	81.000	63.100	62.167	77.800	62.533
		0.4	0.5	0.1	68.733	87.700	69.000	68.067	84.500	68.733
		0.5	0.1	0.4	48.867	65.700	50.775	49.608	61.700	48.867
		0.5	0.2	0.3	55.067	72.400	56.675	55.508	68.400	55.067
		0.5	0.3	0.2	61.267	79.100	62.575	61.408	75.100	61.267
		0.5	0.4	0.1	67.467	85.800	68.475	67.308	81.800	67.467
		0.6	0.1	0.3	53.800	70.500	56.150	54.750	65.700	53.800
		0.6	0.2	0.2	60.000	77.200	62.050	60.650	72.400	60.000
		0.6	0.3	0.1	66.200	83.900	67.950	66.550	79.100	66.200
		0.7	0.1	0.2	58.733	75.300	61.525	59.892	69.700	58.733
		0.7	0.2	0.1	64.933	82.000	67.425	65.792	76.400	64.933
		0.8	0.1	0.1	63.667	80.100	66.900	65.033	73.700	63.667
		SUM			1984.00	2640.00	2001.00	1973.00	2544.00	1984.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
16	4	0.1	0.1	0.8	32.058	31.175	31.158	31.175	31.158	32.058
		0.1	0.2	0.7	36.458	34.675	34.658	34.675	34.658	36.458
		0.1	0.3	0.6	40.858	38.175	38.158	38.175	38.158	40.858
		0.1	0.4	0.5	45.258	41.675	41.658	41.675	41.658	45.258
		0.1	0.5	0.4	49.658	45.175	45.158	45.175	45.158	49.658
		0.1	0.6	0.3	54.058	48.675	48.658	48.675	48.658	54.058
		0.1	0.7	0.2	58.458	52.175	52.158	52.175	52.158	58.458
		0.1	0.8	0.1	62.858	55.675	55.658	55.675	55.658	62.858
		0.2	0.1	0.7	35.717	34.850	34.817	34.850	34.817	35.717
		0.2	0.2	0.6	40.117	38.350	38.317	38.350	38.317	40.117
		0.2	0.3	0.5	44.517	41.850	41.817	41.850	41.817	44.517
		0.2	0.4	0.4	48.917	45.350	45.317	45.350	45.317	48.917
		0.2	0.5	0.3	53.317	48.850	48.817	48.850	48.817	53.317
		0.2	0.6	0.2	57.717	52.350	52.317	52.350	52.317	57.717
		0.2	0.7	0.1	62.117	55.850	55.817	55.850	55.817	62.117
		0.3	0.1	0.6	39.375	38.525	38.475	38.525	38.475	39.375
		0.3	0.2	0.5	43.775	42.025	41.975	42.025	41.975	43.775
		0.3	0.3	0.4	48.175	45.525	45.475	45.525	45.475	48.175
		0.3	0.4	0.3	52.575	49.025	48.975	49.025	48.975	52.575
		0.3	0.5	0.2	56.975	52.525	52.475	52.525	52.475	56.975
		0.3	0.6	0.1	61.375	56.025	55.975	56.025	55.975	61.375
		0.4	0.1	0.5	43.033	42.200	42.133	42.200	42.133	43.033
		0.4	0.2	0.4	47.433	45.700	45.633	45.700	45.633	47.433
		0.4	0.3	0.3	51.833	49.200	49.133	49.200	49.133	51.833
		0.4	0.4	0.2	56.233	52.700	52.633	52.700	52.633	56.233
		0.4	0.5	0.1	60.633	56.200	56.133	56.200	56.133	60.633
		0.5	0.1	0.4	46.692	45.875	45.792	45.875	45.792	46.692
		0.5	0.2	0.3	51.092	49.375	49.292	49.375	49.292	51.092
		0.5	0.3	0.2	55.492	52.875	52.792	52.875	52.792	55.492
		0.5	0.4	0.1	59.892	56.375	56.292	56.375	56.292	59.892
		0.6	0.1	0.3	50.350	49.550	49.450	49.550	49.450	50.350
		0.6	0.2	0.2	54.750	53.050	52.950	53.050	52.950	54.750
		0.6	0.3	0.1	59.150	56.550	56.450	56.550	56.450	59.150
		0.7	0.1	0.2	54.008	53.225	53.108	53.225	53.108	54.008
		0.7	0.2	0.1	58.408	56.725	56.608	56.725	56.608	58.408
		0.8	0.1	0.1	57.667	56.900	56.767	56.900	56.767	57.667
		SUM			1831.00	1725.00	1723.00	1725.00	1723.00	1831.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
18	5	0.1	0.1	0.8	32.683	32.000	31.983	32.000	31.983	32.683
		0.1	0.2	0.7	37.483	36.100	36.083	36.100	36.083	37.483
		0.1	0.3	0.6	42.283	40.200	40.183	40.200	40.183	42.283
		0.1	0.4	0.5	47.083	44.300	44.283	44.300	44.283	47.083
		0.1	0.5	0.4	51.883	48.400	48.383	48.400	48.383	51.883
		0.1	0.6	0.3	56.683	52.500	52.483	52.500	52.483	56.683
		0.1	0.7	0.2	61.483	56.600	56.583	56.600	56.583	61.483
		0.1	0.8	0.1	66.283	60.700	60.683	60.700	60.683	66.283
		0.2	0.1	0.7	36.567	35.900	35.867	35.900	35.867	36.567
		0.2	0.2	0.6	41.367	40.000	39.967	40.000	39.967	41.367
		0.2	0.3	0.5	46.167	44.100	44.067	44.100	44.067	46.167
		0.2	0.4	0.4	50.967	48.200	48.167	48.200	48.167	50.967
		0.2	0.5	0.3	55.767	52.300	52.267	52.300	52.267	55.767
		0.2	0.6	0.2	60.567	56.400	56.367	56.400	56.367	60.567
		0.2	0.7	0.1	65.367	60.500	60.467	60.500	60.467	65.367
		0.3	0.1	0.6	40.450	39.800	39.750	39.800	39.750	40.450
		0.3	0.2	0.5	45.250	43.900	43.850	43.900	43.850	45.250
		0.3	0.3	0.4	50.050	48.000	47.950	48.000	47.950	50.050
		0.3	0.4	0.3	54.850	52.100	52.050	52.100	52.050	54.850
		0.3	0.5	0.2	59.650	56.200	56.150	56.200	56.150	59.650
		0.3	0.6	0.1	64.450	60.300	60.250	60.300	60.250	64.450
		0.4	0.1	0.5	44.333	43.700	43.633	43.700	43.633	44.333
		0.4	0.2	0.4	49.133	47.800	47.733	47.800	47.733	49.133
		0.4	0.3	0.3	53.933	51.900	51.833	51.900	51.833	53.933
		0.4	0.4	0.2	58.733	56.000	55.933	56.000	55.933	58.733
		0.4	0.5	0.1	63.533	60.100	60.033	60.100	60.033	63.533
		0.5	0.1	0.4	48.217	47.600	47.517	47.600	47.517	48.217
		0.5	0.2	0.3	53.017	51.700	51.617	51.700	51.617	53.017
		0.5	0.3	0.2	57.817	55.800	55.717	55.800	55.717	57.817
		0.5	0.4	0.1	62.617	59.900	59.817	59.900	59.817	62.617
		0.6	0.1	0.3	52.100	51.500	51.400	51.500	51.400	52.100
		0.6	0.2	0.2	56.900	55.600	55.500	55.600	55.500	56.900
		0.6	0.3	0.1	61.700	59.700	59.600	59.700	59.600	61.700
		0.7	0.1	0.2	55.983	55.400	55.283	55.400	55.283	55.983
		0.7	0.2	0.1	60.783	59.500	59.383	59.500	59.383	60.783
		0.8	0.1	0.1	59.867	59.300	59.167	59.300	59.167	59.867
		SUM			1906.00	1824.00	1822.00	1824.00	1822.00	1906.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
18	6	0.1	0.1	0.8	33.308	32.825	32.808	32.825	32.808	33.308
		0.1	0.2	0.7	38.508	37.525	37.508	37.525	37.508	38.508
		0.1	0.3	0.6	43.708	42.225	42.208	42.225	42.208	43.708
		0.1	0.4	0.5	48.908	46.925	46.908	46.925	46.908	48.908
		0.1	0.5	0.4	54.108	51.625	51.608	51.625	51.608	54.108
		0.1	0.6	0.3	59.308	56.325	56.308	56.325	56.308	59.308
		0.1	0.7	0.2	64.508	61.025	61.008	61.025	61.008	64.508
		0.1	0.8	0.1	69.708	65.725	65.708	65.725	65.708	69.708
		0.2	0.1	0.7	37.417	36.950	36.917	36.950	36.917	37.417
		0.2	0.2	0.6	42.617	41.650	41.617	41.650	41.617	42.617
		0.2	0.3	0.5	47.817	46.350	46.317	46.350	46.317	47.817
		0.2	0.4	0.4	53.017	51.050	51.017	51.050	51.017	53.017
		0.2	0.5	0.3	58.217	55.750	55.717	55.750	55.717	58.217
		0.2	0.6	0.2	63.417	60.450	60.417	60.450	60.417	63.417
		0.2	0.7	0.1	68.617	65.150	65.117	65.150	65.117	68.617
		0.3	0.1	0.6	41.525	41.075	41.025	41.075	41.025	41.525
		0.3	0.2	0.5	46.725	45.775	45.725	45.775	45.725	46.725
		0.3	0.3	0.4	51.925	50.475	50.425	50.475	50.425	51.925
		0.3	0.4	0.3	57.125	55.175	55.125	55.175	55.125	57.125
		0.3	0.5	0.2	62.325	59.875	59.825	59.875	59.825	62.325
		0.3	0.6	0.1	67.525	64.575	64.525	64.575	64.525	67.525
		0.4	0.1	0.5	45.633	45.200	45.133	45.200	45.133	45.633
		0.4	0.2	0.4	50.833	49.900	49.833	49.900	49.833	50.833
		0.4	0.3	0.3	56.033	54.600	54.533	54.600	54.533	56.033
		0.4	0.4	0.2	61.233	59.300	59.233	59.300	59.233	61.233
		0.4	0.5	0.1	66.433	64.000	63.933	64.000	63.933	66.433
		0.5	0.1	0.4	49.742	49.325	49.242	49.325	49.242	49.742
		0.5	0.2	0.3	54.942	54.025	53.942	54.025	53.942	54.942
		0.5	0.3	0.2	60.142	58.725	58.642	58.725	58.642	60.142
		0.5	0.4	0.1	65.342	63.425	63.342	63.425	63.342	65.342
		0.6	0.1	0.3	53.850	53.450	53.350	53.450	53.350	53.850
		0.6	0.2	0.2	59.050	58.150	58.050	58.150	58.050	59.050
		0.6	0.3	0.1	64.250	62.850	62.750	62.850	62.750	64.250
		0.7	0.1	0.2	57.958	57.575	57.458	57.575	57.458	57.958
		0.7	0.2	0.1	63.158	62.275	62.158	62.275	62.158	63.158
		0.8	0.1	0.1	62.067	61.700	61.567	61.700	61.567	62.067
		SUM			1981.00	1923.00	1921.00	1923.00	1921.00	1981.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
18	7	0.1	0.1	0.8	33.933	33.650	33.633	33.650	33.633	33.933
		0.1	0.2	0.7	39.533	38.950	38.933	38.950	38.933	39.533
		0.1	0.3	0.6	45.133	44.250	44.233	44.250	44.233	45.133
		0.1	0.4	0.5	50.733	49.550	49.533	49.550	49.533	50.733
		0.1	0.5	0.4	56.333	54.850	54.833	54.850	54.833	56.333
		0.1	0.6	0.3	61.933	60.150	60.133	60.150	60.133	61.933
		0.1	0.7	0.2	67.533	65.450	65.433	65.450	65.433	67.533
		0.1	0.8	0.1	73.133	70.750	70.733	70.750	70.733	73.133
		0.2	0.1	0.7	38.267	38.000	37.967	38.000	37.967	38.267
		0.2	0.2	0.6	43.867	43.300	43.267	43.300	43.267	43.867
		0.2	0.3	0.5	49.467	48.600	48.567	48.600	48.567	49.467
		0.2	0.4	0.4	55.067	53.900	53.867	53.900	53.867	55.067
		0.2	0.5	0.3	60.667	59.200	59.167	59.200	59.167	60.667
		0.2	0.6	0.2	66.267	64.500	64.467	64.500	64.467	66.267
		0.2	0.7	0.1	71.867	69.800	69.767	69.800	69.767	71.867
		0.3	0.1	0.6	42.600	42.350	42.300	42.350	42.300	42.600
		0.3	0.2	0.5	48.200	47.650	47.600	47.650	47.600	48.200
		0.3	0.3	0.4	53.800	52.950	52.900	52.950	52.900	53.800
		0.3	0.4	0.3	59.400	58.250	58.200	58.250	58.200	59.400
		0.3	0.5	0.2	65.000	63.550	63.500	63.550	63.500	65.000
		0.3	0.6	0.1	70.600	68.850	68.800	68.850	68.800	70.600
		0.4	0.1	0.5	46.933	46.700	46.633	46.700	46.633	46.933
		0.4	0.2	0.4	52.533	52.000	51.933	52.000	51.933	52.533
		0.4	0.3	0.3	58.133	57.300	57.233	57.300	57.233	58.133
		0.4	0.4	0.2	63.733	62.600	62.533	62.600	62.533	63.733
		0.4	0.5	0.1	69.333	67.900	67.833	67.900	67.833	69.333
		0.5	0.1	0.4	51.267	51.050	50.967	51.050	50.967	51.267
		0.5	0.2	0.3	56.867	56.350	56.267	56.350	56.267	56.867
		0.5	0.3	0.2	62.467	61.650	61.567	61.650	61.567	62.467
		0.5	0.4	0.1	68.067	66.950	66.867	66.950	66.867	68.067
		0.6	0.1	0.3	55.600	55.400	55.300	55.400	55.300	55.600
		0.6	0.2	0.2	61.200	60.700	60.600	60.700	60.600	61.200
		0.6	0.3	0.1	66.800	66.000	65.900	66.000	65.900	66.800
		0.7	0.1	0.2	59.933	59.750	59.633	59.750	59.633	59.933
		0.7	0.2	0.1	65.533	65.050	64.933	65.050	64.933	65.533
		0.8	0.1	0.1	64.267	64.100	63.967	64.100	63.967	64.267
		SUM			2056.00	2022.00	2020.00	2022.00	2020.00	2056.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
18	8	0.1	0.1	0.8	34.558	34.475	34.458	34.475	34.458	34.558
		0.1	0.2	0.7	40.558	40.375	40.358	40.375	40.358	40.558
		0.1	0.3	0.6	46.558	46.275	46.258	46.275	46.258	46.558
		0.1	0.4	0.5	52.558	52.175	52.158	52.175	52.158	52.558
		0.1	0.5	0.4	58.558	58.075	58.058	58.075	58.058	58.558
		0.1	0.6	0.3	64.558	63.975	63.958	63.975	63.958	64.558
		0.1	0.7	0.2	70.558	69.875	69.858	69.875	69.858	70.558
		0.1	0.8	0.1	76.558	75.775	75.758	75.775	75.758	76.558
		0.2	0.1	0.7	39.117	39.050	39.017	39.050	39.017	39.117
		0.2	0.2	0.6	45.117	44.950	44.917	44.950	44.917	45.117
		0.2	0.3	0.5	51.117	50.850	50.817	50.850	50.817	51.117
		0.2	0.4	0.4	57.117	56.750	56.717	56.750	56.717	57.117
		0.2	0.5	0.3	63.117	62.650	62.617	62.650	62.617	63.117
		0.2	0.6	0.2	69.117	68.550	68.517	68.550	68.517	69.117
		0.2	0.7	0.1	75.117	74.450	74.417	74.450	74.417	75.117
		0.3	0.1	0.6	43.675	43.625	43.575	43.625	43.575	43.675
		0.3	0.2	0.5	49.675	49.525	49.475	49.525	49.475	49.675
		0.3	0.3	0.4	55.675	55.425	55.375	55.425	55.375	55.675
		0.3	0.4	0.3	61.675	61.325	61.275	61.325	61.275	61.675
		0.3	0.5	0.2	67.675	67.225	67.175	67.225	67.175	67.675
		0.3	0.6	0.1	73.675	73.125	73.075	73.125	73.075	73.675
		0.4	0.1	0.5	48.233	48.200	48.133	48.200	48.133	48.233
		0.4	0.2	0.4	54.233	54.100	54.033	54.100	54.033	54.233
		0.4	0.3	0.3	60.233	60.000	59.933	60.000	59.933	60.233
		0.4	0.4	0.2	66.233	65.900	65.833	65.900	65.833	66.233
		0.4	0.5	0.1	72.233	71.800	71.733	71.800	71.733	72.233
		0.5	0.1	0.4	52.792	52.775	52.692	52.775	52.692	52.792
		0.5	0.2	0.3	58.792	58.675	58.592	58.675	58.592	58.792
		0.5	0.3	0.2	64.792	64.575	64.492	64.575	64.492	64.792
		0.5	0.4	0.1	70.792	70.475	70.392	70.475	70.392	70.792
		0.6	0.1	0.3	57.350	57.350	57.250	57.350	57.250	57.350
		0.6	0.2	0.2	63.350	63.250	63.150	63.250	63.150	63.350
		0.6	0.3	0.1	69.350	69.150	69.050	69.150	69.050	69.350
		0.7	0.1	0.2	61.908	61.925	61.808	61.925	61.808	61.908
		0.7	0.2	0.1	67.908	67.825	67.708	67.825	67.708	67.908
		0.8	0.1	0.1	66.467	66.500	66.367	66.500	66.367	66.467
		SUM			2131.00	2121.00	2119.00	2121.00	2119.00	2131.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
19	4	0.1	0.1	0.8	37.483	36.800	36.783	36.800	36.783	37.483
		0.1	0.2	0.7	41.683	40.300	40.283	40.300	40.283	41.683
		0.1	0.3	0.6	45.883	43.800	43.783	43.800	43.783	45.883
		0.1	0.4	0.5	50.083	47.300	47.283	47.300	47.283	50.083
		0.1	0.5	0.4	54.283	50.800	50.783	50.800	50.783	54.283
		0.1	0.6	0.3	58.483	54.300	54.283	54.300	54.283	58.483
		0.1	0.7	0.2	62.683	57.800	57.783	57.800	57.783	62.683
		0.1	0.8	0.1	66.883	61.300	61.283	61.300	61.283	66.883
		0.2	0.1	0.7	40.767	40.100	40.067	40.100	40.067	40.767
		0.2	0.2	0.6	44.967	43.600	43.567	43.600	43.567	44.967
		0.2	0.3	0.5	49.167	47.100	47.067	47.100	47.067	49.167
		0.2	0.4	0.4	53.367	50.600	50.567	50.600	50.567	53.367
		0.2	0.5	0.3	57.567	54.100	54.067	54.100	54.067	57.567
		0.2	0.6	0.2	61.767	57.600	57.567	57.600	57.567	61.767
		0.2	0.7	0.1	65.967	61.100	61.067	61.100	61.067	65.967
		0.3	0.1	0.6	44.050	43.400	43.350	43.400	43.350	44.050
		0.3	0.2	0.5	48.250	46.900	46.850	46.900	46.850	48.250
		0.3	0.3	0.4	52.450	50.400	50.350	50.400	50.350	52.450
		0.3	0.4	0.3	56.650	53.900	53.850	53.900	53.850	56.650
		0.3	0.5	0.2	60.850	57.400	57.350	57.400	57.350	60.850
		0.3	0.6	0.1	65.050	60.900	60.850	60.900	60.850	65.050
		0.4	0.1	0.5	47.333	46.700	46.633	46.700	46.633	47.333
		0.4	0.2	0.4	51.533	50.200	50.133	50.200	50.133	51.533
		0.4	0.3	0.3	55.733	53.700	53.633	53.700	53.633	55.733
		0.4	0.4	0.2	59.933	57.200	57.133	57.200	57.133	59.933
		0.4	0.5	0.1	64.133	60.700	60.633	60.700	60.633	64.133
		0.5	0.1	0.4	50.617	50.000	49.917	50.000	49.917	50.617
		0.5	0.2	0.3	54.817	53.500	53.417	53.500	53.417	54.817
		0.5	0.3	0.2	59.017	57.000	56.917	57.000	56.917	59.017
		0.5	0.4	0.1	63.217	60.500	60.417	60.500	60.417	63.217
		0.6	0.1	0.3	53.900	53.300	53.200	53.300	53.200	53.900
		0.6	0.2	0.2	58.100	56.800	56.700	56.800	56.700	58.100
		0.6	0.3	0.1	62.300	60.300	60.200	60.300	60.200	62.300
		0.7	0.1	0.2	57.183	56.600	56.483	56.600	56.483	57.183
		0.7	0.2	0.1	61.383	60.100	59.983	60.100	59.983	61.383
		0.8	0.1	0.1	60.467	59.900	59.767	59.900	59.767	60.467
		SUM			1978.00	1896.00	1894.00	1896.00	1894.00	1978.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
19	5	0.1	0.1	0.8	38.108	37.625	37.608	37.625	37.608	38.108
		0.1	0.2	0.7	42.708	41.725	41.708	41.725	41.708	42.708
		0.1	0.3	0.6	47.308	45.825	45.808	45.825	45.808	47.308
		0.1	0.4	0.5	51.908	49.925	49.908	49.925	49.908	51.908
		0.1	0.5	0.4	56.508	54.025	54.008	54.025	54.008	56.508
		0.1	0.6	0.3	61.108	58.125	58.108	58.125	58.108	61.108
		0.1	0.7	0.2	65.708	62.225	62.208	62.225	62.208	65.708
		0.1	0.8	0.1	70.308	66.325	66.308	66.325	66.308	70.308
		0.2	0.1	0.7	41.617	41.150	41.117	41.150	41.117	41.617
		0.2	0.2	0.6	46.217	45.250	45.217	45.250	45.217	46.217
		0.2	0.3	0.5	50.817	49.350	49.317	49.350	49.317	50.817
		0.2	0.4	0.4	55.417	53.450	53.417	53.450	53.417	55.417
		0.2	0.5	0.3	60.017	57.550	57.517	57.550	57.517	60.017
		0.2	0.6	0.2	64.617	61.650	61.617	61.650	61.617	64.617
		0.2	0.7	0.1	69.217	65.750	65.717	65.750	65.717	69.217
		0.3	0.1	0.6	45.125	44.675	44.625	44.675	44.625	45.125
		0.3	0.2	0.5	49.725	48.775	48.725	48.775	48.725	49.725
		0.3	0.3	0.4	54.325	52.875	52.825	52.875	52.825	54.325
		0.3	0.4	0.3	58.925	56.975	56.925	56.975	56.925	58.925
		0.3	0.5	0.2	63.525	61.075	61.025	61.075	61.025	63.525
		0.3	0.6	0.1	68.125	65.175	65.125	65.175	65.125	68.125
		0.4	0.1	0.5	48.633	48.200	48.133	48.200	48.133	48.633
		0.4	0.2	0.4	53.233	52.300	52.233	52.300	52.233	53.233
		0.4	0.3	0.3	57.833	56.400	56.333	56.400	56.333	57.833
		0.4	0.4	0.2	62.433	60.500	60.433	60.500	60.433	62.433
		0.4	0.5	0.1	67.033	64.600	64.533	64.600	64.533	67.033
		0.5	0.1	0.4	52.142	51.725	51.642	51.725	51.642	52.142
		0.5	0.2	0.3	56.742	55.825	55.742	55.825	55.742	56.742
		0.5	0.3	0.2	61.342	59.925	59.842	59.925	59.842	61.342
		0.5	0.4	0.1	65.942	64.025	63.942	64.025	63.942	65.942
		0.6	0.1	0.3	55.650	55.250	55.150	55.250	55.150	55.650
		0.6	0.2	0.2	60.250	59.350	59.250	59.350	59.250	60.250
		0.6	0.3	0.1	64.850	63.450	63.350	63.450	63.350	64.850
		0.7	0.1	0.2	59.158	58.775	58.658	58.775	58.658	59.158
		0.7	0.2	0.1	63.758	62.875	62.758	62.875	62.758	63.758
		0.8	0.1	0.1	62.667	62.300	62.167	62.300	62.167	62.667
		SUM			2053.00	1995.00	1993.00	1995.00	1993.00	2053.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
19	6	0.1	0.1	0.8	38.733	38.450	38.433	38.450	38.433	38.733
		0.1	0.2	0.7	43.733	43.150	43.133	43.150	43.133	43.733
		0.1	0.3	0.6	48.733	47.850	47.833	47.850	47.833	48.733
		0.1	0.4	0.5	53.733	52.550	52.533	52.550	52.533	53.733
		0.1	0.5	0.4	58.733	57.250	57.233	57.250	57.233	58.733
		0.1	0.6	0.3	63.733	61.950	61.933	61.950	61.933	63.733
		0.1	0.7	0.2	68.733	66.650	66.633	66.650	66.633	68.733
		0.1	0.8	0.1	73.733	71.350	71.333	71.350	71.333	73.733
		0.2	0.1	0.7	42.467	42.200	42.167	42.200	42.167	42.467
		0.2	0.2	0.6	47.467	46.900	46.867	46.900	46.867	47.467
		0.2	0.3	0.5	52.467	51.600	51.567	51.600	51.567	52.467
		0.2	0.4	0.4	57.467	56.300	56.267	56.300	56.267	57.467
		0.2	0.5	0.3	62.467	61.000	60.967	61.000	60.967	62.467
		0.2	0.6	0.2	67.467	65.700	65.667	65.700	65.667	67.467
		0.2	0.7	0.1	72.467	70.400	70.367	70.400	70.367	72.467
		0.3	0.1	0.6	46.200	45.950	45.900	45.950	45.900	46.200
		0.3	0.2	0.5	51.200	50.650	50.600	50.650	50.600	51.200
		0.3	0.3	0.4	56.200	55.350	55.300	55.350	55.300	56.200
		0.3	0.4	0.3	61.200	60.050	60.000	60.050	60.000	61.200
		0.3	0.5	0.2	66.200	64.750	64.700	64.750	64.700	66.200
		0.3	0.6	0.1	71.200	69.450	69.400	69.450	69.400	71.200
		0.4	0.1	0.5	49.933	49.700	49.633	49.700	49.633	49.933
		0.4	0.2	0.4	54.933	54.400	54.333	54.400	54.333	54.933
		0.4	0.3	0.3	59.933	59.100	59.033	59.100	59.033	59.933
		0.4	0.4	0.2	64.933	63.800	63.733	63.800	63.733	64.933
		0.4	0.5	0.1	69.933	68.500	68.433	68.500	68.433	69.933
		0.5	0.1	0.4	53.667	53.450	53.367	53.450	53.367	53.667
		0.5	0.2	0.3	58.667	58.150	58.067	58.150	58.067	58.667
		0.5	0.3	0.2	63.667	62.850	62.767	62.850	62.767	63.667
		0.5	0.4	0.1	68.667	67.550	67.467	67.550	67.467	68.667
		0.6	0.1	0.3	57.400	57.200	57.100	57.200	57.100	57.400
		0.6	0.2	0.2	62.400	61.900	61.800	61.900	61.800	62.400
		0.6	0.3	0.1	67.400	66.600	66.500	66.600	66.500	67.400
		0.7	0.1	0.2	61.133	60.950	60.833	60.950	60.833	61.133
		0.7	0.2	0.1	66.133	65.650	65.533	65.650	65.533	66.133
		0.8	0.1	0.1	64.867	64.700	64.567	64.700	64.567	64.867
		SUM			2128.00	2094.00	2092.00	2094.00	2092.00	2128.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
19	7	0.1	0.1	0.8	39.358	39.275	39.258	39.275	39.258	39.358
		0.1	0.2	0.7	44.758	44.575	44.558	44.575	44.558	44.758
		0.1	0.3	0.6	50.158	49.875	49.858	49.875	49.858	50.158
		0.1	0.4	0.5	55.558	55.175	55.158	55.175	55.158	55.558
		0.1	0.5	0.4	60.958	60.475	60.458	60.475	60.458	60.958
		0.1	0.6	0.3	66.358	65.775	65.758	65.775	65.758	66.358
		0.1	0.7	0.2	71.758	71.075	71.058	71.075	71.058	71.758
		0.1	0.8	0.1	77.158	76.375	76.358	76.375	76.358	77.158
		0.2	0.1	0.7	43.317	43.250	43.217	43.250	43.217	43.317
		0.2	0.2	0.6	48.717	48.550	48.517	48.550	48.517	48.717
		0.2	0.3	0.5	54.117	53.850	53.817	53.850	53.817	54.117
		0.2	0.4	0.4	59.517	59.150	59.117	59.150	59.117	59.517
		0.2	0.5	0.3	64.917	64.450	64.417	64.450	64.417	64.917
		0.2	0.6	0.2	70.317	69.750	69.717	69.750	69.717	70.317
		0.2	0.7	0.1	75.717	75.050	75.017	75.050	75.017	75.717
		0.3	0.1	0.6	47.275	47.225	47.175	47.225	47.175	47.275
		0.3	0.2	0.5	52.675	52.525	52.475	52.525	52.475	52.675
		0.3	0.3	0.4	58.075	57.825	57.775	57.825	57.775	58.075
		0.3	0.4	0.3	63.475	63.125	63.075	63.125	63.075	63.475
		0.3	0.5	0.2	68.875	68.425	68.375	68.425	68.375	68.875
		0.3	0.6	0.1	74.275	73.725	73.675	73.725	73.675	74.275
		0.4	0.1	0.5	51.233	51.200	51.133	51.200	51.133	51.233
		0.4	0.2	0.4	56.633	56.500	56.433	56.500	56.433	56.633
		0.4	0.3	0.3	62.033	61.800	61.733	61.800	61.733	62.033
		0.4	0.4	0.2	67.433	67.100	67.033	67.100	67.033	67.433
		0.4	0.5	0.1	72.833	72.400	72.333	72.400	72.333	72.833
		0.5	0.1	0.4	55.192	55.175	55.092	55.175	55.092	55.192
		0.5	0.2	0.3	60.592	60.475	60.392	60.475	60.392	60.592
		0.5	0.3	0.2	65.992	65.775	65.692	65.775	65.692	65.992
		0.5	0.4	0.1	71.392	71.075	70.992	71.075	70.992	71.392
		0.6	0.1	0.3	59.150	59.150	59.050	59.150	59.050	59.150
		0.6	0.2	0.2	64.550	64.450	64.350	64.450	64.350	64.550
		0.6	0.3	0.1	69.950	69.750	69.650	69.750	69.650	69.950
		0.7	0.1	0.2	63.108	63.125	63.008	63.125	63.008	63.108
		0.7	0.2	0.1	68.508	68.425	68.308	68.425	68.308	68.508
		0.8	0.1	0.1	67.067	67.100	66.967	67.100	66.967	67.067
		SUM			2203.00	2193.00	2191.00	2193.00	2191.00	2203.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
19	8	0.1	0.1	0.8	40.083	40.100	40.083	40.100	40.083	40.083
		0.1	0.2	0.7	45.983	46.000	45.983	46.000	45.983	45.983
		0.1	0.3	0.6	51.883	51.900	51.883	51.900	51.883	51.883
		0.1	0.4	0.5	57.783	57.800	57.783	57.800	57.783	57.783
		0.1	0.5	0.4	63.683	63.700	63.683	63.700	63.683	63.683
		0.1	0.6	0.3	69.583	69.600	69.583	69.600	69.583	69.583
		0.1	0.7	0.2	75.483	75.500	75.483	75.500	75.483	75.483
		0.1	0.8	0.1	81.383	81.400	81.383	81.400	81.383	81.383
		0.2	0.1	0.7	44.267	44.300	44.267	44.300	44.267	44.267
		0.2	0.2	0.6	50.167	50.200	50.167	50.200	50.167	50.167
		0.2	0.3	0.5	56.067	56.100	56.067	56.100	56.067	56.067
		0.2	0.4	0.4	61.967	62.000	61.967	62.000	61.967	61.967
		0.2	0.5	0.3	67.867	67.900	67.867	67.900	67.867	67.867
		0.2	0.6	0.2	73.767	73.800	73.767	73.800	73.767	73.767
		0.2	0.7	0.1	79.667	79.700	79.667	79.700	79.667	79.667
		0.3	0.1	0.6	48.450	48.500	48.450	48.500	48.450	48.450
		0.3	0.2	0.5	54.350	54.400	54.350	54.400	54.350	54.350
		0.3	0.3	0.4	60.250	60.300	60.250	60.300	60.250	60.250
		0.3	0.4	0.3	66.150	66.200	66.150	66.200	66.150	66.150
		0.3	0.5	0.2	72.050	72.100	72.050	72.100	72.050	72.050
		0.3	0.6	0.1	77.950	78.000	77.950	78.000	77.950	77.950
		0.4	0.1	0.5	52.633	52.700	52.633	52.700	52.633	52.633
		0.4	0.2	0.4	58.533	58.600	58.533	58.600	58.533	58.533
		0.4	0.3	0.3	64.433	64.500	64.433	64.500	64.433	64.433
		0.4	0.4	0.2	70.333	70.400	70.333	70.400	70.333	70.333
		0.4	0.5	0.1	76.233	76.300	76.233	76.300	76.233	76.233
		0.5	0.1	0.4	56.817	56.900	56.817	56.900	56.817	56.817
		0.5	0.2	0.3	62.717	62.800	62.717	62.800	62.717	62.717
		0.5	0.3	0.2	68.617	68.700	68.617	68.700	68.617	68.617
		0.5	0.4	0.1	74.517	74.600	74.517	74.600	74.517	74.517
		0.6	0.1	0.3	61.000	61.100	61.000	61.100	61.000	61.000
		0.6	0.2	0.2	66.900	67.000	66.900	67.000	66.900	66.900
		0.6	0.3	0.1	72.800	72.900	72.800	72.900	72.800	72.800
		0.7	0.1	0.2	65.183	65.300	65.183	65.300	65.183	65.183
		0.7	0.2	0.1	71.083	71.200	71.083	71.200	71.083	71.083
		0.8	0.1	0.1	69.367	69.500	69.367	69.500	69.367	69.367
		SUM			2290.00	2292.00	2290.00	2292.00	2290.00	2290.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
20	4	0.1	0.1	0.8	42.908	23.150	42.408	42.425	42.408	42.908
		0.1	0.2	0.7	46.908	26.250	45.908	45.925	45.908	46.908
		0.1	0.3	0.6	50.908	29.350	49.408	49.425	49.408	50.908
		0.1	0.4	0.5	54.908	32.450	52.908	52.925	52.908	54.908
		0.1	0.5	0.4	58.908	35.550	56.408	56.425	56.408	58.908
		0.1	0.6	0.3	62.908	38.650	59.908	59.925	59.908	62.908
		0.1	0.7	0.2	66.908	41.750	63.408	63.425	63.408	66.908
		0.1	0.8	0.1	70.908	44.850	66.908	66.925	66.908	70.908
		0.2	0.1	0.7	45.817	27.200	45.317	45.350	45.317	45.817
		0.2	0.2	0.6	49.817	30.300	48.817	48.850	48.817	49.817
		0.2	0.3	0.5	53.817	33.400	52.317	52.350	52.317	53.817
		0.2	0.4	0.4	57.817	36.500	55.817	55.850	55.817	57.817
		0.2	0.5	0.3	61.817	39.600	59.317	59.350	59.317	61.817
		0.2	0.6	0.2	65.817	42.700	62.817	62.850	62.817	65.817
		0.2	0.7	0.1	69.817	45.800	66.317	66.350	66.317	69.817
		0.3	0.1	0.6	48.725	31.250	48.225	48.275	48.225	48.725
		0.3	0.2	0.5	52.725	34.350	51.725	51.775	51.725	52.725
		0.3	0.3	0.4	56.725	37.450	55.225	55.275	55.225	56.725
		0.3	0.4	0.3	60.725	40.550	58.725	58.775	58.725	60.725
		0.3	0.5	0.2	64.725	43.650	62.225	62.275	62.225	64.725
		0.3	0.6	0.1	68.725	46.750	65.725	65.775	65.725	68.725
		0.4	0.1	0.5	51.633	35.300	51.133	51.200	51.133	51.633
		0.4	0.2	0.4	55.633	38.400	54.633	54.700	54.633	55.633
		0.4	0.3	0.3	59.633	41.500	58.133	58.200	58.133	59.633
		0.4	0.4	0.2	63.633	44.600	61.633	61.700	61.633	63.633
		0.4	0.5	0.1	67.633	47.700	65.133	65.200	65.133	67.633
		0.5	0.1	0.4	54.542	39.350	54.042	54.125	54.042	54.542
		0.5	0.2	0.3	58.542	42.450	57.542	57.625	57.542	58.542
		0.5	0.3	0.2	62.542	45.550	61.042	61.125	61.042	62.542
		0.5	0.4	0.1	66.542	48.650	64.542	64.625	64.542	66.542
		0.6	0.1	0.3	57.450	43.400	56.950	57.050	56.950	57.450
		0.6	0.2	0.2	61.450	46.500	60.450	60.550	60.450	61.450
		0.6	0.3	0.1	65.450	49.600	63.950	64.050	63.950	65.450
		0.7	0.1	0.2	60.358	47.450	59.858	59.975	59.858	60.358
		0.7	0.2	0.1	64.358	50.550	63.358	63.475	63.358	64.358
		0.8	0.1	0.1	63.267	51.500	62.767	62.900	62.767	63.267
		SUM			2125.00	1434.00	2065.00	2067.00	2065.00	2125.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
		0.1	0.1	0.8	43.533	23.833	43.233	43.250	43.233	43.533
		0.1	0.2	0.7	47.933	27.433	47.333	47.350	47.333	47.933
		0.1	0.3	0.6	52.333	31.033	51.433	51.450	51.433	52.333
		0.1	0.4	0.5	56.733	34.633	55.533	55.550	55.533	56.733
		0.1	0.5	0.4	61.133	38.233	59.633	59.650	59.633	61.133
		0.1	0.6	0.3	65.533	41.833	63.733	63.750	63.733	65.533
		0.1	0.7	0.2	69.933	45.433	67.833	67.850	67.833	69.933
		0.1	0.8	0.1	74.333	49.033	71.933	71.950	71.933	74.333
		0.2	0.1	0.7	46.667	28.067	46.367	46.400	46.367	46.667
		0.2	0.2	0.6	51.067	31.667	50.467	50.500	50.467	51.067
		0.2	0.3	0.5	55.467	35.267	54.567	54.600	54.567	55.467
		0.2	0.4	0.4	59.867	38.867	58.667	58.700	58.667	59.867
		0.2	0.5	0.3	64.267	42.467	62.767	62.800	62.767	64.267
		0.2	0.6	0.2	68.667	46.067	66.867	66.900	66.867	68.667
		0.2	0.7	0.1	73.067	49.667	70.967	71.000	70.967	73.067
		0.3	0.1	0.6	49.800	32.300	49.500	49.550	49.500	49.800
		0.3	0.2	0.5	54.200	35.900	53.600	53.650	53.600	54.200
		0.3	0.3	0.4	58.600	39.500	57.700	57.750	57.700	58.600
		0.3	0.4	0.3	63.000	43.100	61.800	61.850	61.800	63.000
		0.3	0.5	0.2	67.400	46.700	65.900	65.950	65.900	67.400
		0.3	0.6	0.1	71.800	50.300	70.000	70.050	70.000	71.800
		0.4	0.1	0.5	52.933	36.533	52.633	52.700	52.633	52.933
		0.4	0.2	0.4	57.333	40.133	56.733	56.800	56.733	57.333
		0.4	0.3	0.3	61.733	43.733	60.833	60.900	60.833	61.733
		0.4	0.4	0.2	66.133	47.333	64.933	65.000	64.933	66.133
		0.4	0.5	0.1	70.533	50.933	69.033	69.100	69.033	70.533
		0.5	0.1	0.4	56.067	40.767	55.767	55.850	55.767	56.067
		0.5	0.2	0.3	60.467	44.367	59.867	59.950	59.867	60.467
		0.5	0.3	0.2	64.867	47.967	63.967	64.050	63.967	64.867
		0.5	0.4	0.1	69.267	51.567	68.067	68.150	68.067	69.267
		0.6	0.1	0.3	59.200	45.000	58.900	59.000	58.900	59.200
		0.6	0.2	0.2	63.600	48.600	63.000	63.100	63.000	63.600
		0.6	0.3	0.1	68.000	52.200	67.100	67.200	67.100	68.000
		0.7	0.1	0.2	62.333	49.233	62.033	62.150	62.033	62.333
		0.7	0.2	0.1	66.733	52.833	66.133	66.250	66.133	66.733
		0.8	0.1	0.1	65.467	53.467	65.167	65.300	65.167	65.467
		SUM			2200.00	1516.00	2164.00	2166.00	2164.00	2200.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
20	6	0.1	0.1	0.8	44.158	24.517	44.058	44.075	44.058	44.158
		0.1	0.2	0.7	48.958	28.617	48.758	48.775	48.758	48.958
		0.1	0.3	0.6	53.758	32.717	53.458	53.475	53.458	53.758
		0.1	0.4	0.5	58.558	36.817	58.158	58.175	58.158	58.558
		0.1	0.5	0.4	63.358	40.917	62.858	62.875	62.858	63.358
		0.1	0.6	0.3	68.158	45.017	67.558	67.575	67.558	68.158
		0.1	0.7	0.2	72.958	49.117	72.258	72.275	72.258	72.958
		0.1	0.8	0.1	77.758	53.217	76.958	76.975	76.958	77.758
		0.2	0.1	0.7	47.517	28.933	47.417	47.450	47.417	47.517
		0.2	0.2	0.6	52.317	33.033	52.117	52.150	52.117	52.317
		0.2	0.3	0.5	57.117	37.133	56.817	56.850	56.817	57.117
		0.2	0.4	0.4	61.917	41.233	61.517	61.550	61.517	61.917
		0.2	0.5	0.3	66.717	45.333	66.217	66.250	66.217	66.717
		0.2	0.6	0.2	71.517	49.433	70.917	70.950	70.917	71.517
		0.2	0.7	0.1	76.317	53.533	75.617	75.650	75.617	76.317
		0.3	0.1	0.6	50.875	33.350	50.775	50.825	50.775	50.875
		0.3	0.2	0.5	55.675	37.450	55.475	55.525	55.475	55.675
		0.3	0.3	0.4	60.475	41.550	60.175	60.225	60.175	60.475
		0.3	0.4	0.3	65.275	45.650	64.875	64.925	64.875	65.275
		0.3	0.5	0.2	70.075	49.750	69.575	69.625	69.575	70.075
		0.3	0.6	0.1	74.875	53.850	74.275	74.325	74.275	74.875
		0.4	0.1	0.5	54.233	37.767	54.133	54.200	54.133	54.233
		0.4	0.2	0.4	59.033	41.867	58.833	58.900	58.833	59.033
		0.4	0.3	0.3	63.833	45.967	63.533	63.600	63.533	63.833
		0.4	0.4	0.2	68.633	50.067	68.233	68.300	68.233	68.633
		0.4	0.5	0.1	73.433	54.167	72.933	73.000	72.933	73.433
		0.5	0.1	0.4	57.592	42.183	57.492	57.575	57.492	57.592
		0.5	0.2	0.3	62.392	46.283	62.192	62.275	62.192	62.392
		0.5	0.3	0.2	67.192	50.383	66.892	66.975	66.892	67.192
		0.5	0.4	0.1	71.992	54.483	71.592	71.675	71.592	71.992
		0.6	0.1	0.3	60.950	46.600	60.850	60.950	60.850	60.950
		0.6	0.2	0.2	65.750	50.700	65.550	65.650	65.550	65.750
		0.6	0.3	0.1	70.550	54.800	70.250	70.350	70.250	70.550
		0.7	0.1	0.2	64.308	51.017	64.208	64.325	64.208	64.308
		0.7	0.2	0.1	69.108	55.117	68.908	69.025	68.908	69.108
		0.8	0.1	0.1	67.667	55.433	67.567	67.700	67.567	67.667
		SUM			2275.00	1598.00	2263.00	2265.00	2263.00	2275.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
20	7	0.1	0.1	0.8	44.883	25.200	44.883	44.900	44.883	44.883
		0.1	0.2	0.7	50.183	29.800	50.183	50.200	50.183	50.183
		0.1	0.3	0.6	55.483	34.400	55.483	55.500	55.483	55.483
		0.1	0.4	0.5	60.783	39.000	60.783	60.800	60.783	60.783
		0.1	0.5	0.4	66.083	43.600	66.083	66.100	66.083	66.083
		0.1	0.6	0.3	71.383	48.200	71.383	71.400	71.383	71.383
		0.1	0.7	0.2	76.683	52.800	76.683	76.700	76.683	76.683
		0.1	0.8	0.1	81.983	57.400	81.983	82.000	81.983	81.983
		0.2	0.1	0.7	48.467	29.800	48.467	48.500	48.467	48.467
		0.2	0.2	0.6	53.767	34.400	53.767	53.800	53.767	53.767
		0.2	0.3	0.5	59.067	39.000	59.067	59.100	59.067	59.067
		0.2	0.4	0.4	64.367	43.600	64.367	64.400	64.367	64.367
		0.2	0.5	0.3	69.667	48.200	69.667	69.700	69.667	69.667
		0.2	0.6	0.2	74.967	52.800	74.967	75.000	74.967	74.967
		0.2	0.7	0.1	80.267	57.400	80.267	80.300	80.267	80.267
		0.3	0.1	0.6	52.050	34.400	52.050	52.100	52.050	52.050
		0.3	0.2	0.5	57.350	39.000	57.350	57.400	57.350	57.350
		0.3	0.3	0.4	62.650	43.600	62.650	62.700	62.650	62.650
		0.3	0.4	0.3	67.950	48.200	67.950	68.000	67.950	67.950
		0.3	0.5	0.2	73.250	52.800	73.250	73.300	73.250	73.250
		0.3	0.6	0.1	78.550	57.400	78.550	78.600	78.550	78.550
		0.4	0.1	0.5	55.633	39.000	55.633	55.700	55.633	55.633
		0.4	0.2	0.4	60.933	43.600	60.933	61.000	60.933	60.933
		0.4	0.3	0.3	66.233	48.200	66.233	66.300	66.233	66.233
		0.4	0.4	0.2	71.533	52.800	71.533	71.600	71.533	71.533
		0.4	0.5	0.1	76.833	57.400	76.833	76.900	76.833	76.833
		0.5	0.1	0.4	59.217	43.600	59.217	59.300	59.217	59.217
		0.5	0.2	0.3	64.517	48.200	64.517	64.600	64.517	64.517
		0.5	0.3	0.2	69.817	52.800	69.817	69.900	69.817	69.817
		0.5	0.4	0.1	75.117	57.400	75.117	75.200	75.117	75.117
		0.6	0.1	0.3	62.800	48.200	62.800	62.900	62.800	62.800
		0.6	0.2	0.2	68.100	52.800	68.100	68.200	68.100	68.100
		0.6	0.3	0.1	73.400	57.400	73.400	73.500	73.400	73.400
		0.7	0.1	0.2	66.383	52.800	66.383	66.500	66.383	66.383
		0.7	0.2	0.1	71.683	57.400	71.683	71.800	71.683	71.683
		0.8	0.1	0.1	69.967	57.400	69.967	70.100	69.967	69.967
		SUM			2362.00	1680.00	2362.00	2364.00	2362.00	2362.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
20	8	0.1	0.1	0.8	45.708	25.883	45.708	45.725	45.708	45.708
		0.1	0.2	0.7	51.608	30.983	51.608	51.625	51.608	51.608
		0.1	0.3	0.6	57.508	36.083	57.508	57.525	57.508	57.508
		0.1	0.4	0.5	63.408	41.183	63.408	63.425	63.408	63.408
		0.1	0.5	0.4	69.308	46.283	69.308	69.325	69.308	69.308
		0.1	0.6	0.3	75.208	51.383	75.208	75.225	75.208	75.208
		0.1	0.7	0.2	81.108	56.483	81.108	81.125	81.108	81.108
		0.1	0.8	0.1	87.008	61.583	87.008	87.025	87.008	87.008
		0.2	0.1	0.7	49.517	30.667	49.517	49.550	49.517	49.517
		0.2	0.2	0.6	55.417	35.767	55.417	55.450	55.417	55.417
		0.2	0.3	0.5	61.317	40.867	61.317	61.350	61.317	61.317
		0.2	0.4	0.4	67.217	45.967	67.217	67.250	67.217	67.217
		0.2	0.5	0.3	73.117	51.067	73.117	73.150	73.117	73.117
		0.2	0.6	0.2	79.017	56.167	79.017	79.050	79.017	79.017
		0.2	0.7	0.1	84.917	61.267	84.917	84.950	84.917	84.917
		0.3	0.1	0.6	53.325	35.450	53.325	53.375	53.325	53.325
		0.3	0.2	0.5	59.225	40.550	59.225	59.275	59.225	59.225
		0.3	0.3	0.4	65.125	45.650	65.125	65.175	65.125	65.125
		0.3	0.4	0.3	71.025	50.750	71.025	71.075	71.025	71.025
		0.3	0.5	0.2	76.925	55.850	76.925	76.975	76.925	76.925
		0.3	0.6	0.1	82.825	60.950	82.825	82.875	82.825	82.825
		0.4	0.1	0.5	57.133	40.233	57.133	57.200	57.133	57.133
		0.4	0.2	0.4	63.033	45.333	63.033	63.100	63.033	63.033
		0.4	0.3	0.3	68.933	50.433	68.933	69.000	68.933	68.933
		0.4	0.4	0.2	74.833	55.533	74.833	74.900	74.833	74.833
		0.4	0.5	0.1	80.733	60.633	80.733	80.800	80.733	80.733
		0.5	0.1	0.4	60.942	45.017	60.942	61.025	60.942	60.942
		0.5	0.2	0.3	66.842	50.117	66.842	66.925	66.842	66.842
		0.5	0.3	0.2	72.742	55.217	72.742	72.825	72.742	72.742
		0.5	0.4	0.1	78.642	60.317	78.642	78.725	78.642	78.642
		0.6	0.1	0.3	64.750	49.800	64.750	64.850	64.750	64.750
		0.6	0.2	0.2	70.650	54.900	70.650	70.750	70.650	70.650
		0.6	0.3	0.1	76.550	60.000	76.550	76.650	76.550	76.550
		0.7	0.1	0.2	68.558	54.583	68.558	68.675	68.558	68.558
		0.7	0.2	0.1	74.458	59.683	74.458	74.575	74.458	74.458
		0.8	0.1	0.1	72.367	59.367	72.367	72.500	72.367	72.367
		SUM			2461.00	1762.00	2461.00	2463.00	2461.00	2461.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
21	4	0.1	0.1	0.8	29.025	27.833	28.592	27.817	28.133	29.025
		0.1	0.2	0.7	33.325	30.933	31.892	30.917	31.533	33.325
		0.1	0.3	0.6	37.625	34.033	35.192	34.017	34.933	37.625
		0.1	0.4	0.5	41.925	37.133	38.492	37.117	38.333	41.925
		0.1	0.5	0.4	46.225	40.233	41.792	40.217	41.733	46.225
		0.1	0.6	0.3	50.525	43.333	45.092	43.317	45.133	50.525
		0.1	0.7	0.2	54.825	46.433	48.392	46.417	48.533	54.825
		0.1	0.8	0.1	59.125	49.533	51.692	49.517	51.933	59.125
		0.2	0.1	0.7	32.750	31.567	32.883	31.533	31.867	32.750
		0.2	0.2	0.6	37.050	34.667	36.183	34.633	35.267	37.050
		0.2	0.3	0.5	41.350	37.767	39.483	37.733	38.667	41.350
		0.2	0.4	0.4	45.650	40.867	42.783	40.833	42.067	45.650
		0.2	0.5	0.3	49.950	43.967	46.083	43.933	45.467	49.950
		0.2	0.6	0.2	54.250	47.067	49.383	47.033	48.867	54.250
		0.2	0.7	0.1	58.550	50.167	52.683	50.133	52.267	58.550
		0.3	0.1	0.6	36.475	35.300	37.175	35.250	35.600	36.475
		0.3	0.2	0.5	40.775	38.400	40.475	38.350	39.000	40.775
		0.3	0.3	0.4	45.075	41.500	43.775	41.450	42.400	45.075
		0.3	0.4	0.3	49.375	44.600	47.075	44.550	45.800	49.375
		0.3	0.5	0.2	53.675	47.700	50.375	47.650	49.200	53.675
		0.3	0.6	0.1	57.975	50.800	53.675	50.750	52.600	57.975
		0.4	0.1	0.5	40.200	39.033	41.467	38.967	39.333	40.200
		0.4	0.2	0.4	44.500	42.133	44.767	42.067	42.733	44.500
		0.4	0.3	0.3	48.800	45.233	48.067	45.167	46.133	48.800
		0.4	0.4	0.2	53.100	48.333	51.367	48.267	49.533	53.100
		0.4	0.5	0.1	57.400	51.433	54.667	51.367	52.933	57.400
		0.5	0.1	0.4	43.925	42.767	45.758	42.683	43.067	43.925
		0.5	0.2	0.3	48.225	45.867	49.058	45.783	46.467	48.225
		0.5	0.3	0.2	52.525	48.967	52.358	48.883	49.867	52.525
		0.5	0.4	0.1	56.825	52.067	55.658	51.983	53.267	56.825
		0.6	0.1	0.3	47.650	46.500	50.050	46.400	46.800	47.650
		0.6	0.2	0.2	51.950	49.600	53.350	49.500	50.200	51.950
		0.6	0.3	0.1	56.250	52.700	56.650	52.600	53.600	56.250
		0.7	0.1	0.2	51.375	50.233	54.342	50.117	50.533	51.375
		0.7	0.2	0.1	55.675	53.333	57.642	53.217	53.933	55.675
		0.8	0.1	0.1	55.100	53.967	58.633	53.833	54.267	55.100
		SUM			1719.00	1576.00	1667.00	1574.00	1612.00	1719.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
21	5	0.1	0.1	0.8	29.508	28.517	29.200	28.500	28.617	29.508
		0.1	0.2	0.7	34.108	32.117	32.900	32.100	32.317	34.108
		0.1	0.3	0.6	38.708	35.717	36.600	35.700	36.017	38.708
		0.1	0.4	0.5	43.308	39.317	40.300	39.300	39.717	43.308
		0.1	0.5	0.4	47.908	42.917	44.000	42.900	43.417	47.908
		0.1	0.6	0.3	52.508	46.517	47.700	46.500	47.117	52.508
		0.1	0.7	0.2	57.108	50.117	51.400	50.100	50.817	57.108
		0.1	0.8	0.1	61.708	53.717	55.100	53.700	54.517	61.708
		0.2	0.1	0.7	33.417	32.433	33.700	32.400	32.533	33.417
		0.2	0.2	0.6	38.017	36.033	37.400	36.000	36.233	38.017
		0.2	0.3	0.5	42.617	39.633	41.100	39.600	39.933	42.617
		0.2	0.4	0.4	47.217	43.233	44.800	43.200	43.633	47.217
		0.2	0.5	0.3	51.817	46.833	48.500	46.800	47.333	51.817
		0.2	0.6	0.2	56.417	50.433	52.200	50.400	51.033	56.417
		0.2	0.7	0.1	61.017	54.033	55.900	54.000	54.733	61.017
		0.3	0.1	0.6	37.325	36.350	38.200	36.300	36.450	37.325
		0.3	0.2	0.5	41.925	39.950	41.900	39.900	40.150	41.925
		0.3	0.3	0.4	46.525	43.550	45.600	43.500	43.850	46.525
		0.3	0.4	0.3	51.125	47.150	49.300	47.100	47.550	51.125
		0.3	0.5	0.2	55.725	50.750	53.000	50.700	51.250	55.725
		0.3	0.6	0.1	60.325	54.350	56.700	54.300	54.950	60.325
		0.4	0.1	0.5	41.233	40.267	42.700	40.200	40.367	41.233
		0.4	0.2	0.4	45.833	43.867	46.400	43.800	44.067	45.833
		0.4	0.3	0.3	50.433	47.467	50.100	47.400	47.767	50.433
		0.4	0.4	0.2	55.033	51.067	53.800	51.000	51.467	55.033
		0.4	0.5	0.1	59.633	54.667	57.500	54.600	55.167	59.633
		0.5	0.1	0.4	45.142	44.183	47.200	44.100	44.283	45.142
		0.5	0.2	0.3	49.742	47.783	50.900	47.700	47.983	49.742
		0.5	0.3	0.2	54.342	51.383	54.600	51.300	51.683	54.342
		0.5	0.4	0.1	58.942	54.983	58.300	54.900	55.383	58.942
		0.6	0.1	0.3	49.050	48.100	51.700	48.000	48.200	49.050
		0.6	0.2	0.2	53.650	51.700	55.400	51.600	51.900	53.650
		0.6	0.3	0.1	58.250	55.300	59.100	55.200	55.600	58.250
		0.7	0.1	0.2	52.958	52.017	56.200	51.900	52.117	52.958
		0.7	0.2	0.1	57.558	55.617	59.900	55.500	55.817	57.558
		0.8	0.1	0.1	56.867	55.933	60.700	55.800	56.033	56.867
		SUM			1777.00	1658.00	1740.00	1656.00	1670.00	1777.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
21	6	0.1	0.1	0.8	29.992	29.200	29.808	29.183	29.200	29.992
		0.1	0.2	0.7	34.892	33.300	33.908	33.283	33.300	34.892
		0.1	0.3	0.6	39.792	37.400	38.008	37.383	37.400	39.792
		0.1	0.4	0.5	44.692	41.500	42.108	41.483	41.500	44.692
		0.1	0.5	0.4	49.592	45.600	46.208	45.583	45.600	49.592
		0.1	0.6	0.3	54.492	49.700	50.308	49.683	49.700	54.492
		0.1	0.7	0.2	59.392	53.800	54.408	53.783	53.800	59.392
		0.1	0.8	0.1	64.292	57.900	58.508	57.883	57.900	64.292
		0.2	0.1	0.7	34.083	33.300	34.517	33.267	33.300	34.083
		0.2	0.2	0.6	38.983	37.400	38.617	37.367	37.400	38.983
		0.2	0.3	0.5	43.883	41.500	42.717	41.467	41.500	43.883
		0.2	0.4	0.4	48.783	45.600	46.817	45.567	45.600	48.783
		0.2	0.5	0.3	53.683	49.700	50.917	49.667	49.700	53.683
		0.2	0.6	0.2	58.583	53.800	55.017	53.767	53.800	58.583
		0.2	0.7	0.1	63.483	57.900	59.117	57.867	57.900	63.483
		0.3	0.1	0.6	38.175	37.400	39.225	37.350	37.400	38.175
		0.3	0.2	0.5	43.075	41.500	43.325	41.450	41.500	43.075
		0.3	0.3	0.4	47.975	45.600	47.425	45.550	45.600	47.975
		0.3	0.4	0.3	52.875	49.700	51.525	49.650	49.700	52.875
		0.3	0.5	0.2	57.775	53.800	55.625	53.750	53.800	57.775
		0.3	0.6	0.1	62.675	57.900	59.725	57.850	57.900	62.675
		0.4	0.1	0.5	42.267	41.500	43.933	41.433	41.500	42.267
		0.4	0.2	0.4	47.167	45.600	48.033	45.533	45.600	47.167
		0.4	0.3	0.3	52.067	49.700	52.133	49.633	49.700	52.067
		0.4	0.4	0.2	56.967	53.800	56.233	53.733	53.800	56.967
		0.4	0.5	0.1	61.867	57.900	60.333	57.833	57.900	61.867
		0.5	0.1	0.4	46.358	45.600	48.642	45.517	45.600	46.358
		0.5	0.2	0.3	51.258	49.700	52.742	49.617	49.700	51.258
		0.5	0.3	0.2	56.158	53.800	56.842	53.717	53.800	56.158
		0.5	0.4	0.1	61.058	57.900	60.942	57.817	57.900	61.058
		0.6	0.1	0.3	50.450	49.700	53.350	49.600	49.700	50.450
		0.6	0.2	0.2	55.350	53.800	57.450	53.700	53.800	55.350
		0.6	0.3	0.1	60.250	57.900	61.550	57.800	57.900	60.250
		0.7	0.1	0.2	54.542	53.800	58.058	53.683	53.800	54.542
		0.7	0.2	0.1	59.442	57.900	62.158	57.783	57.900	59.442
		0.8	0.1	0.1	58.633	57.900	62.767	57.767	57.900	58.633
		SUM			1835.00	1740.00	1813.00	1738.00	1740.00	1835.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
21	7	0.1	0.1	0.8	30.475	29.883	30.517	29.867	29.883	30.475
		0.1	0.2	0.7	35.675	34.483	35.117	34.467	34.483	35.675
		0.1	0.3	0.6	40.875	39.083	39.717	39.067	39.083	40.875
		0.1	0.4	0.5	46.075	43.683	44.317	43.667	43.683	46.075
		0.1	0.5	0.4	51.275	48.283	48.917	48.267	48.283	51.275
		0.1	0.6	0.3	56.475	52.883	53.517	52.867	52.883	56.475
		0.1	0.7	0.2	61.675	57.483	58.117	57.467	57.483	61.675
		0.1	0.8	0.1	66.875	62.083	62.717	62.067	62.083	66.875
		0.2	0.1	0.7	34.750	34.167	35.433	34.133	34.167	34.750
		0.2	0.2	0.6	39.950	38.767	40.033	38.733	38.767	39.950
		0.2	0.3	0.5	45.150	43.367	44.633	43.333	43.367	45.150
		0.2	0.4	0.4	50.350	47.967	49.233	47.933	47.967	50.350
		0.2	0.5	0.3	55.550	52.567	53.833	52.533	52.567	55.550
		0.2	0.6	0.2	60.750	57.167	58.433	57.133	57.167	60.750
		0.2	0.7	0.1	65.950	61.767	63.033	61.733	61.767	65.950
		0.3	0.1	0.6	39.025	38.450	40.350	38.400	38.450	39.025
		0.3	0.2	0.5	44.225	43.050	44.950	43.000	43.050	44.225
		0.3	0.3	0.4	49.425	47.650	49.550	47.600	47.650	49.425
		0.3	0.4	0.3	54.625	52.250	54.150	52.200	52.250	54.625
		0.3	0.5	0.2	59.825	56.850	58.750	56.800	56.850	59.825
		0.3	0.6	0.1	65.025	61.450	63.350	61.400	61.450	65.025
		0.4	0.1	0.5	43.300	42.733	45.267	42.667	42.733	43.300
		0.4	0.2	0.4	48.500	47.333	49.867	47.267	47.333	48.500
		0.4	0.3	0.3	53.700	51.933	54.467	51.867	51.933	53.700
		0.4	0.4	0.2	58.900	56.533	59.067	56.467	56.533	58.900
		0.4	0.5	0.1	64.100	61.133	63.667	61.067	61.133	64.100
		0.5	0.1	0.4	47.575	47.017	50.183	46.933	47.017	47.575
		0.5	0.2	0.3	52.775	51.617	54.783	51.533	51.617	52.775
		0.5	0.3	0.2	57.975	56.217	59.383	56.133	56.217	57.975
		0.5	0.4	0.1	63.175	60.817	63.983	60.733	60.817	63.175
		0.6	0.1	0.3	51.850	51.300	55.100	51.200	51.300	51.850
		0.6	0.2	0.2	57.050	55.900	59.700	55.800	55.900	57.050
		0.6	0.3	0.1	62.250	60.500	64.300	60.400	60.500	62.250
		0.7	0.1	0.2	56.125	55.583	60.017	55.467	55.583	56.125
		0.7	0.2	0.1	61.325	60.183	64.617	60.067	60.183	61.325
		0.8	0.1	0.1	60.400	59.867	64.933	59.733	59.867	60.400
		SUM			1893.00	1822.00	1898.00	1820.00	1822.00	1893.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
21	8	0.1	0.1	0.8	30.958	30.567	31.225	30.550	30.567	30.958
		0.1	0.2	0.7	36.458	35.667	36.325	35.650	35.667	36.458
		0.1	0.3	0.6	41.958	40.767	41.425	40.750	40.767	41.958
		0.1	0.4	0.5	47.458	45.867	46.525	45.850	45.867	47.458
		0.1	0.5	0.4	52.958	50.967	51.625	50.950	50.967	52.958
		0.1	0.6	0.3	58.458	56.067	56.725	56.050	56.067	58.458
		0.1	0.7	0.2	63.958	61.167	61.825	61.150	61.167	63.958
		0.1	0.8	0.1	69.458	66.267	66.925	66.250	66.267	69.458
		0.2	0.1	0.7	35.417	35.033	36.350	35.000	35.033	35.417
		0.2	0.2	0.6	40.917	40.133	41.450	40.100	40.133	40.917
		0.2	0.3	0.5	46.417	45.233	46.550	45.200	45.233	46.417
		0.2	0.4	0.4	51.917	50.333	51.650	50.300	50.333	51.917
		0.2	0.5	0.3	57.417	55.433	56.750	55.400	55.433	57.417
		0.2	0.6	0.2	62.917	60.533	61.850	60.500	60.533	62.917
		0.2	0.7	0.1	68.417	65.633	66.950	65.600	65.633	68.417
		0.3	0.1	0.6	39.875	39.500	41.475	39.450	39.500	39.875
		0.3	0.2	0.5	45.375	44.600	46.575	44.550	44.600	45.375
		0.3	0.3	0.4	50.875	49.700	51.675	49.650	49.700	50.875
		0.3	0.4	0.3	56.375	54.800	56.775	54.750	54.800	56.375
		0.3	0.5	0.2	61.875	59.900	61.875	59.850	59.900	61.875
		0.3	0.6	0.1	67.375	65.000	66.975	64.950	65.000	67.375
		0.4	0.1	0.5	44.333	43.967	46.600	43.900	43.967	44.333
		0.4	0.2	0.4	49.833	49.067	51.700	49.000	49.067	49.833
		0.4	0.3	0.3	55.333	54.167	56.800	54.100	54.167	55.333
		0.4	0.4	0.2	60.833	59.267	61.900	59.200	59.267	60.833
		0.4	0.5	0.1	66.333	64.367	67.000	64.300	64.367	66.333
		0.5	0.1	0.4	48.792	48.433	51.725	48.350	48.433	48.792
		0.5	0.2	0.3	54.292	53.533	56.825	53.450	53.533	54.292
		0.5	0.3	0.2	59.792	58.633	61.925	58.550	58.633	59.792
		0.5	0.4	0.1	65.292	63.733	67.025	63.650	63.733	65.292
		0.6	0.1	0.3	53.250	52.900	56.850	52.800	52.900	53.250
		0.6	0.2	0.2	58.750	58.000	61.950	57.900	58.000	58.750
		0.6	0.3	0.1	64.250	63.100	67.050	63.000	63.100	64.250
		0.7	0.1	0.2	57.708	57.367	61.975	57.250	57.367	57.708
		0.7	0.2	0.1	63.208	62.467	67.075	62.350	62.467	63.208
		0.8	0.1	0.1	62.167	61.833	67.100	61.700	61.833	62.167
		SUM			1951.00	1904.00	1983.00	1902.00	1904.00	1951.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
22	4	0.1	0.1	0.8	33.508	32.517	32.517	32.500	32.617	33.508
		0.1	0.2	0.7	37.608	35.617	35.617	35.600	35.817	37.608
		0.1	0.3	0.6	41.708	38.717	38.717	38.700	39.017	41.708
		0.1	0.4	0.5	45.808	41.817	41.817	41.800	42.217	45.808
		0.1	0.5	0.4	49.908	44.917	44.917	44.900	45.417	49.908
		0.1	0.6	0.3	54.008	48.017	48.017	48.000	48.617	54.008
		0.1	0.7	0.2	58.108	51.117	51.117	51.100	51.817	58.108
		0.1	0.8	0.1	62.208	54.217	54.217	54.200	55.017	62.208
		0.2	0.1	0.7	36.917	35.933	35.933	35.900	36.033	36.917
		0.2	0.2	0.6	41.017	39.033	39.033	39.000	39.233	41.017
		0.2	0.3	0.5	45.117	42.133	42.133	42.100	42.433	45.117
		0.2	0.4	0.4	49.217	45.233	45.233	45.200	45.633	49.217
		0.2	0.5	0.3	53.317	48.333	48.333	48.300	48.833	53.317
		0.2	0.6	0.2	57.417	51.433	51.433	51.400	52.033	57.417
		0.2	0.7	0.1	61.517	54.533	54.533	54.500	55.233	61.517
		0.3	0.1	0.6	40.325	39.350	39.350	39.300	39.450	40.325
		0.3	0.2	0.5	44.425	42.450	42.450	42.400	42.650	44.425
		0.3	0.3	0.4	48.525	45.550	45.550	45.500	45.850	48.525
		0.3	0.4	0.3	52.625	48.650	48.650	48.600	49.050	52.625
		0.3	0.5	0.2	56.725	51.750	51.750	51.700	52.250	56.725
		0.3	0.6	0.1	60.825	54.850	54.850	54.800	55.450	60.825
		0.4	0.1	0.5	43.733	42.767	42.767	42.700	42.867	43.733
		0.4	0.2	0.4	47.833	45.867	45.867	45.800	46.067	47.833
		0.4	0.3	0.3	51.933	48.967	48.967	48.900	49.267	51.933
		0.4	0.4	0.2	56.033	52.067	52.067	52.000	52.467	56.033
		0.4	0.5	0.1	60.133	55.167	55.167	55.100	55.667	60.133
		0.5	0.1	0.4	47.142	46.183	46.183	46.100	46.283	47.142
		0.5	0.2	0.3	51.242	49.283	49.283	49.200	49.483	51.242
		0.5	0.3	0.2	55.342	52.383	52.383	52.300	52.683	55.342
		0.5	0.4	0.1	59.442	55.483	55.483	55.400	55.883	59.442
		0.6	0.1	0.3	50.550	49.600	49.600	49.500	49.700	50.550
		0.6	0.2	0.2	54.650	52.700	52.700	52.600	52.900	54.650
		0.6	0.3	0.1	58.750	55.800	55.800	55.700	56.100	58.750
		0.7	0.1	0.2	53.958	53.017	53.017	52.900	53.117	53.958
		0.7	0.2	0.1	58.058	56.117	56.117	56.000	56.317	58.058
		0.8	0.1	0.1	57.367	56.433	56.433	56.300	56.533	57.367
		SUM			1837.00	1718.00	1718.00	1716.00	1730.00	1837.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
22	5	0.1	0.1	0.8	33.992	33.200	33.200	33.183	33.200	33.992
		0.1	0.2	0.7	38.392	36.800	36.800	36.783	36.800	38.392
		0.1	0.3	0.6	42.792	40.400	40.400	40.383	40.400	42.792
		0.1	0.4	0.5	47.192	44.000	44.000	43.983	44.000	47.192
		0.1	0.5	0.4	51.592	47.600	47.600	47.583	47.600	51.592
		0.1	0.6	0.3	55.992	51.200	51.200	51.183	51.200	55.992
		0.1	0.7	0.2	60.392	54.800	54.800	54.783	54.800	60.392
		0.1	0.8	0.1	64.792	58.400	58.400	58.383	58.400	64.792
		0.2	0.1	0.7	37.583	36.800	36.800	36.767	36.800	37.583
		0.2	0.2	0.6	41.983	40.400	40.400	40.367	40.400	41.983
		0.2	0.3	0.5	46.383	44.000	44.000	43.967	44.000	46.383
		0.2	0.4	0.4	50.783	47.600	47.600	47.567	47.600	50.783
		0.2	0.5	0.3	55.183	51.200	51.200	51.167	51.200	55.183
		0.2	0.6	0.2	59.583	54.800	54.800	54.767	54.800	59.583
		0.2	0.7	0.1	63.983	58.400	58.400	58.367	58.400	63.983
		0.3	0.1	0.6	41.175	40.400	40.400	40.350	40.400	41.175
		0.3	0.2	0.5	45.575	44.000	44.000	43.950	44.000	45.575
		0.3	0.3	0.4	49.975	47.600	47.600	47.550	47.600	49.975
		0.3	0.4	0.3	54.375	51.200	51.200	51.150	51.200	54.375
		0.3	0.5	0.2	58.775	54.800	54.800	54.750	54.800	58.775
		0.3	0.6	0.1	63.175	58.400	58.400	58.350	58.400	63.175
		0.4	0.1	0.5	44.767	44.000	44.000	43.933	44.000	44.767
		0.4	0.2	0.4	49.167	47.600	47.600	47.533	47.600	49.167
		0.4	0.3	0.3	53.567	51.200	51.200	51.133	51.200	53.567
		0.4	0.4	0.2	57.967	54.800	54.800	54.733	54.800	57.967
		0.4	0.5	0.1	62.367	58.400	58.400	58.333	58.400	62.367
		0.5	0.1	0.4	48.358	47.600	47.600	47.517	47.600	48.358
		0.5	0.2	0.3	52.758	51.200	51.200	51.117	51.200	52.758
		0.5	0.3	0.2	57.158	54.800	54.800	54.717	54.800	57.158
		0.5	0.4	0.1	61.558	58.400	58.400	58.317	58.400	61.558
		0.6	0.1	0.3	51.950	51.200	51.200	51.100	51.200	51.950
		0.6	0.2	0.2	56.350	54.800	54.800	54.700	54.800	56.350
		0.6	0.3	0.1	60.750	58.400	58.400	58.300	58.400	60.750
		0.7	0.1	0.2	55.542	54.800	54.800	54.683	54.800	55.542
		0.7	0.2	0.1	59.942	58.400	58.400	58.283	58.400	59.942
		0.8	0.1	0.1	59.133	58.400	58.400	58.267	58.400	59.133
		SUM			1895.00	1800.00	1800.00	1798.00	1800.00	1895.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
22	6	0.1	0.1	0.8	34.475	33.883	33.883	33.867	33.883	34.475
		0.1	0.2	0.7	39.175	37.983	37.983	37.967	37.983	39.175
		0.1	0.3	0.6	43.875	42.083	42.083	42.067	42.083	43.875
		0.1	0.4	0.5	48.575	46.183	46.183	46.167	46.183	48.575
		0.1	0.5	0.4	53.275	50.283	50.283	50.267	50.283	53.275
		0.1	0.6	0.3	57.975	54.383	54.383	54.367	54.383	57.975
		0.1	0.7	0.2	62.675	58.483	58.483	58.467	58.483	62.675
		0.1	0.8	0.1	67.375	62.583	62.583	62.567	62.583	67.375
		0.2	0.1	0.7	38.250	37.667	37.667	37.633	37.667	38.250
		0.2	0.2	0.6	42.950	41.767	41.767	41.733	41.767	42.950
		0.2	0.3	0.5	47.650	45.867	45.867	45.833	45.867	47.650
		0.2	0.4	0.4	52.350	49.967	49.967	49.933	49.967	52.350
		0.2	0.5	0.3	57.050	54.067	54.067	54.033	54.067	57.050
		0.2	0.6	0.2	61.750	58.167	58.167	58.133	58.167	61.750
		0.2	0.7	0.1	66.450	62.267	62.267	62.233	62.267	66.450
		0.3	0.1	0.6	42.025	41.450	41.450	41.400	41.450	42.025
		0.3	0.2	0.5	46.725	45.550	45.550	45.500	45.550	46.725
		0.3	0.3	0.4	51.425	49.650	49.650	49.600	49.650	51.425
		0.3	0.4	0.3	56.125	53.750	53.750	53.700	53.750	56.125
		0.3	0.5	0.2	60.825	57.850	57.850	57.800	57.850	60.825
		0.3	0.6	0.1	65.525	61.950	61.950	61.900	61.950	65.525
		0.4	0.1	0.5	45.800	45.233	45.233	45.167	45.233	45.800
		0.4	0.2	0.4	50.500	49.333	49.333	49.267	49.333	50.500
		0.4	0.3	0.3	55.200	53.433	53.433	53.367	53.433	55.200
		0.4	0.4	0.2	59.900	57.533	57.533	57.467	57.533	59.900
		0.4	0.5	0.1	64.600	61.633	61.633	61.567	61.633	64.600
		0.5	0.1	0.4	49.575	49.017	49.017	48.933	49.017	49.575
		0.5	0.2	0.3	54.275	53.117	53.117	53.033	53.117	54.275
		0.5	0.3	0.2	58.975	57.217	57.217	57.133	57.217	58.975
		0.5	0.4	0.1	63.675	61.317	61.317	61.233	61.317	63.675
		0.6	0.1	0.3	53.350	52.800	52.800	52.700	52.800	53.350
		0.6	0.2	0.2	58.050	56.900	56.900	56.800	56.900	58.050
		0.6	0.3	0.1	62.750	61.000	61.000	60.900	61.000	62.750
		0.7	0.1	0.2	57.125	56.583	56.583	56.467	56.583	57.125
		0.7	0.2	0.1	61.825	60.683	60.683	60.567	60.683	61.825
		0.8	0.1	0.1	60.900	60.367	60.367	60.233	60.367	60.900
		SUM			1953.00	1882.00	1882.00	1880.00	1882.00	1953.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
22	7	0.1	0.1	0.8	34.958	34.567	34.567	34.550	34.567	34.958
		0.1	0.2	0.7	39.958	39.167	39.167	39.150	39.167	39.958
		0.1	0.3	0.6	44.958	43.767	43.767	43.750	43.767	44.958
		0.1	0.4	0.5	49.958	48.367	48.367	48.350	48.367	49.958
		0.1	0.5	0.4	54.958	52.967	52.967	52.950	52.967	54.958
		0.1	0.6	0.3	59.958	57.567	57.567	57.550	57.567	59.958
		0.1	0.7	0.2	64.958	62.167	62.167	62.150	62.167	64.958
		0.1	0.8	0.1	69.958	66.767	66.767	66.750	66.767	69.958
		0.2	0.1	0.7	38.917	38.533	38.533	38.500	38.533	38.917
		0.2	0.2	0.6	43.917	43.133	43.133	43.100	43.133	43.917
		0.2	0.3	0.5	48.917	47.733	47.733	47.700	47.733	48.917
		0.2	0.4	0.4	53.917	52.333	52.333	52.300	52.333	53.917
		0.2	0.5	0.3	58.917	56.933	56.933	56.900	56.933	58.917
		0.2	0.6	0.2	63.917	61.533	61.533	61.500	61.533	63.917
		0.2	0.7	0.1	68.917	66.133	66.133	66.100	66.133	68.917
		0.3	0.1	0.6	42.875	42.500	42.500	42.450	42.500	42.875
		0.3	0.2	0.5	47.875	47.100	47.100	47.050	47.100	47.875
		0.3	0.3	0.4	52.875	51.700	51.700	51.650	51.700	52.875
		0.3	0.4	0.3	57.875	56.300	56.300	56.250	56.300	57.875
		0.3	0.5	0.2	62.875	60.900	60.900	60.850	60.900	62.875
		0.3	0.6	0.1	67.875	65.500	65.500	65.450	65.500	67.875
		0.4	0.1	0.5	46.833	46.467	46.467	46.400	46.467	46.833
		0.4	0.2	0.4	51.833	51.067	51.067	51.000	51.067	51.833
		0.4	0.3	0.3	56.833	55.667	55.667	55.600	55.667	56.833
		0.4	0.4	0.2	61.833	60.267	60.267	60.200	60.267	61.833
		0.4	0.5	0.1	66.833	64.867	64.867	64.800	64.867	66.833
		0.5	0.1	0.4	50.792	50.433	50.433	50.350	50.433	50.792
		0.5	0.2	0.3	55.792	55.033	55.033	54.950	55.033	55.792
		0.5	0.3	0.2	60.792	59.633	59.633	59.550	59.633	60.792
		0.5	0.4	0.1	65.792	64.233	64.233	64.150	64.233	65.792
		0.6	0.1	0.3	54.750	54.400	54.400	54.300	54.400	54.750
		0.6	0.2	0.2	59.750	59.000	59.000	58.900	59.000	59.750
		0.6	0.3	0.1	64.750	63.600	63.600	63.500	63.600	64.750
		0.7	0.1	0.2	58.708	58.367	58.367	58.250	58.367	58.708
		0.7	0.2	0.1	63.708	62.967	62.967	62.850	62.967	63.708
		0.8	0.1	0.1	62.667	62.333	62.333	62.200	62.333	62.667
		SUM			2011.00	1964.00	1964.00	1962.00	1964.00	2011.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
22	8	0.1	0.1	0.8	35.442	35.250	35.250	35.233	35.250	35.442
		0.1	0.2	0.7	40.742	40.350	40.350	40.333	40.350	40.742
		0.1	0.3	0.6	46.042	45.450	45.450	45.433	45.450	46.042
		0.1	0.4	0.5	51.342	50.550	50.550	50.533	50.550	51.342
		0.1	0.5	0.4	56.642	55.650	55.650	55.633	55.650	56.642
		0.1	0.6	0.3	61.942	60.750	60.750	60.733	60.750	61.942
		0.1	0.7	0.2	67.242	65.850	65.850	65.833	65.850	67.242
		0.1	0.8	0.1	72.542	70.950	70.950	70.933	70.950	72.542
		0.2	0.1	0.7	39.583	39.400	39.400	39.367	39.400	39.583
		0.2	0.2	0.6	44.883	44.500	44.500	44.467	44.500	44.883
		0.2	0.3	0.5	50.183	49.600	49.600	49.567	49.600	50.183
		0.2	0.4	0.4	55.483	54.700	54.700	54.667	54.700	55.483
		0.2	0.5	0.3	60.783	59.800	59.800	59.767	59.800	60.783
		0.2	0.6	0.2	66.083	64.900	64.900	64.867	64.900	66.083
		0.2	0.7	0.1	71.383	70.000	70.000	69.967	70.000	71.383
		0.3	0.1	0.6	43.725	43.550	43.550	43.500	43.550	43.725
		0.3	0.2	0.5	49.025	48.650	48.650	48.600	48.650	49.025
		0.3	0.3	0.4	54.325	53.750	53.750	53.700	53.750	54.325
		0.3	0.4	0.3	59.625	58.850	58.850	58.800	58.850	59.625
		0.3	0.5	0.2	64.925	63.950	63.950	63.900	63.950	64.925
		0.3	0.6	0.1	70.225	69.050	69.050	69.000	69.050	70.225
		0.4	0.1	0.5	47.867	47.700	47.700	47.633	47.700	47.867
		0.4	0.2	0.4	53.167	52.800	52.800	52.733	52.800	53.167
		0.4	0.3	0.3	58.467	57.900	57.900	57.833	57.900	58.467
		0.4	0.4	0.2	63.767	63.000	63.000	62.933	63.000	63.767
		0.4	0.5	0.1	69.067	68.100	68.100	68.033	68.100	69.067
		0.5	0.1	0.4	52.008	51.850	51.850	51.767	51.850	52.008
		0.5	0.2	0.3	57.308	56.950	56.950	56.867	56.950	57.308
		0.5	0.3	0.2	62.608	62.050	62.050	61.967	62.050	62.608
		0.5	0.4	0.1	67.908	67.150	67.150	67.067	67.150	67.908
		0.6	0.1	0.3	56.150	56.000	56.000	55.900	56.000	56.150
		0.6	0.2	0.2	61.450	61.100	61.100	61.000	61.100	61.450
		0.6	0.3	0.1	66.750	66.200	66.200	66.100	66.200	66.750
		0.7	0.1	0.2	60.292	60.150	60.150	60.033	60.150	60.292
		0.7	0.2	0.1	65.592	65.250	65.250	65.133	65.250	65.592
		0.8	0.1	0.1	64.433	64.300	64.300	64.167	64.300	64.433
		SUM			2069.00	2046.00	2046.00	2044.00	2046.00	2069.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
23	4	0.1	0.1	0.8	17.708	37.200	36.992	15.117	15.800	17.708
		0.1	0.2	0.7	23.008	40.300	40.092	17.817	19.200	23.008
		0.1	0.3	0.6	28.308	43.400	43.192	20.517	22.600	28.308
		0.1	0.4	0.5	33.608	46.500	46.292	23.217	26.000	33.608
		0.1	0.5	0.4	38.908	49.600	49.392	25.917	29.400	38.908
		0.1	0.6	0.3	44.208	52.700	52.492	28.617	32.800	44.208
		0.1	0.7	0.2	49.508	55.800	55.592	31.317	36.200	49.508
		0.1	0.8	0.1	54.808	58.900	58.692	34.017	39.600	54.808
		0.2	0.1	0.7	22.117	40.300	39.883	19.533	20.200	22.117
		0.2	0.2	0.6	27.417	43.400	42.983	22.233	23.600	27.417
		0.2	0.3	0.5	32.717	46.500	46.083	24.933	27.000	32.717
		0.2	0.4	0.4	38.017	49.600	49.183	27.633	30.400	38.017
		0.2	0.5	0.3	43.317	52.700	52.283	30.333	33.800	43.317
		0.2	0.6	0.2	48.617	55.800	55.383	33.033	37.200	48.617
		0.2	0.7	0.1	53.917	58.900	58.483	35.733	40.600	53.917
		0.3	0.1	0.6	26.525	43.400	42.775	23.950	24.600	26.525
		0.3	0.2	0.5	31.825	46.500	45.875	26.650	28.000	31.825
		0.3	0.3	0.4	37.125	49.600	48.975	29.350	31.400	37.125
		0.3	0.4	0.3	42.425	52.700	52.075	32.050	34.800	42.425
		0.3	0.5	0.2	47.725	55.800	55.175	34.750	38.200	47.725
		0.3	0.6	0.1	53.025	58.900	58.275	37.450	41.600	53.025
		0.4	0.1	0.5	30.933	46.500	45.667	28.367	29.000	30.933
		0.4	0.2	0.4	36.233	49.600	48.767	31.067	32.400	36.233
		0.4	0.3	0.3	41.533	52.700	51.867	33.767	35.800	41.533
		0.4	0.4	0.2	46.833	55.800	54.967	36.467	39.200	46.833
		0.4	0.5	0.1	52.133	58.900	58.067	39.167	42.600	52.133
		0.5	0.1	0.4	35.342	49.600	48.558	32.783	33.400	35.342
		0.5	0.2	0.3	40.642	52.700	51.658	35.483	36.800	40.642
		0.5	0.3	0.2	45.942	55.800	54.758	38.183	40.200	45.942
		0.5	0.4	0.1	51.242	58.900	57.858	40.883	43.600	51.242
		0.6	0.1	0.3	39.750	52.700	51.450	37.200	37.800	39.750
		0.6	0.2	0.2	45.050	55.800	54.550	39.900	41.200	45.050
		0.6	0.3	0.1	50.350	58.900	57.650	42.600	44.600	50.350
		0.7	0.1	0.2	44.158	55.800	54.342	41.617	42.200	44.158
		0.7	0.2	0.1	49.458	58.900	57.442	44.317	45.600	49.458
		0.8	0.1	0.1	48.567	58.900	57.233	46.033	46.600	48.567
		SUM			1453.00	1860.00	1835.00	1142.00	1224.00	1453.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
23	5	0.1	0.1	0.8	18.150	37.883	37.667	15.658	16.142	18.150
		0.1	0.2	0.7	23.750	41.483	41.267	18.758	19.742	23.750
		0.1	0.3	0.6	29.350	45.083	44.867	21.858	23.342	29.350
		0.1	0.4	0.5	34.950	48.683	48.467	24.958	26.942	34.950
		0.1	0.5	0.4	40.550	52.283	52.067	28.058	30.542	40.550
		0.1	0.6	0.3	46.150	55.883	55.667	31.158	34.142	46.150
		0.1	0.7	0.2	51.750	59.483	59.267	34.258	37.742	51.750
		0.1	0.8	0.1	57.350	63.083	62.867	37.358	41.342	57.350
		0.2	0.1	0.7	22.700	41.167	40.733	20.217	20.683	22.700
		0.2	0.2	0.6	28.300	44.767	44.333	23.317	24.283	28.300
		0.2	0.3	0.5	33.900	48.367	47.933	26.417	27.883	33.900
		0.2	0.4	0.4	39.500	51.967	51.533	29.517	31.483	39.500
		0.2	0.5	0.3	45.100	55.567	55.133	32.617	35.083	45.100
		0.2	0.6	0.2	50.700	59.167	58.733	35.717	38.683	50.700
		0.2	0.7	0.1	56.300	62.767	62.333	38.817	42.283	56.300
		0.3	0.1	0.6	27.250	44.450	43.800	24.775	25.225	27.250
		0.3	0.2	0.5	32.850	48.050	47.400	27.875	28.825	32.850
		0.3	0.3	0.4	38.450	51.650	51.000	30.975	32.425	38.450
		0.3	0.4	0.3	44.050	55.250	54.600	34.075	36.025	44.050
		0.3	0.5	0.2	49.650	58.850	58.200	37.175	39.625	49.650
		0.3	0.6	0.1	55.250	62.450	61.800	40.275	43.225	55.250
		0.4	0.1	0.5	31.800	47.733	46.867	29.333	29.767	31.800
		0.4	0.2	0.4	37.400	51.333	50.467	32.433	33.367	37.400
		0.4	0.3	0.3	43.000	54.933	54.067	35.533	36.967	43.000
		0.4	0.4	0.2	48.600	58.533	57.667	38.633	40.567	48.600
		0.4	0.5	0.1	54.200	62.133	61.267	41.733	44.167	54.200
		0.5	0.1	0.4	36.350	51.017	49.933	33.892	34.308	36.350
		0.5	0.2	0.3	41.950	54.617	53.533	36.992	37.908	41.950
		0.5	0.3	0.2	47.550	58.217	57.133	40.092	41.508	47.550
		0.5	0.4	0.1	53.150	61.817	60.733	43.192	45.108	53.150
		0.6	0.1	0.3	40.900	54.300	53.000	38.450	38.850	40.900
		0.6	0.2	0.2	46.500	57.900	56.600	41.550	42.450	46.500
		0.6	0.3	0.1	52.100	61.500	60.200	44.650	46.050	52.100
		0.7	0.1	0.2	45.450	57.583	56.067	43.008	43.392	45.450
		0.7	0.2	0.1	51.050	61.183	59.667	46.108	46.992	51.050
		0.8	0.1	0.1	50.000	60.867	59.133	47.567	47.933	50.000
		SUM			1506.00	1942.00	1916.00	1207.00	1265.00	1506.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
23	6	0.1	0.1	0.8	18.592	38.567	38.342	16.200	16.483	18.592
		0.1	0.2	0.7	24.492	42.667	42.442	19.700	20.283	24.492
		0.1	0.3	0.6	30.392	46.767	46.542	23.200	24.083	30.392
		0.1	0.4	0.5	36.292	50.867	50.642	26.700	27.883	36.292
		0.1	0.5	0.4	42.192	54.967	54.742	30.200	31.683	42.192
		0.1	0.6	0.3	48.092	59.067	58.842	33.700	35.483	48.092
		0.1	0.7	0.2	53.992	63.167	62.942	37.200	39.283	53.992
		0.1	0.8	0.1	59.892	67.267	67.042	40.700	43.083	59.892
		0.2	0.1	0.7	23.283	42.033	41.583	20.900	21.167	23.283
		0.2	0.2	0.6	29.183	46.133	45.683	24.400	24.967	29.183
		0.2	0.3	0.5	35.083	50.233	49.783	27.900	28.767	35.083
		0.2	0.4	0.4	40.983	54.333	53.883	31.400	32.567	40.983
		0.2	0.5	0.3	46.883	58.433	57.983	34.900	36.367	46.883
		0.2	0.6	0.2	52.783	62.533	62.083	38.400	40.167	52.783
		0.2	0.7	0.1	58.683	66.633	66.183	41.900	43.967	58.683
		0.3	0.1	0.6	27.975	45.500	44.825	25.600	25.850	27.975
		0.3	0.2	0.5	33.875	49.600	48.925	29.100	29.650	33.875
		0.3	0.3	0.4	39.775	53.700	53.025	32.600	33.450	39.775
		0.3	0.4	0.3	45.675	57.800	57.125	36.100	37.250	45.675
		0.3	0.5	0.2	51.575	61.900	61.225	39.600	41.050	51.575
		0.3	0.6	0.1	57.475	66.000	65.325	43.100	44.850	57.475
		0.4	0.1	0.5	32.667	48.967	48.067	30.300	30.533	32.667
		0.4	0.2	0.4	38.567	53.067	52.167	33.800	34.333	38.567
		0.4	0.3	0.3	44.467	57.167	56.267	37.300	38.133	44.467
		0.4	0.4	0.2	50.367	61.267	60.367	40.800	41.933	50.367
		0.4	0.5	0.1	56.267	65.367	64.467	44.300	45.733	56.267
		0.5	0.1	0.4	37.358	52.433	51.308	35.000	35.217	37.358
		0.5	0.2	0.3	43.258	56.533	55.408	38.500	39.017	43.258
		0.5	0.3	0.2	49.158	60.633	59.508	42.000	42.817	49.158
		0.5	0.4	0.1	55.058	64.733	63.608	45.500	46.617	55.058
		0.6	0.1	0.3	42.050	55.900	54.550	39.700	39.900	42.050
		0.6	0.2	0.2	47.950	60.000	58.650	43.200	43.700	47.950
		0.6	0.3	0.1	53.850	64.100	62.750	46.700	47.500	53.850
		0.7	0.1	0.2	46.742	59.367	57.792	44.400	44.583	46.742
		0.7	0.2	0.1	52.642	63.467	61.892	47.900	48.383	52.642
		0.8	0.1	0.1	51.433	62.833	61.033	49.100	49.267	51.433
		SUM			1559.00	2024.00	1997.00	1272.00	1306.00	1559.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
23	7	0.1	0.1	0.8	19.033	39.250	39.017	16.742	16.825	19.033
		0.1	0.2	0.7	25.233	43.850	43.617	20.642	20.825	25.233
		0.1	0.3	0.6	31.433	48.450	48.217	24.542	24.825	31.433
		0.1	0.4	0.5	37.633	53.050	52.817	28.442	28.825	37.633
		0.1	0.5	0.4	43.833	57.650	57.417	32.342	32.825	43.833
		0.1	0.6	0.3	50.033	62.250	62.017	36.242	36.825	50.033
		0.1	0.7	0.2	56.233	66.850	66.617	40.142	40.825	56.233
		0.1	0.8	0.1	62.433	71.450	71.217	44.042	44.825	62.433
		0.2	0.1	0.7	23.867	42.900	42.433	21.583	21.650	23.867
		0.2	0.2	0.6	30.067	47.500	47.033	25.483	25.650	30.067
		0.2	0.3	0.5	36.267	52.100	51.633	29.383	29.650	36.267
		0.2	0.4	0.4	42.467	56.700	56.233	33.283	33.650	42.467
		0.2	0.5	0.3	48.667	61.300	60.833	37.183	37.650	48.667
		0.2	0.6	0.2	54.867	65.900	65.433	41.083	41.650	54.867
		0.2	0.7	0.1	61.067	70.500	70.033	44.983	45.650	61.067
		0.3	0.1	0.6	28.700	46.550	45.850	26.425	26.475	28.700
		0.3	0.2	0.5	34.900	51.150	50.450	30.325	30.475	34.900
		0.3	0.3	0.4	41.100	55.750	55.050	34.225	34.475	41.100
		0.3	0.4	0.3	47.300	60.350	59.650	38.125	38.475	47.300
		0.3	0.5	0.2	53.500	64.950	64.250	42.025	42.475	53.500
		0.3	0.6	0.1	59.700	69.550	68.850	45.925	46.475	59.700
		0.4	0.1	0.5	33.533	50.200	49.267	31.267	31.300	33.533
		0.4	0.2	0.4	39.733	54.800	53.867	35.167	35.300	39.733
		0.4	0.3	0.3	45.933	59.400	58.467	39.067	39.300	45.933
		0.4	0.4	0.2	52.133	64.000	63.067	42.967	43.300	52.133
		0.4	0.5	0.1	58.333	68.600	67.667	46.867	47.300	58.333
		0.5	0.1	0.4	38.367	53.850	52.683	36.108	36.125	38.367
		0.5	0.2	0.3	44.567	58.450	57.283	40.008	40.125	44.567
		0.5	0.3	0.2	50.767	63.050	61.883	43.908	44.125	50.767
		0.5	0.4	0.1	56.967	67.650	66.483	47.808	48.125	56.967
		0.6	0.1	0.3	43.200	57.500	56.100	40.950	40.950	43.200
		0.6	0.2	0.2	49.400	62.100	60.700	44.850	44.950	49.400
		0.6	0.3	0.1	55.600	66.700	65.300	48.750	48.950	55.600
		0.7	0.1	0.2	48.033	61.150	59.517	45.792	45.775	48.033
		0.7	0.2	0.1	54.233	65.750	64.117	49.692	49.775	54.233
		0.8	0.1	0.1	52.867	64.800	62.933	50.633	50.600	52.867
		SUM			1612.00	2106.00	2078.00	1337.00	1347.00	1612.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
23	8	0.1	0.1	0.8	19.475	39.933	39.692	17.283	17.267	19.475
		0.1	0.2	0.7	25.975	45.033	44.792	21.583	21.567	25.975
		0.1	0.3	0.6	32.475	50.133	49.892	25.883	25.867	32.475
		0.1	0.4	0.5	38.975	55.233	54.992	30.183	30.167	38.975
		0.1	0.5	0.4	45.475	60.333	60.092	34.483	34.467	45.475
		0.1	0.6	0.3	51.975	65.433	65.192	38.783	38.767	51.975
		0.1	0.7	0.2	58.475	70.533	70.292	43.083	43.067	58.475
		0.1	0.8	0.1	64.975	75.633	75.392	47.383	47.367	64.975
		0.2	0.1	0.7	24.450	43.767	43.283	22.267	22.233	24.450
		0.2	0.2	0.6	30.950	48.867	48.383	26.567	26.533	30.950
		0.2	0.3	0.5	37.450	53.967	53.483	30.867	30.833	37.450
		0.2	0.4	0.4	43.950	59.067	58.583	35.167	35.133	43.950
		0.2	0.5	0.3	50.450	64.167	63.683	39.467	39.433	50.450
		0.2	0.6	0.2	56.950	69.267	68.783	43.767	43.733	56.950
		0.2	0.7	0.1	63.450	74.367	73.883	48.067	48.033	63.450
		0.3	0.1	0.6	29.425	47.600	46.875	27.250	27.200	29.425
		0.3	0.2	0.5	35.925	52.700	51.975	31.550	31.500	35.925
		0.3	0.3	0.4	42.425	57.800	57.075	35.850	35.800	42.425
		0.3	0.4	0.3	48.925	62.900	62.175	40.150	40.100	48.925
		0.3	0.5	0.2	55.425	68.000	67.275	44.450	44.400	55.425
		0.3	0.6	0.1	61.925	73.100	72.375	48.750	48.700	61.925
		0.4	0.1	0.5	34.400	51.433	50.467	32.233	32.167	34.400
		0.4	0.2	0.4	40.900	56.533	55.567	36.533	36.467	40.900
		0.4	0.3	0.3	47.400	61.633	60.667	40.833	40.767	47.400
		0.4	0.4	0.2	53.900	66.733	65.767	45.133	45.067	53.900
		0.4	0.5	0.1	60.400	71.833	70.867	49.433	49.367	60.400
		0.5	0.1	0.4	39.375	55.267	54.058	37.217	37.133	39.375
		0.5	0.2	0.3	45.875	60.367	59.158	41.517	41.433	45.875
		0.5	0.3	0.2	52.375	65.467	64.258	45.817	45.733	52.375
		0.5	0.4	0.1	58.875	70.567	69.358	50.117	50.033	58.875
		0.6	0.1	0.3	44.350	59.100	57.650	42.200	42.100	44.350
		0.6	0.2	0.2	50.850	64.200	62.750	46.500	46.400	50.850
		0.6	0.3	0.1	57.350	69.300	67.850	50.800	50.700	57.350
		0.7	0.1	0.2	49.325	62.933	61.242	47.183	47.067	49.325
		0.7	0.2	0.1	55.825	68.033	66.342	51.483	51.367	55.825
		0.8	0.1	0.1	54.300	66.767	64.833	52.167	52.033	54.300
		SUM			1665.00	2188.00	2159.00	1402.00	1400.00	1665.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
24	4	0.1	0.1	0.8	21.350	30.850	30.633	18.858	19.342	21.350
		0.1	0.2	0.7	26.550	33.850	33.633	21.558	22.542	26.550
		0.1	0.3	0.6	31.750	36.850	36.633	24.258	25.742	31.750
		0.1	0.4	0.5	36.950	39.850	39.633	26.958	28.942	36.950
		0.1	0.5	0.4	42.150	42.850	42.633	29.658	32.142	42.150
		0.1	0.6	0.3	47.350	45.850	45.633	32.358	35.342	47.350
		0.1	0.7	0.2	52.550	48.850	48.633	35.058	38.542	52.550
		0.1	0.8	0.1	57.750	51.850	51.633	37.758	41.742	57.750
		0.2	0.1	0.7	25.500	34.700	34.267	23.017	23.483	25.500
		0.2	0.2	0.6	30.700	37.700	37.267	25.717	26.683	30.700
		0.2	0.3	0.5	35.900	40.700	40.267	28.417	29.883	35.900
		0.2	0.4	0.4	41.100	43.700	43.267	31.117	33.083	41.100
		0.2	0.5	0.3	46.300	46.700	46.267	33.817	36.283	46.300
		0.2	0.6	0.2	51.500	49.700	49.267	36.517	39.483	51.500
		0.2	0.7	0.1	56.700	52.700	52.267	39.217	42.683	56.700
		0.3	0.1	0.6	29.650	38.550	37.900	27.175	27.625	29.650
		0.3	0.2	0.5	34.850	41.550	40.900	29.875	30.825	34.850
		0.3	0.3	0.4	40.050	44.550	43.900	32.575	34.025	40.050
		0.3	0.4	0.3	45.250	47.550	46.900	35.275	37.225	45.250
		0.3	0.5	0.2	50.450	50.550	49.900	37.975	40.425	50.450
		0.3	0.6	0.1	55.650	53.550	52.900	40.675	43.625	55.650
		0.4	0.1	0.5	33.800	42.400	41.533	31.333	31.767	33.800
		0.4	0.2	0.4	39.000	45.400	44.533	34.033	34.967	39.000
		0.4	0.3	0.3	44.200	48.400	47.533	36.733	38.167	44.200
		0.4	0.4	0.2	49.400	51.400	50.533	39.433	41.367	49.400
		0.4	0.5	0.1	54.600	54.400	53.533	42.133	44.567	54.600
		0.5	0.1	0.4	37.950	46.250	45.167	35.492	35.908	37.950
		0.5	0.2	0.3	43.150	49.250	48.167	38.192	39.108	43.150
		0.5	0.3	0.2	48.350	52.250	51.167	40.892	42.308	48.350
		0.5	0.4	0.1	53.550	55.250	54.167	43.592	45.508	53.550
		0.6	0.1	0.3	42.100	50.100	48.800	39.650	40.050	42.100
		0.6	0.2	0.2	47.300	53.100	51.800	42.350	43.250	47.300
		0.6	0.3	0.1	52.500	56.100	54.800	45.050	46.450	52.500
		0.7	0.1	0.2	46.250	53.950	52.433	43.808	44.192	46.250
		0.7	0.2	0.1	51.450	56.950	55.433	46.508	47.392	51.450
		0.8	0.1	0.1	50.400	57.800	56.067	47.967	48.333	50.400
		SUM			1554.00	1686.00	1660.00	1255.00	1313.00	1554.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
24	5	0.1	0.1	0.8	21.792	31.425	31.200	19.400	19.683	21.792
		0.1	0.2	0.7	27.292	34.825	34.600	22.500	23.083	27.292
		0.1	0.3	0.6	32.792	38.225	38.000	25.600	26.483	32.792
		0.1	0.4	0.5	38.292	41.625	41.400	28.700	29.883	38.292
		0.1	0.5	0.4	43.792	45.025	44.800	31.800	33.283	43.792
		0.1	0.6	0.3	49.292	48.425	48.200	34.900	36.683	49.292
		0.1	0.7	0.2	54.792	51.825	51.600	38.000	40.083	54.792
		0.1	0.8	0.1	60.292	55.225	55.000	41.100	43.483	60.292
		0.2	0.1	0.7	26.083	35.450	35.000	23.700	23.967	26.083
		0.2	0.2	0.6	31.583	38.850	38.400	26.800	27.367	31.583
		0.2	0.3	0.5	37.083	42.250	41.800	29.900	30.767	37.083
		0.2	0.4	0.4	42.583	45.650	45.200	33.000	34.167	42.583
		0.2	0.5	0.3	48.083	49.050	48.600	36.100	37.567	48.083
		0.2	0.6	0.2	53.583	52.450	52.000	39.200	40.967	53.583
		0.2	0.7	0.1	59.083	55.850	55.400	42.300	44.367	59.083
		0.3	0.1	0.6	30.375	39.475	38.800	28.000	28.250	30.375
		0.3	0.2	0.5	35.875	42.875	42.200	31.100	31.650	35.875
		0.3	0.3	0.4	41.375	46.275	45.600	34.200	35.050	41.375
		0.3	0.4	0.3	46.875	49.675	49.000	37.300	38.450	46.875
		0.3	0.5	0.2	52.375	53.075	52.400	40.400	41.850	52.375
		0.3	0.6	0.1	57.875	56.475	55.800	43.500	45.250	57.875
		0.4	0.1	0.5	34.667	43.500	42.600	32.300	32.533	34.667
		0.4	0.2	0.4	40.167	46.900	46.000	35.400	35.933	40.167
		0.4	0.3	0.3	45.667	50.300	49.400	38.500	39.333	45.667
		0.4	0.4	0.2	51.167	53.700	52.800	41.600	42.733	51.167
		0.4	0.5	0.1	56.667	57.100	56.200	44.700	46.133	56.667
		0.5	0.1	0.4	38.958	47.525	46.400	36.600	36.817	38.958
		0.5	0.2	0.3	44.458	50.925	49.800	39.700	40.217	44.458
		0.5	0.3	0.2	49.958	54.325	53.200	42.800	43.617	49.958
		0.5	0.4	0.1	55.458	57.725	56.600	45.900	47.017	55.458
		0.6	0.1	0.3	43.250	51.550	50.200	40.900	41.100	43.250
		0.6	0.2	0.2	48.750	54.950	53.600	44.000	44.500	48.750
		0.6	0.3	0.1	54.250	58.350	57.000	47.100	47.900	54.250
		0.7	0.1	0.2	47.542	55.575	54.000	45.200	45.383	47.542
		0.7	0.2	0.1	53.042	58.975	57.400	48.300	48.783	53.042
		0.8	0.1	0.1	51.833	59.600	57.800	49.500	49.667	51.833
		SUM			1607.00	1755.00	1728.00	1320.00	1354.00	1607.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
24	6	0.1	0.1	0.8	22.233	32.000	31.767	19.942	20.025	22.233
		0.1	0.2	0.7	28.033	35.800	35.567	23.442	23.625	28.033
		0.1	0.3	0.6	33.833	39.600	39.367	26.942	27.225	33.833
		0.1	0.4	0.5	39.633	43.400	43.167	30.442	30.825	39.633
		0.1	0.5	0.4	45.433	47.200	46.967	33.942	34.425	45.433
		0.1	0.6	0.3	51.233	51.000	50.767	37.442	38.025	51.233
		0.1	0.7	0.2	57.033	54.800	54.567	40.942	41.625	57.033
		0.1	0.8	0.1	62.833	58.600	58.367	44.442	45.225	62.833
		0.2	0.1	0.7	26.667	36.200	35.733	24.383	24.450	26.667
		0.2	0.2	0.6	32.467	40.000	39.533	27.883	28.050	32.467
		0.2	0.3	0.5	38.267	43.800	43.333	31.383	31.650	38.267
		0.2	0.4	0.4	44.067	47.600	47.133	34.883	35.250	44.067
		0.2	0.5	0.3	49.867	51.400	50.933	38.383	38.850	49.867
		0.2	0.6	0.2	55.667	55.200	54.733	41.883	42.450	55.667
		0.2	0.7	0.1	61.467	59.000	58.533	45.383	46.050	61.467
		0.3	0.1	0.6	31.100	40.400	39.700	28.825	28.875	31.100
		0.3	0.2	0.5	36.900	44.200	43.500	32.325	32.475	36.900
		0.3	0.3	0.4	42.700	48.000	47.300	35.825	36.075	42.700
		0.3	0.4	0.3	48.500	51.800	51.100	39.325	39.675	48.500
		0.3	0.5	0.2	54.300	55.600	54.900	42.825	43.275	54.300
		0.3	0.6	0.1	60.100	59.400	58.700	46.325	46.875	60.100
		0.4	0.1	0.5	35.533	44.600	43.667	33.267	33.300	35.533
		0.4	0.2	0.4	41.333	48.400	47.467	36.767	36.900	41.333
		0.4	0.3	0.3	47.133	52.200	51.267	40.267	40.500	47.133
		0.4	0.4	0.2	52.933	56.000	55.067	43.767	44.100	52.933
		0.4	0.5	0.1	58.733	59.800	58.867	47.267	47.700	58.733
		0.5	0.1	0.4	39.967	48.800	47.633	37.708	37.725	39.967
		0.5	0.2	0.3	45.767	52.600	51.433	41.208	41.325	45.767
		0.5	0.3	0.2	51.567	56.400	55.233	44.708	44.925	51.567
		0.5	0.4	0.1	57.367	60.200	59.033	48.208	48.525	57.367
		0.6	0.1	0.3	44.400	53.000	51.600	42.150	42.150	44.400
		0.6	0.2	0.2	50.200	56.800	55.400	45.650	45.750	50.200
		0.6	0.3	0.1	56.000	60.600	59.200	49.150	49.350	56.000
		0.7	0.1	0.2	48.833	57.200	55.567	46.592	46.575	48.833
		0.7	0.2	0.1	54.633	61.000	59.367	50.092	50.175	54.633
		0.8	0.1	0.1	53.267	61.400	59.533	51.033	51.000	53.267
		SUM			1660.00	1824.00	1796.00	1385.00	1395.00	1660.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
24	7	0.1	0.1	0.8	22.675	32.575	32.333	20.483	20.467	22.675
		0.1	0.2	0.7	28.775	36.775	36.533	24.383	24.367	28.775
		0.1	0.3	0.6	34.875	40.975	40.733	28.283	28.267	34.875
		0.1	0.4	0.5	40.975	45.175	44.933	32.183	32.167	40.975
		0.1	0.5	0.4	47.075	49.375	49.133	36.083	36.067	47.075
		0.1	0.6	0.3	53.175	53.575	53.333	39.983	39.967	53.175
		0.1	0.7	0.2	59.275	57.775	57.533	43.883	43.867	59.275
		0.1	0.8	0.1	65.375	61.975	61.733	47.783	47.767	65.375
		0.2	0.1	0.7	27.250	36.950	36.467	25.067	25.033	27.250
		0.2	0.2	0.6	33.350	41.150	40.667	28.967	28.933	33.350
		0.2	0.3	0.5	39.450	45.350	44.867	32.867	32.833	39.450
		0.2	0.4	0.4	45.550	49.550	49.067	36.767	36.733	45.550
		0.2	0.5	0.3	51.650	53.750	53.267	40.667	40.633	51.650
		0.2	0.6	0.2	57.750	57.950	57.467	44.567	44.533	57.750
		0.2	0.7	0.1	63.850	62.150	61.667	48.467	48.433	63.850
		0.3	0.1	0.6	31.825	41.325	40.600	29.650	29.600	31.825
		0.3	0.2	0.5	37.925	45.525	44.800	33.550	33.500	37.925
		0.3	0.3	0.4	44.025	49.725	49.000	37.450	37.400	44.025
		0.3	0.4	0.3	50.125	53.925	53.200	41.350	41.300	50.125
		0.3	0.5	0.2	56.225	58.125	57.400	45.250	45.200	56.225
		0.3	0.6	0.1	62.325	62.325	61.600	49.150	49.100	62.325
		0.4	0.1	0.5	36.400	45.700	44.733	34.233	34.167	36.400
		0.4	0.2	0.4	42.500	49.900	48.933	38.133	38.067	42.500
		0.4	0.3	0.3	48.600	54.100	53.133	42.033	41.967	48.600
		0.4	0.4	0.2	54.700	58.300	57.333	45.933	45.867	54.700
		0.4	0.5	0.1	60.800	62.500	61.533	49.833	49.767	60.800
		0.5	0.1	0.4	40.975	50.075	48.867	38.817	38.733	40.975
		0.5	0.2	0.3	47.075	54.275	53.067	42.717	42.633	47.075
		0.5	0.3	0.2	53.175	58.475	57.267	46.617	46.533	53.175
		0.5	0.4	0.1	59.275	62.675	61.467	50.517	50.433	59.275
		0.6	0.1	0.3	45.550	54.450	53.000	43.400	43.300	45.550
		0.6	0.2	0.2	51.650	58.650	57.200	47.300	47.200	51.650
		0.6	0.3	0.1	57.750	62.850	61.400	51.200	51.100	57.750
		0.7	0.1	0.2	50.125	58.825	57.133	47.983	47.867	50.125
		0.7	0.2	0.1	56.225	63.025	61.333	51.883	51.767	56.225
		0.8	0.1	0.1	54.700	63.200	61.267	52.567	52.433	54.700
		SUM			1713.00	1893.00	1864.00	1450.00	1448.00	1713.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
24	8	0.1	0.1	0.8	23.117	33.150	32.900	21.025	21.008	23.117
		0.1	0.2	0.7	29.517	37.750	37.500	25.325	25.308	29.517
		0.1	0.3	0.6	35.917	42.350	42.100	29.625	29.608	35.917
		0.1	0.4	0.5	42.317	46.950	46.700	33.925	33.908	42.317
		0.1	0.5	0.4	48.717	51.550	51.300	38.225	38.208	48.717
		0.1	0.6	0.3	55.117	56.150	55.900	42.525	42.508	55.117
		0.1	0.7	0.2	61.517	60.750	60.500	46.825	46.808	61.517
		0.1	0.8	0.1	67.917	65.350	65.100	51.125	51.108	67.917
		0.2	0.1	0.7	27.833	37.700	37.200	25.750	25.717	27.833
		0.2	0.2	0.6	34.233	42.300	41.800	30.050	30.017	34.233
		0.2	0.3	0.5	40.633	46.900	46.400	34.350	34.317	40.633
		0.2	0.4	0.4	47.033	51.500	51.000	38.650	38.617	47.033
		0.2	0.5	0.3	53.433	56.100	55.600	42.950	42.917	53.433
		0.2	0.6	0.2	59.833	60.700	60.200	47.250	47.217	59.833
		0.2	0.7	0.1	66.233	65.300	64.800	51.550	51.517	66.233
		0.3	0.1	0.6	32.550	42.250	41.500	30.475	30.425	32.550
		0.3	0.2	0.5	38.950	46.850	46.100	34.775	34.725	38.950
		0.3	0.3	0.4	45.350	51.450	50.700	39.075	39.025	45.350
		0.3	0.4	0.3	51.750	56.050	55.300	43.375	43.325	51.750
		0.3	0.5	0.2	58.150	60.650	59.900	47.675	47.625	58.150
		0.3	0.6	0.1	64.550	65.250	64.500	51.975	51.925	64.550
		0.4	0.1	0.5	37.267	46.800	45.800	35.200	35.133	37.267
		0.4	0.2	0.4	43.667	51.400	50.400	39.500	39.433	43.667
		0.4	0.3	0.3	50.067	56.000	55.000	43.800	43.733	50.067
		0.4	0.4	0.2	56.467	60.600	59.600	48.100	48.033	56.467
		0.4	0.5	0.1	62.867	65.200	64.200	52.400	52.333	62.867
		0.5	0.1	0.4	41.983	51.350	50.100	39.925	39.842	41.983
		0.5	0.2	0.3	48.383	55.950	54.700	44.225	44.142	48.383
		0.5	0.3	0.2	54.783	60.550	59.300	48.525	48.442	54.783
		0.5	0.4	0.1	61.183	65.150	63.900	52.825	52.742	61.183
		0.6	0.1	0.3	46.700	55.900	54.400	44.650	44.550	46.700
		0.6	0.2	0.2	53.100	60.500	59.000	48.950	48.850	53.100
		0.6	0.3	0.1	59.500	65.100	63.600	53.250	53.150	59.500
		0.7	0.1	0.2	51.417	60.450	58.700	49.375	49.258	51.417
		0.7	0.2	0.1	57.817	65.050	63.300	53.675	53.558	57.817
		0.8	0.1	0.1	56.133	65.000	63.000	54.100	53.967	56.133
		SUM			1766.00	1962.00	1932.00	1515.00	1513.00	1766.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
25	4	0.1	0.1	0.8	24.992	23.108	10.450	22.600	22.883	24.992
		0.1	0.2	0.7	30.092	25.808	13.050	25.300	25.883	30.092
		0.1	0.3	0.6	35.192	28.508	15.650	28.000	28.883	35.192
		0.1	0.4	0.5	40.292	31.208	18.250	30.700	31.883	40.292
		0.1	0.5	0.4	45.392	33.908	20.850	33.400	34.883	45.392
		0.1	0.6	0.3	50.492	36.608	23.450	36.100	37.883	50.492
		0.1	0.7	0.2	55.592	39.308	26.050	38.800	40.883	55.592
		0.1	0.8	0.1	60.692	42.008	28.650	41.500	43.883	60.692
		0.2	0.1	0.7	28.883	27.517	15.300	26.500	26.767	28.883
		0.2	0.2	0.6	33.983	30.217	17.900	29.200	29.767	33.983
		0.2	0.3	0.5	39.083	32.917	20.500	31.900	32.767	39.083
		0.2	0.4	0.4	44.183	35.617	23.100	34.600	35.767	44.183
		0.2	0.5	0.3	49.283	38.317	25.700	37.300	38.767	49.283
		0.2	0.6	0.2	54.383	41.017	28.300	40.000	41.767	54.383
		0.2	0.7	0.1	59.483	43.717	30.900	42.700	44.767	59.483
		0.3	0.1	0.6	32.775	31.925	20.150	30.400	30.650	32.775
		0.3	0.2	0.5	37.875	34.625	22.750	33.100	33.650	37.875
		0.3	0.3	0.4	42.975	37.325	25.350	35.800	36.650	42.975
		0.3	0.4	0.3	48.075	40.025	27.950	38.500	39.650	48.075
		0.3	0.5	0.2	53.175	42.725	30.550	41.200	42.650	53.175
		0.3	0.6	0.1	58.275	45.425	33.150	43.900	45.650	58.275
		0.4	0.1	0.5	36.667	36.333	25.000	34.300	34.533	36.667
		0.4	0.2	0.4	41.767	39.033	27.600	37.000	37.533	41.767
		0.4	0.3	0.3	46.867	41.733	30.200	39.700	40.533	46.867
		0.4	0.4	0.2	51.967	44.433	32.800	42.400	43.533	51.967
		0.4	0.5	0.1	57.067	47.133	35.400	45.100	46.533	57.067
		0.5	0.1	0.4	40.558	40.742	29.850	38.200	38.417	40.558
		0.5	0.2	0.3	45.658	43.442	32.450	40.900	41.417	45.658
		0.5	0.3	0.2	50.758	46.142	35.050	43.600	44.417	50.758
		0.5	0.4	0.1	55.858	48.842	37.650	46.300	47.417	55.858
		0.6	0.1	0.3	44.450	45.150	34.700	42.100	42.300	44.450
		0.6	0.2	0.2	49.550	47.850	37.300	44.800	45.300	49.550
		0.6	0.3	0.1	54.650	50.550	39.900	47.500	48.300	54.650
		0.7	0.1	0.2	48.342	49.558	39.550	46.000	46.183	48.342
		0.7	0.2	0.1	53.442	52.258	42.150	48.700	49.183	53.442
		0.8	0.1	0.1	52.233	53.967	44.400	49.900	50.067	52.233
		SUM			1655.00	1429.00	**1002.00**	1368.00	1402.00	1655.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
25	5	0.1	0.1	0.8	25.433	23.667	10.875	23.142	23.225	25.433
		0.1	0.2	0.7	30.833	26.767	13.775	26.242	26.425	30.833
		0.1	0.3	0.6	36.233	29.867	16.675	29.342	29.625	36.233
		0.1	0.4	0.5	41.633	32.967	19.575	32.442	32.825	41.633
		0.1	0.5	0.4	47.033	36.067	22.475	35.542	36.025	47.033
		0.1	0.6	0.3	52.433	39.167	25.375	38.642	39.225	52.433
		0.1	0.7	0.2	57.833	42.267	28.275	41.742	42.425	57.833
		0.1	0.8	0.1	63.233	45.367	31.175	44.842	45.625	63.233
		0.2	0.1	0.7	29.467	28.233	15.850	27.183	27.250	29.467
		0.2	0.2	0.6	34.867	31.333	18.750	30.283	30.450	34.867
		0.2	0.3	0.5	40.267	34.433	21.650	33.383	33.650	40.267
		0.2	0.4	0.4	45.667	37.533	24.550	36.483	36.850	45.667
		0.2	0.5	0.3	51.067	40.633	27.450	39.583	40.050	51.067
		0.2	0.6	0.2	56.467	43.733	30.350	42.683	43.250	56.467
		0.2	0.7	0.1	61.867	46.833	33.250	45.783	46.450	61.867
		0.3	0.1	0.6	33.500	32.800	20.825	31.225	31.275	33.500
		0.3	0.2	0.5	38.900	35.900	23.725	34.325	34.475	38.900
		0.3	0.3	0.4	44.300	39.000	26.625	37.425	37.675	44.300
		0.3	0.4	0.3	49.700	42.100	29.525	40.525	40.875	49.700
		0.3	0.5	0.2	55.100	45.200	32.425	43.625	44.075	55.100
		0.3	0.6	0.1	60.500	48.300	35.325	46.725	47.275	60.500
		0.4	0.1	0.5	37.533	37.367	25.800	35.267	35.300	37.533
		0.4	0.2	0.4	42.933	40.467	28.700	38.367	38.500	42.933
		0.4	0.3	0.3	48.333	43.567	31.600	41.467	41.700	48.333
		0.4	0.4	0.2	53.733	46.667	34.500	44.567	44.900	53.733
		0.4	0.5	0.1	59.133	49.767	37.400	47.667	48.100	59.133
		0.5	0.1	0.4	41.567	41.933	30.775	39.308	39.325	41.567
		0.5	0.2	0.3	46.967	45.033	33.675	42.408	42.525	46.967
		0.5	0.3	0.2	52.367	48.133	36.575	45.508	45.725	52.367
		0.5	0.4	0.1	57.767	51.233	39.475	48.608	48.925	57.767
		0.6	0.1	0.3	45.600	46.500	35.750	43.350	43.350	45.600
		0.6	0.2	0.2	51.000	49.600	38.650	46.450	46.550	51.000
		0.6	0.3	0.1	56.400	52.700	41.550	49.550	49.750	56.400
		0.7	0.1	0.2	49.633	51.067	40.725	47.392	47.375	49.633
		0.7	0.2	0.1	55.033	54.167	43.625	50.492	50.575	55.033
		0.8	0.1	0.1	53.667	55.633	45.700	51.433	51.400	53.667
		SUM			1708.00	1496.00	**1053.00**	1433.00	1443.00	1708.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
25	6	0.1	0.1	0.8	25.875	24.225	11.300	23.683	23.667	25.875
		0.1	0.2	0.7	31.575	27.725	14.500	27.183	27.167	31.575
		0.1	0.3	0.6	37.275	31.225	17.700	30.683	30.667	37.275
		0.1	0.4	0.5	42.975	34.725	20.900	34.183	34.167	42.975
		0.1	0.5	0.4	48.675	38.225	24.100	37.683	37.667	48.675
		0.1	0.6	0.3	54.375	41.725	27.300	41.183	41.167	54.375
		0.1	0.7	0.2	60.075	45.225	30.500	44.683	44.667	60.075
		0.1	0.8	0.1	65.775	48.725	33.700	48.183	48.167	65.775
		0.2	0.1	0.7	30.050	28.950	16.400	27.867	27.833	30.050
		0.2	0.2	0.6	35.750	32.450	19.600	31.367	31.333	35.750
		0.2	0.3	0.5	41.450	35.950	22.800	34.867	34.833	41.450
		0.2	0.4	0.4	47.150	39.450	26.000	38.367	38.333	47.150
		0.2	0.5	0.3	52.850	42.950	29.200	41.867	41.833	52.850
		0.2	0.6	0.2	58.550	46.450	32.400	45.367	45.333	58.550
		0.2	0.7	0.1	64.250	49.950	35.600	48.867	48.833	64.250
		0.3	0.1	0.6	34.225	33.675	21.500	32.050	32.000	34.225
		0.3	0.2	0.5	39.925	37.175	24.700	35.550	35.500	39.925
		0.3	0.3	0.4	45.625	40.675	27.900	39.050	39.000	45.625
		0.3	0.4	0.3	51.325	44.175	31.100	42.550	42.500	51.325
		0.3	0.5	0.2	57.025	47.675	34.300	46.050	46.000	57.025
		0.3	0.6	0.1	62.725	51.175	37.500	49.550	49.500	62.725
		0.4	0.1	0.5	38.400	38.400	26.600	36.233	36.167	38.400
		0.4	0.2	0.4	44.100	41.900	29.800	39.733	39.667	44.100
		0.4	0.3	0.3	49.800	45.400	33.000	43.233	43.167	49.800
		0.4	0.4	0.2	55.500	48.900	36.200	46.733	46.667	55.500
		0.4	0.5	0.1	61.200	52.400	39.400	50.233	50.167	61.200
		0.5	0.1	0.4	42.575	43.125	31.700	40.417	40.333	42.575
		0.5	0.2	0.3	48.275	46.625	34.900	43.917	43.833	48.275
		0.5	0.3	0.2	53.975	50.125	38.100	47.417	47.333	53.975
		0.5	0.4	0.1	59.675	53.625	41.300	50.917	50.833	59.675
		0.6	0.1	0.3	46.750	47.850	36.800	44.600	44.500	46.750
		0.6	0.2	0.2	52.450	51.350	40.000	48.100	48.000	52.450
		0.6	0.3	0.1	58.150	54.850	43.200	51.600	51.500	58.150
		0.7	0.1	0.2	50.925	52.575	41.900	48.783	48.667	50.925
		0.7	0.2	0.1	56.625	56.075	45.100	52.283	52.167	56.625
		0.8	0.1	0.1	55.100	57.300	47.000	52.967	52.833	55.100
		SUM			1761.00	1563.00	1104.00	1498.00	1496.00	1761.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
25	7	0.1	0.1	0.8	26.317	24.783	11.725	24.225	24.208	26.317
		0.1	0.2	0.7	32.317	28.683	15.225	28.125	28.108	32.317
		0.1	0.3	0.6	38.317	32.583	18.725	32.025	32.008	38.317
		0.1	0.4	0.5	44.317	36.483	22.225	35.925	35.908	44.317
		0.1	0.5	0.4	50.317	40.383	25.725	39.825	39.808	50.317
		0.1	0.6	0.3	56.317	44.283	29.225	43.725	43.708	56.317
		0.1	0.7	0.2	62.317	48.183	32.725	47.625	47.608	62.317
		0.1	0.8	0.1	68.317	52.083	36.225	51.525	51.508	68.317
		0.2	0.1	0.7	30.633	29.667	16.950	28.550	28.517	30.633
		0.2	0.2	0.6	36.633	33.567	20.450	32.450	32.417	36.633
		0.2	0.3	0.5	42.633	37.467	23.950	36.350	36.317	42.633
		0.2	0.4	0.4	48.633	41.367	27.450	40.250	40.217	48.633
		0.2	0.5	0.3	54.633	45.267	30.950	44.150	44.117	54.633
		0.2	0.6	0.2	60.633	49.167	34.450	48.050	48.017	60.633
		0.2	0.7	0.1	66.633	53.067	37.950	51.950	51.917	66.633
		0.3	0.1	0.6	34.950	34.550	22.175	32.875	32.825	34.950
		0.3	0.2	0.5	40.950	38.450	25.675	36.775	36.725	40.950
		0.3	0.3	0.4	46.950	42.350	29.175	40.675	40.625	46.950
		0.3	0.4	0.3	52.950	46.250	32.675	44.575	44.525	52.950
		0.3	0.5	0.2	58.950	50.150	36.175	48.475	48.425	58.950
		0.3	0.6	0.1	64.950	54.050	39.675	52.375	52.325	64.950
		0.4	0.1	0.5	39.267	39.433	27.400	37.200	37.133	39.267
		0.4	0.2	0.4	45.267	43.333	30.900	41.100	41.033	45.267
		0.4	0.3	0.3	51.267	47.233	34.400	45.000	44.933	51.267
		0.4	0.4	0.2	57.267	51.133	37.900	48.900	48.833	57.267
		0.4	0.5	0.1	63.267	55.033	41.400	52.800	52.733	63.267
		0.5	0.1	0.4	43.583	44.317	32.625	41.525	41.442	43.583
		0.5	0.2	0.3	49.583	48.217	36.125	45.425	45.342	49.583
		0.5	0.3	0.2	55.583	52.117	39.625	49.325	49.242	55.583
		0.5	0.4	0.1	61.583	56.017	43.125	53.225	53.142	61.583
		0.6	0.1	0.3	47.900	49.200	37.850	45.850	45.750	47.900
		0.6	0.2	0.2	53.900	53.100	41.350	49.750	49.650	53.900
		0.6	0.3	0.1	59.900	57.000	44.850	53.650	53.550	59.900
		0.7	0.1	0.2	52.217	54.083	43.075	50.175	50.068	52.217
		0.7	0.2	0.1	58.217	57.983	46.575	54.075	53.958	58.217
		0.8	0.1	0.1	56.533	58.967	48.300	54.500	54.367	56.533
		SUM			1814.00	1630.00	1155.00	1563.00	1561.00	1814.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
25	8	0.1	0.2	0.7	33.058	29.642	15.950	29.067	29.050	33.058
		0.1	0.3	0.6	39.358	33.942	19.750	33.367	33.350	39.358
		0.1	0.4	0.5	45.658	38.242	23.550	37.667	37.650	45.658
		0.1	0.5	0.4	51.958	42.542	27.350	41.967	41.950	51.958
		0.1	0.6	0.3	58.258	46.842	31.150	46.267	46.250	58.258
		0.1	0.7	0.2	64.558	51.142	34.950	50.567	50.550	64.558
		0.1	0.8	0.1	70.858	55.442	38.750	54.867	54.850	70.858
		0.2	0.1	0.7	31.217	30.383	17.500	29.233	29.200	31.217
		0.2	0.2	0.6	37.517	34.683	21.300	33.533	33.500	37.517
		0.2	0.3	0.5	43.817	38.983	25.100	37.833	37.800	43.817
		0.2	0.4	0.4	50.117	43.283	28.900	42.133	42.100	50.117
		0.2	0.5	0.3	56.417	47.583	32.700	46.433	46.400	56.417
		0.2	0.6	0.2	62.717	51.883	36.500	50.733	50.700	62.717
		0.2	0.7	0.1	69.017	56.183	40.300	55.033	55.000	69.017
		0.3	0.1	0.6	35.675	35.425	22.850	33.700	33.650	35.675
		0.3	0.2	0.5	41.975	39.725	26.650	38.000	37.950	41.975
		0.3	0.3	0.4	48.275	44.025	30.450	42.300	42.250	48.275
		0.3	0.4	0.3	54.575	48.325	34.250	46.600	46.550	54.575
		0.3	0.5	0.2	60.875	52.625	38.050	50.900	50.850	60.875
		0.3	0.6	0.1	67.175	56.925	41.850	55.200	55.150	67.175
		0.4	0.1	0.5	40.133	40.467	28.200	38.167	38.100	40.133
		0.4	0.2	0.4	46.433	44.767	32.000	42.467	42.400	46.433
		0.4	0.3	0.3	52.733	49.067	35.800	46.767	46.700	52.733
		0.4	0.4	0.2	59.033	53.367	39.600	51.067	51.000	59.033
		0.4	0.5	0.1	65.333	57.667	43.400	55.367	55.300	65.333
		0.5	0.1	0.4	44.592	45.508	33.550	42.633	42.550	44.592
		0.5	0.2	0.3	50.892	49.808	37.350	46.933	46.850	50.892
		0.5	0.3	0.2	57.192	54.108	41.150	51.233	51.150	57.192
		0.5	0.4	0.1	63.492	58.408	44.950	55.533	55.450	63.492
		0.6	0.1	0.3	49.050	50.550	38.900	47.100	47.000	49.050
		0.6	0.2	0.2	55.350	54.850	42.700	51.400	51.300	55.350
		0.6	0.3	0.1	61.650	59.150	46.500	55.700	55.600	61.650
		0.7	0.1	0.2	53.508	55.592	44.250	51.567	51.450	53.508
		0.7	0.2	0.1	59.808	59.892	48.050	55.867	55.750	59.808
		0.8	0.1	0.1	57.967	60.633	49.600	56.033	55.900	57.967
		SUM			1867.00	1697.00	1206.00	1628.00	1626.00	1867.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
26	4	0.1	0.1	0.8	28.633	13.267	13.275	26.342	26.425	28.633
		0.1	0.2	0.7	33.633	15.867	15.875	29.042	29.225	33.633
		0.1	0.3	0.6	38.633	18.467	18.475	31.742	32.025	38.633
		0.1	0.4	0.5	43.633	21.067	21.075	34.442	34.825	43.633
		0.1	0.5	0.4	48.633	23.667	23.675	37.142	37.625	48.633
		0.1	0.6	0.3	53.633	26.267	26.275	39.842	40.425	53.633
		0.1	0.7	0.2	58.633	28.867	28.875	42.542	43.225	58.633
		0.1	0.8	0.1	63.633	31.467	31.475	45.242	46.025	63.633
		0.2	0.1	0.7	32.267	17.933	17.950	29.983	30.050	32.267
		0.2	0.2	0.6	37.267	20.533	20.550	32.683	32.850	37.267
		0.2	0.3	0.5	42.267	23.133	23.150	35.383	35.650	42.267
		0.2	0.4	0.4	47.267	25.733	25.750	38.083	38.450	47.267
		0.2	0.5	0.3	52.267	28.333	28.350	40.783	41.250	52.267
		0.2	0.6	0.2	57.267	30.933	30.950	43.483	44.050	57.267
		0.2	0.7	0.1	62.267	33.533	33.550	46.183	46.850	62.267
		0.3	0.1	0.6	35.900	22.600	22.625	33.625	33.675	35.900
		0.3	0.2	0.5	40.900	25.200	25.225	36.325	36.475	40.900
		0.3	0.3	0.4	45.900	27.800	27.825	39.025	39.275	45.900
		0.3	0.4	0.3	50.900	30.400	30.425	41.725	42.075	50.900
		0.3	0.5	0.2	55.900	33.000	33.025	44.425	44.875	55.900
		0.3	0.6	0.1	60.900	35.600	35.625	47.125	47.675	60.900
		0.4	0.1	0.5	39.533	27.267	27.300	37.267	37.300	39.533
		0.4	0.2	0.4	44.533	29.867	29.900	39.967	40.100	44.533
		0.4	0.3	0.3	49.533	32.467	32.500	42.667	42.900	49.533
		0.4	0.4	0.2	54.533	35.067	35.100	45.367	45.700	54.533
		0.4	0.5	0.1	59.533	37.667	37.700	48.067	48.500	59.533
		0.5	0.1	0.4	43.167	31.933	31.975	40.908	40.925	43.167
		0.5	0.2	0.3	48.167	34.533	34.575	43.608	43.725	48.167
		0.5	0.3	0.2	53.167	37.133	37.175	46.308	46.525	53.167
		0.5	0.4	0.1	58.167	39.733	39.775	49.008	49.325	58.167
		0.6	0.1	0.3	46.800	36.600	36.650	44.550	44.550	46.800
		0.6	0.2	0.2	51.800	39.200	39.250	47.250	47.350	51.800
		0.6	0.3	0.1	56.800	41.800	41.850	49.950	50.150	56.800
		0.7	0.1	0.2	50.433	41.267	41.325	48.192	48.175	50.433
		0.7	0.2	0.1	55.433	43.867	43.925	50.892	50.975	55.433
		0.8	0.1	0.1	54.067	45.933	46.000	51.833	51.800	54.067
		SUM			1756.00	1088.00	1089.00	1481.00	1491.00	1756.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
26	5	0.1	0.1	0.8	29.075	13.692	13.700	26.883	26.867	29.075
		0.1	0.2	0.7	34.375	16.592	16.600	29.983	29.967	34.375
		0.1	0.3	0.6	39.675	19.492	19.500	33.083	33.067	39.675
		0.1	0.4	0.5	44.975	22.392	22.400	36.183	36.167	44.975
		0.1	0.5	0.4	50.275	25.292	25.300	39.283	39.267	50.275
		0.1	0.6	0.3	55.575	28.192	28.200	42.383	42.367	55.575
		0.1	0.7	0.2	60.875	31.092	31.100	45.483	45.467	60.875
		0.1	0.8	0.1	66.175	33.992	34.000	48.583	48.567	66.175
		0.2	0.1	0.7	32.850	18.483	18.500	30.667	30.633	32.850
		0.2	0.2	0.6	38.150	21.383	21.400	33.767	33.733	38.150
		0.2	0.3	0.5	43.450	24.283	24.300	36.867	36.833	43.450
		0.2	0.4	0.4	48.750	27.183	27.200	39.967	39.933	48.750
		0.2	0.5	0.3	54.050	30.083	30.100	43.067	43.033	54.050
		0.2	0.6	0.2	59.350	32.983	33.000	46.167	46.133	59.350
		0.2	0.7	0.1	64.650	35.883	35.900	49.267	49.233	64.650
		0.3	0.1	0.6	36.625	23.275	23.300	34.450	34.400	36.625
		0.3	0.2	0.5	41.925	26.175	26.200	37.550	37.500	41.925
		0.3	0.3	0.4	47.225	29.075	29.100	40.650	40.600	47.225
		0.3	0.4	0.3	52.525	31.975	32.000	43.750	43.700	52.525
		0.3	0.5	0.2	57.825	34.875	34.900	46.850	46.800	57.825
		0.3	0.6	0.1	63.125	37.775	37.800	49.950	49.900	63.125
		0.4	0.1	0.5	40.400	28.067	28.100	38.233	38.167	40.400
		0.4	0.2	0.4	45.700	30.967	31.000	41.333	41.267	45.700
		0.4	0.3	0.3	51.000	33.867	33.900	44.433	44.367	51.000
		0.4	0.4	0.2	56.300	36.767	36.800	47.533	47.467	56.300
		0.4	0.5	0.1	61.600	39.667	39.700	50.633	50.567	61.600
		0.5	0.1	0.4	44.175	32.858	32.900	42.017	41.933	44.175
		0.5	0.2	0.3	49.475	35.758	35.800	45.117	45.033	49.475
		0.5	0.3	0.2	54.775	38.658	38.700	48.217	48.133	54.775
		0.5	0.4	0.1	60.075	41.558	41.600	51.317	51.233	60.075
		0.6	0.1	0.3	47.950	37.650	37.700	45.800	45.700	47.950
		0.6	0.2	0.2	53.250	40.550	40.600	48.900	48.800	53.250
		0.6	0.3	0.1	58.550	43.450	43.500	52.000	51.900	58.550
		0.7	0.1	0.2	51.725	42.442	42.500	49.583	49.467	51.725
		0.7	0.2	0.1	57.025	45.342	45.400	52.683	52.567	57.025
		0.8	0.1	0.1	55.500	47.233	47.300	53.367	53.233	55.500
		SUM			1809.00	1139.00	1140.00	1546.00	1544.00	1809.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
26	6	0.1	0.1	0.8	29.517	14.117	14.125	27.425	27.408	29.517
		0.1	0.2	0.7	35.117	17.317	17.325	30.925	30.908	35.117
		0.1	0.3	0.6	40.717	20.517	20.525	34.425	34.408	40.717
		0.1	0.4	0.5	46.317	23.717	23.725	37.925	37.908	46.317
		0.1	0.5	0.4	51.917	26.917	26.925	41.425	41.408	51.917
		0.1	0.6	0.3	57.517	30.117	30.125	44.925	44.908	57.517
		0.1	0.7	0.2	63.117	33.317	33.325	48.425	48.408	63.117
		0.1	0.8	0.1	68.717	36.517	36.525	51.925	51.908	68.717
		0.2	0.1	0.7	33.433	19.033	19.050	31.350	31.317	33.433
		0.2	0.2	0.6	39.033	22.233	22.250	34.850	34.817	39.033
		0.2	0.3	0.5	44.633	25.433	25.450	38.350	38.317	44.633
		0.2	0.4	0.4	50.233	28.633	28.650	41.850	41.817	50.233
		0.2	0.5	0.3	55.833	31.833	31.850	45.350	45.317	55.833
		0.2	0.6	0.2	61.433	35.033	35.050	48.850	48.817	61.433
		0.2	0.7	0.1	67.033	38.233	38.250	52.350	52.317	67.033
		0.3	0.1	0.6	37.350	23.950	23.975	35.275	35.225	37.350
		0.3	0.2	0.5	42.950	27.150	27.175	38.775	38.725	42.950
		0.3	0.3	0.4	48.550	30.350	30.375	42.275	42.225	48.550
		0.3	0.4	0.3	54.150	33.550	33.575	45.775	45.725	54.150
		0.3	0.5	0.2	59.750	36.750	36.775	49.275	49.225	59.750
		0.3	0.6	0.1	65.350	39.950	39.975	52.775	52.725	65.350
		0.4	0.1	0.5	41.267	28.867	28.900	39.200	39.133	41.267
		0.4	0.2	0.4	46.867	32.067	32.100	42.700	42.633	46.867
		0.4	0.3	0.3	52.467	35.267	35.300	46.200	46.133	52.467
		0.4	0.4	0.2	58.067	38.467	38.500	49.700	49.633	58.067
		0.4	0.5	0.1	63.667	41.667	41.700	53.200	53.133	63.667
		0.5	0.1	0.4	45.183	33.783	33.825	43.125	43.042	45.183
		0.5	0.2	0.3	50.783	36.983	37.025	46.625	46.542	50.783
		0.5	0.3	0.2	56.383	40.183	40.225	50.125	50.042	56.383
		0.5	0.4	0.1	61.983	43.383	43.425	53.625	53.542	61.983
		0.6	0.1	0.3	49.100	38.700	38.750	47.050	46.950	49.100
		0.6	0.2	0.2	54.700	41.900	41.950	50.550	50.450	54.700
		0.6	0.3	0.1	60.300	45.100	45.150	54.050	53.950	60.300
		0.7	0.1	0.2	53.017	43.617	43.675	50.975	50.858	53.017
		0.7	0.2	0.1	58.617	46.817	46.875	54.475	54.358	58.617
		0.8	0.1	0.1	56.933	48.533	48.600	54.900	54.767	56.933
		SUM			1862.00	1190.00	1191.00	1611.00	1609.00	1862.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
26	7	0 1	0.1	0.8	29 958	14.542	14 550	27.967	27 950	29 958
		0.1	0 2	0.7	35 858	18 042	18 050	31.867	31.850	35 858
		0.1	0 3	0 6	41.758	21.542	21 550	35 767	35 750	41.758
		0.1	0 4	0 5	47.658	25.042	25.050	39 667	39.650	47.658
		0.1	0 5	0 4	53.558	28.542	28.550	43.567	43.550	53.558
		0.1	0.6	0 3	59 458	32 042	32 050	47 467	47 450	59 458
		0 1	0 7	0 2	65 358	35 542	35.550	51.367	51.350	65.358
		0 1	0 8	0 1	71.258	39.042	39.050	55 267	55.250	71 258
		0.2	0 1	0.7	34 017	19 583	19 600	32 033	32.000	34.017
		0 2	0 2	0.6	39 917	23 083	23.100	35.933	35 900	39 917
		0 2	0.3	0 5	45 817	26.583	26.600	39 833	39.800	45 817
		0 2	0.4	0 4	51,717	30.083	30.100	43 733	43.700	51 717
		0 2	0.5	0 3	57.617	33.583	33.600	47 633	47 600	57 617
		0 2	0.6	0 2	63 517	37.083	37.100	51.533	51 500	63 517
		0 2	0 7	0.1	69 417	40 583	40 600	55 433	55.400	69 417
		0 3	0 1	0 6	38 075	24 625	24 650	36.100	36.050	38.075
		0 3	0 2	0 5	43 975	28 125	28 150	40.000	39 950	43.975
		0.3	0 3	0.4	49.875	31.625	31.650	43 900	43 850	49.875
		0 3	0.4	0.3	55 775	35.125	35 150	47 800	47 750	55 775
		0 3	0 5	0.2	61.675	38 625	38 650	51 700	51 650	61.675
		0 3	0 6	0.1	67.575	42.125	42.150	55 600	55 550	67.575
		0 4	0 1	0 5	42.133	29 667	29.700	40 167	40 100	42.133
		0 4	0 2	0 4	48 033	33 167	33 200	44 067	44.000	48 033
		0.4	0 3	0 3	53 933	36 667	36 700	47.967	47.900	53 933
		0 4	0 4	0 2	59 833	40.167	40.200	51 867	51 800	59 833
		0 4	0 5	0 1	65 733	43.667	43 700	55 767	55.700	65 733
		0 5	0.1	0 4	46.192	34 708	34 750	44 233	44 150	46.192
		0 5	0.2	0 3	52.092	38.208	38 250	48 133	48.050	52.092
		0 5	0.3	0 2	57.992	41.708	41 750	52 033	51 950	57.992
		0 5	0.4	0 1	63 892	45.208	45 250	55.933	55 850	63.892
		0 6	0.1	0 3	50.250	39.750	39 800	48.300	48 200	50 250
		0 6	0 2	0 2	56 150	43.250	43.300	52.200	52 100	56.150
		0 6	0 3	0 1	62 050	46 750	46.800	56 100	56 000	62 050
		0 7	0 1	0.2	54 308	44 792	44 850	52 367	52 250	54.308
		0 7	0 2	0 1	60 208	48 292	48 350	56.267	56 150	60.208
		0 8	0 1	0.1	58 367	49 833	49 900	56 433	56 300	58 367
		SUM			1915 00	1241 00	1242 00	1676.00	1674 00	1915 00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
26	8	0 1	0 1	0 8	30 400	14 967	14 975	28 508	28 492	30 400
		0.1	0 2	0.7	36 600	18 767	18 775	32.808	32.792	36 600
		0.1	0 3	0.6	42 800	22 567	22.575	37 108	37.092	42.800
		0 1	0.4	0 5	49,000	26.367	26 375	41 408	41.392	49.000
		0 1	0 5	0 4	55.200	30 167	30 175	45 708	45 692	55.200
		0 1	0 6	0 3	61 400	33 967	33.975	50 008	49 992	61.400
		0.1	0 7	0 2	67 600	37 767	37 775	54.308	54 292	67 600
		0 1	0 8	0.1	73 800	41 567	41 575	58 608	58 592	73 800
		0 2	0.1	0 7	34.600	20 133	20 150	32.717	32 683	34 600
		0.2	0 2	0 6	40 800	23.933	23 950	37 017	36.983	40 800
		0 2	0 3	0.5	47 000	27 733	27.750	41 317	41 283	47.000
		0 2	0 4	0.4	53 200	31 533	31.550	45 617	45 583	53 200
		0 2	0.5	0 3	59 400	35 333	35 350	49 917	49 883	59 400
		0 2	0.6	0 2	65 600	39.133	39.150	54.217	54 183	65.600
		0.2	0.7	0 1	71.800	42.933	42.950	58.517	58 483	71.800
		0.3	0 1	0.6	38 800	25.300	25.325	36.925	36 875	38 800
		0.3	0.2	0 5	45 000	29 100	29 125	41.225	41 175	45 000
		0 3	0 3	0.4	51.200	32 900	32 925	45.525	45 475	51.200
		0.3	0 4	0.3	57.400	36.700	36 725	49.825	49 775	57.400
		0 3	0.5	0.2	63 600	40 500	40 525	54.125	54 075	63 600
		0 3	0 6	0 1	69 800	44.300	44 325	58 425	58 375	69 800
		0 4	0 1	0 5	43 000	30 467	30.500	41 133	41 067	43 000
		0 4	0 2	0 4	49 200	34 267	34 300	45 433	45 367	49 200
		0.4	0 3	0 3	55 400	38.067	38 100	49.733	49.667	55 400
		0 4	0 4	0 2	61 600	41 867	41.900	54 033	53 967	61.600
		0 4	0.5	0 1	67.800	45 667	45 700	58 333	58.267	67 800
		0 5	0 1	0 4	47 200	35.633	35 675	45 342	45.258	47 200
		0 5	0 2	0.3	53 400	39.433	39 475	49 642	49.558	53 400
		0 5	0 3	0.2	59 600	43 233	43 275	53 942	53 858	59 600
		0.5	0 4	0 1	65.800	47.033	47.075	58 242	58.158	65 800
		0 6	0.1	0 3	51 400	40 800	40 850	49 550	49 450	51 400
		0.6	0 2	0 2	57 600	44 600	44 650	53 850	53 750	57 600
		0 6	0.3	0 1	63.800	48.400	48 450	58 150	58 050	63 800
		0 7	0.1	0 2	55.600	45 967	46 025	53.758	53 642	55 600
		0 7	0.2	0 1	61,800	49.767	49 825	58 058	57.942	61.800
		0 8	0.1	0 1	59 800	51 133	51.200	57.967	57 833	59 800
		SUM			1968 00	1292.00	1293 00	1741 00	1739 00	1968 00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
27	4	0.1	0.1	0.8	18.517	16.092	16.100	16.842	17.625	18.517
		0.1	0.2	0.7	23.517	18.692	18.700	20.142	21.725	23.517
		0.1	0.3	0.6	28.517	21.292	21.300	23.442	25.825	28.517
		0.1	0.4	0.5	33.517	23.892	23.900	26.742	29.925	33.517
		0.1	0.5	0.4	38.517	26.492	26.500	30.042	34.025	38.517
		0.1	0.6	0.3	43.517	29.092	29.100	33.342	38.125	43.517
		0.1	0.7	0.2	48.517	31.692	31.700	36.642	42.225	48.517
		0.1	0.8	0.1	53.517	34.292	34.300	39.942	46.325	53.517
		0.2	0.1	0.7	23.033	20.583	20.600	21.383	22.150	23.033
		0.2	0.2	0.6	28.033	23.183	23.200	24.683	26.250	28.033
		0.2	0.3	0.5	33.033	25.783	25.800	27.983	30.350	33.033
		0.2	0.4	0.4	38.033	28.383	28.400	31.283	34.450	38.033
		0.2	0.5	0.3	43.033	30.983	31.000	34.583	38.550	43.033
		0.2	0.6	0.2	48.033	33.583	33.600	37.883	42.650	48.033
		0.2	0.7	0.1	53.033	36.183	36.200	41.183	46.750	53.033
		0.3	0.1	0.6	27.550	25.075	25.100	25.925	26.675	27.550
		0.3	0.2	0.5	32.550	27.675	27.700	29.225	30.775	32.550
		0.3	0.3	0.4	37.550	30.275	30.300	32.525	34.875	37.550
		0.3	0.4	0.3	42.550	32.875	32.900	35.825	38.975	42.550
		0.3	0.5	0.2	47.550	35.475	35.500	39.125	43.075	47.550
		0.3	0.6	0.1	52.550	38.075	38.100	42.425	47.175	52.550
		0.4	0.1	0.5	32.067	29.567	29.600	30.467	31.200	32.067
		0.4	0.2	0.4	37.067	32.167	32.200	33.767	35.300	37.067
		0.4	0.3	0.3	42.067	34.767	34.800	37.067	39.400	42.067
		0.4	0.4	0.2	47.067	37.367	37.400	40.367	43.500	47.067
		0.4	0.5	0.1	52.067	39.967	40.000	43.667	47.600	52.067
		0.5	0.1	0.4	36.583	34.058	34.100	35.008	35.725	36.583
		0.5	0.2	0.3	41.583	36.658	36.700	38.308	39.825	41.583
		0.5	0.3	0.2	46.583	39.258	39.300	41.608	43.925	46.583
		0.5	0.4	0.1	51.583	41.858	41.900	44.908	48.025	51.583
		0.6	0.1	0.3	41.100	38.550	38.600	39.550	40.250	41.100
		0.6	0.2	0.2	46.100	41.150	41.200	42.850	44.350	46.100
		0.6	0.3	0.1	51.100	43.750	43.800	46.150	48.450	51.100
		0.7	0.1	0.2	45.617	43.042	43.100	44.092	44.775	45.617
		0.7	0.2	0.1	50.617	45.642	45.700	47.392	48.875	50.617
		0.8	0.1	0.1	50.133	47.533	47.600	48.633	49.300	50.133
		SUM			1466.00	1175.00	1176.00	1265.00	1359.00	1466.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
27	5	0.1	0.1	0.8	18.842	16.517	16.525	17.167	17.950	18.842
		0.1	0.2	0.7	24.042	19.417	19.425	20.667	22.250	24.042
		0.1	0.3	0.6	29.242	22.317	22.325	24.167	26.550	29.242
		0.1	0.4	0.5	34.442	25.217	25.225	27.667	30.850	34.442
		0.1	0.5	0.4	39.642	28.117	28.125	31.167	35.150	39.642
		0.1	0.6	0.3	44.842	31.017	31.025	34.667	39.450	44.842
		0.1	0.7	0.2	50.042	33.917	33.925	38.167	43.750	50.042
		0.1	0.8	0.1	55.242	36.817	36.825	41.667	48.050	55.242
		0.2	0.1	0.7	23.483	21.133	21.150	21.833	22.600	23.483
		0.2	0.2	0.6	28.683	24.033	24.050	25.333	26.900	28.683
		0.2	0.3	0.5	33.883	26.933	26.950	28.833	31.200	33.883
		0.2	0.4	0.4	39.083	29.833	29.850	32.333	35.500	39.083
		0.2	0.5	0.3	44.283	32.733	32.750	35.833	39.800	44.283
		0.2	0.6	0.2	49.483	35.633	35.650	39.333	44.100	49.483
		0.2	0.7	0.1	54.683	38.533	38.550	42.833	48.400	54.683
		0.3	0.1	0.6	28.125	25.750	25.775	26.500	27.250	28.125
		0.3	0.2	0.5	33.325	28.650	28.675	30.000	31.550	33.325
		0.3	0.3	0.4	38.525	31.550	31.575	33.500	35.850	38.525
		0.3	0.4	0.3	43.725	34.450	34.475	37.000	40.150	43.725
		0.3	0.5	0.2	48.925	37.350	37.375	40.500	44.450	48.925
		0.3	0.6	0.1	54.125	40.250	40.275	44.000	48.750	54.125
		0.4	0.1	0.5	32.767	30.367	30.400	31.167	31.900	32.767
		0.4	0.2	0.4	37.967	33.267	33.300	34.667	36.200	37.967
		0.4	0.3	0.3	43.167	36.167	36.200	38.167	40.500	43.167
		0.4	0.4	0.2	48.367	39.067	39.100	41.667	44.800	48.367
		0.4	0.5	0.1	53.567	41.967	42.000	45.167	49.100	53.567
		0.5	0.1	0.4	37.408	34.983	35.025	35.833	36.550	37.408
		0.5	0.2	0.3	42.608	37.883	37.925	39.333	40.850	42.608
		0.5	0.3	0.2	47.808	40.783	40.825	42.833	45.150	47.808
		0.5	0.4	0.1	53.008	43.683	43.725	46.333	49.450	53.008
		0.6	0.1	0.3	42.050	39.600	39.650	40.500	41.200	42.050
		0.6	0.2	0.2	47.250	42.500	42.550	44.000	45.500	47.250
		0.6	0.3	0.1	52.450	45.400	45.450	47.500	49.800	52.450
		0.7	0.1	0.2	46.692	44.217	44.275	45.167	45.850	46.692
		0.7	0.2	0.1	51.892	47.117	47.175	48.667	50.150	51.892
		0.8	0.1	0.1	51.333	48.833	48.900	49.833	50.500	51.333
		SUM			1505.00	1226.00	1227.00	1304.00	1398.00	1505.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
27	6	0.1	0.1	0.8	19.167	16.942	16.950	17.492	18.275	19.167
		0.1	0.2	0.7	24.567	20.142	20.150	21.192	22.775	24.567
		0.1	0.3	0.6	29.967	23.342	23.350	24.892	27.275	29.967
		0.1	0.4	0.5	35.367	26.542	26.550	28.592	31.775	35.367
		0.1	0.5	0.4	40.767	29.742	29.750	32.292	36.275	40.767
		0.1	0.6	0.3	46.167	32.942	32.950	35.992	40.775	46.167
		0.1	0.7	0.2	51.567	36.142	36.150	39.692	45.275	51.567
		0.1	0.8	0.1	56.967	39.342	39.350	43.392	49.775	56.967
		0.2	0.1	0.7	23.933	21.683	21.700	22.283	23.050	23.933
		0.2	0.2	0.6	29.333	24.883	24.900	25.983	27.550	29.333
		0.2	0.3	0.5	34.733	28.083	28.100	29.683	32.050	34.733
		0.2	0.4	0.4	40.133	31.283	31.300	33.383	36.550	40.133
		0.2	0.5	0.3	45.533	34.483	34.500	37.083	41.050	45.533
		0.2	0.6	0.2	50.933	37.683	37.700	40.783	45.550	50.933
		0.2	0.7	0.1	56.333	40.883	40.900	44.483	50.050	56.333
		0.3	0.1	0.6	28.700	26.425	26.450	27.075	27.825	28.700
		0.3	0.2	0.5	34.100	29.625	29.650	30.775	32.325	34.100
		0.3	0.3	0.4	39.500	32.825	32.850	34.475	36.825	39.500
		0.3	0.4	0.3	44.900	36.025	36.050	38.175	41.325	44.900
		0.3	0.5	0.2	50.300	39.225	39.250	41.875	45.825	50.300
		0.3	0.6	0.1	55.700	42.425	42.450	45.575	50.325	55.700
		0.4	0.1	0.5	33.467	31.167	31.200	31.867	32.600	33.467
		0.4	0.2	0.4	38.867	34.367	34.400	35.567	37.100	38.867
		0.4	0.3	0.3	44.267	37.567	37.600	39.267	41.600	44.267
		0.4	0.4	0.2	49.667	40.767	40.800	42.967	46.100	49.667
		0.4	0.5	0.1	55.067	43.967	44.000	46.667	50.600	55.067
		0.5	0.1	0.4	38.233	35.908	35.950	36.658	37.375	38.233
		0.5	0.2	0.3	43.633	39.108	39.150	40.358	41.875	43.633
		0.5	0.3	0.2	49.033	42.308	42.350	44.058	46.375	49.033
		0.5	0.4	0.1	54.433	45.508	45.550	47.758	50.875	54.433
		0.6	0.1	0.3	43.000	40.650	40.700	41.450	42.150	43.000
		0.6	0.2	0.2	48.400	43.850	43.900	45.150	46.650	48.400
		0.6	0.3	0.1	53.800	47.050	47.100	48.850	51.150	53.800
		0.7	0.1	0.2	47.767	45.392	45.450	46.242	46.925	47.767
		0.7	0.2	0.1	53.167	48.592	48.650	49.942	51.425	53.167
		0.8	0.1	0.1	52.533	50.133	50.200	51.033	51.700	52.533
		SUM			1544.00	1277.00	1278.00	1343.00	1437.00	1544.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
27	7	0.1	0.1	0.8	19.492	17.367	17.375	17.817	18.600	19.492
		0.1	0.2	0.7	25.092	20.867	20.875	21.717	23.300	25.092
		0.1	0.3	0.6	30.692	24.367	24.375	25.617	28.000	30.692
		0.1	0.4	0.5	36.292	27.867	27.875	29.517	32.700	36.292
		0.1	0.5	0.4	41.892	31.367	31.375	33.417	37.400	41.892
		0.1	0.6	0.3	47.492	34.867	34.875	37.317	42.100	47.492
		0.1	0.7	0.2	53.092	38.367	38.375	41.217	46.800	53.092
		0.1	0.8	0.1	58.692	41.867	41.875	45.117	51.500	58.692
		0.2	0.1	0.7	24.383	22.233	22.250	22.733	23.500	24.383
		0.2	0.2	0.6	29.983	25.733	25.750	26.633	28.200	29.983
		0.2	0.3	0.5	35.583	29.233	29.250	30.533	32.900	35.583
		0.2	0.4	0.4	41.183	32.733	32.750	34.433	37.600	41.183
		0.2	0.5	0.3	46.783	36.233	36.250	38.333	42.300	46.783
		0.2	0.6	0.2	52.383	39.733	39.750	42.233	47.000	52.383
		0.2	0.7	0.1	57.983	43.233	43.250	46.133	51.700	57.983
		0.3	0.1	0.6	29.275	27.100	27.125	27.650	28.400	29.275
		0.3	0.2	0.5	34.875	30.600	30.625	31.550	33.100	34.875
		0.3	0.3	0.4	40.475	34.100	34.125	35.450	37.800	40.475
		0.3	0.4	0.3	46.075	37.600	37.625	39.350	42.500	46.075
		0.3	0.5	0.2	51.675	41.100	41.125	43.250	47.200	51.675
		0.3	0.6	0.1	57.275	44.600	44.625	47.150	51.900	57.275
		0.4	0.1	0.5	34.167	31.967	32.000	32.567	33.300	34.167
		0.4	0.2	0.4	39.767	35.467	35.500	36.467	38.000	39.767
		0.4	0.3	0.3	45.367	38.967	39.000	40.367	42.700	45.367
		0.4	0.4	0.2	50.967	42.467	42.500	44.267	47.400	50.967
		0.4	0.5	0.1	56.567	45.967	46.000	48.167	52.100	56.567
		0.5	0.1	0.4	39.058	36.833	36.875	37.483	38.200	39.058
		0.5	0.2	0.3	44.658	40.333	40.375	41.383	42.900	44.658
		0.5	0.3	0.2	50.258	43.833	43.875	45.283	47.600	50.258
		0.5	0.4	0.1	55.858	47.333	47.375	49.183	52.300	55.858
		0.6	0.1	0.3	43.950	41.700	41.750	42.400	43.100	43.950
		0.6	0.2	0.2	49.550	45.200	45.250	46.300	47.800	49.550
		0.6	0.3	0.1	55.150	48.700	48.750	50.200	52.500	55.150
		0.7	0.1	0.2	48.842	46.567	46.625	47.317	48.000	48.842
		0.7	0.2	0.1	54.442	50.067	50.125	51.217	52.700	54.442
		0.8	0.1	0.1	53.733	51.433	51.500	52.233	52.900	53.733
		SUM			1583.00	1328.00	1329.00	1382.00	1476.00	1583.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
27	8	0.1	0.1	0.8	19.817	17.792	17 800	18 142	18 925	19 817
		0.1	0 2	0.7	25 617	21.592	21 600	22 242	23 825	25 617
		0.1	0 3	0.6	31.417	25 392	25 400	26 342	28 725	31 417
		0.1	0.4	0 5	37 217	29 192	29 200	30 442	33.625	37.217
		0 1	0 5	0 4	43 017	32 992	33.000	34.542	38 525	43 017
		0 1	0 6	0 3	48.817	36 792	36 800	38 642	43 425	48.817
		0.1	0 7	0.2	54 617	40 592	40.600	42.742	48 325	54 617
		0 1	0 8	0 1	60 417	44.392	44.400	46 842	53.225	60 417
		0 2	0 1	0 7	24 833	22.783	22.800	23 183	23 950	24 833
		0 2	0 2	0 6	30 633	26.583	26 600	27 283	28.850	30.633
		0 2	0 3	0 5	36 433	30 383	30.400	31 383	33.750	36 433
		0 2	0 4	0 4	42.233	34 183	34 200	35 483	38 650	42.233
		0 2	0.5	0 3	48.033	37.983	38 000	39 583	43 550	48.033
		0 2	0 6	0 2	53 833	41.783	41 800	43.683	48 450	53 833
		0.2	0 7	0.1	59 633	45 583	45 600	47.783	53 350	59 633
		0.3	0 1	0.6	29 850	27 775	27.800	28 225	28 975	29 850
		0 3	0 2	0.5	35 650	31 575	31.600	32.325	33 875	35 650
		0.3	0 3	0.4	41.450	35 375	35 400	36 425	38 775	41 450
		0 3	0 4	0 3	47.250	39.175	39 200	40 525	43 675	47 250
		0 3	0 5	0.2	53 050	42.975	43 000	44 625	48 575	53 050
		0 3	0 6	0.1	58 850	46.775	46.800	48 725	53 475	58 850
		0.4	0.1	0.5	34 867	32 767	32 800	33.267	34.000	34.867
		0 4	0.2	0 4	40.667	36 567	36 600	37 367	38 900	40 667
		0 4	0.3	0 3	46 467	40 367	40 400	41 467	43 800	46 467
		0 4	0.4	0 2	52 267	44.167	44 200	45 567	48 700	52.267
		0 4	0 5	0 1	58 067	47 967	48.000	49 667	53 600	58.067
		0 5	0 1	0 4	39 883	37 758	37.800	38.308	39 025	39 883
		0 5	0 2	0 3	45 683	41 558	41 600	42.408	43.925	45 683
		0 5	0 3	0 2	51.483	45.358	45 400	46 508	48 825	51 483
		0.5	0 4	0 1	57 283	49 158	49 200	50 608	53.725	57.283
		0 6	0 1	0.3	44 900	42 750	42.800	43 350	44.050	44 900
		0 6	0.2	0 2	50.700	46 550	46 600	47.450	48 950	50 700
		0 6	0 3	0 1	56.500	50 350	50 400	51.550	53 850	56 500
		0 7	0 1	0 2	49 917	47 742	47.800	48 392	49 075	49 917
		0 7	0 2	0.1	55 717	51 542	51.600	52.492	53 975	55 717
		0.8	0 1	0 1	54 933	52.733	52 800	53.433	54.100	54 933
		SUM			1622.00	1379.00	1380 00	1421 00	1515 00	1622.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
28	4	0.1	0 1	0 8	21 242	18.917	18 925	19 567	20.350	21 242
		0 1	0 2	0 7	26 142	21.517	21 525	22 767	24.350	26 142
		0.1	0 3	0.6	31.042	24.117	24.125	25 967	28.350	31 042
		0 1	0 4	0.5	35.942	26 717	26.725	29 167	32.350	35.942
		0 1	0 5	0 4	40 842	29.317	29 325	32.367	36 350	40 842
		0 1	0 6	0 3	45 742	31.917	31.925	35 567	40 350	45.742
		0 1	0.7	0 2	50 642	34.517	34.525	38 767	44 350	50.642
		0.1	0 8	0 1	55.542	37.117	37 125	41 967	48.350	55 542
		0 2	0 1	0 7	25 583	23.233	23.250	23 933	24.700	25 583
		0 2	0 2	0 6	30.483	25 833	25.850	27 133	28.700	30.483
		0.2	0 3	0 5	35 383	28 433	28 450	30.333	32.700	35 383
		0.2	0 4	0.4	40 283	31 033	31 050	33.533	36.700	40 283
		0 2	0.5	0.3	45.183	33 633	33 650	36 733	40 700	45.183
		0 2	0 6	0 2	50 083	36 233	36.250	39 933	44 700	50.083
		0 2	0 7	0 1	54 983	38 833	38.850	43 133	48 700	54.983
		0 3	0 1	0 6	29 925	27 550	27.575	28.300	29 050	29 925
		0 3	0.2	0 5	34 825	30 150	30.175	31.500	33 050	34.825
		0 3	0.3	0 4	39.725	32 750	32.775	34.700	37 050	39 725
		0 3	0 4	0 3	44.625	35 350	35.375	37.900	41 050	44.625
		0.3	0 5	0 2	49 525	37.950	37 975	41.100	45 050	49 525
		0 3	0 6	0.1	54 425	40 550	40 575	44.300	49.050	54 425
		0 4	0.1	0 5	34 267	31 867	31.900	32 667	33 400	34.267
		0.4	0 2	0.4	39 167	34 467	34 500	35 867	37.400	39.167
		0 4	0 3	0 3	44 067	37 067	37.100	39 067	41 400	44.067
		0 4	0.4	0 2	48 967	39 667	39.700	42.267	45 400	48 967
		0 4	0 5	0 1	53 867	42 267	42.300	45 467	49 400	53.867
		0 5	0 1	0 4	38.608	36.183	36.225	37 033	37 750	38.608
		0 5	0 2	0 3	43.508	38.783	38.825	40.233	41 750	43 508
		0 5	0 3	0.2	48 408	41.383	41.425	43.433	45 750	48 408
		0.5	0 4	0 1	53 308	43 983	44.025	46 633	49.750	53 308
		0 6	0 1	0.3	42 950	40 500	40 550	41 400	42.100	42 950
		0 6	0 2	0 2	47 850	43 100	43 150	44 600	46.100	47.850
		0 6	0 3	0 1	52 750	45 700	45.750	47 800	50.100	52 750
		0 7	0 1	0.2	47 292	44.817	44 875	45 767	46 450	47 292
		0 7	0 2	0 1	52.192	47 417	47.475	48 967	50 450	52.192
		0 8	0 1	0 1	51.633	49 133	49 200	50 133	50 800	51.633
		SUM			1541.00	1262 00	1263.00	1340.00	1434 00	1541.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
28	5	0.1	0.1	0.8	21.567	19.342	19.350	19.892	20.675	21.567
		0.1	0.2	0.7	26.667	22.242	22.250	23.292	24.875	26.667
		0.1	0.3	0.6	31.767	25.142	25.150	26.692	29.075	31.767
		0.1	0.4	0.5	36.867	28.042	28.050	30.092	33.275	36.867
		0.1	0.5	0.4	41.967	30.942	30.950	33.492	37.475	41.967
		0.1	0.6	0.3	47.067	33.842	33.850	36.892	41.675	47.067
		0.1	0.7	0.2	52.167	36.742	36.750	40.292	45.875	52.167
		0.1	0.8	0.1	57.267	39.642	39.650	43.692	50.075	57.267
		0.2	0.1	0.7	26.033	23.783	23.800	24.383	25.150	26.033
		0.2	0.2	0.6	31.133	26.683	26.700	27.783	29.350	31.133
		0.2	0.3	0.5	36.233	29.583	29.600	31.183	33.550	36.233
		0.2	0.4	0.4	41.333	32.483	32.500	34.583	37.750	41.333
		0.2	0.5	0.3	46.433	35.383	35.400	37.983	41.950	46.433
		0.2	0.6	0.2	51.533	38.283	38.300	41.383	46.150	51.533
		0.2	0.7	0.1	56.633	41.183	41.200	44.783	50.350	56.633
		0.3	0.1	0.6	30.500	28.225	28.250	28.875	29.625	30.500
		0.3	0.2	0.5	35.600	31.125	31.150	32.275	33.825	35.600
		0.3	0.3	0.4	40.700	34.025	34.050	35.675	38.025	40.700
		0.3	0.4	0.3	45.800	36.925	36.950	39.075	42.225	45.800
		0.3	0.5	0.2	50.900	39.825	39.850	42.475	46.425	50.900
		0.3	0.6	0.1	56.000	42.725	42.750	45.875	50.625	56.000
		0.4	0.1	0.5	34.967	32.667	32.700	33.367	34.100	34.967
		0.4	0.2	0.4	40.067	35.567	35.600	36.767	38.300	40.067
		0.4	0.3	0.3	45.167	38.467	38.500	40.167	42.500	45.167
		0.4	0.4	0.2	50.267	41.367	41.400	43.567	46.700	50.267
		0.4	0.5	0.1	55.367	44.267	44.300	46.967	50.900	55.367
		0.5	0.1	0.4	39.433	37.108	37.150	37.858	38.575	39.433
		0.5	0.2	0.3	44.533	40.008	40.050	41.258	42.775	44.533
		0.5	0.3	0.2	49.633	42.908	42.950	44.658	46.975	49.633
		0.5	0.4	0.1	54.733	45.808	45.850	48.058	51.175	54.733
		0.6	0.1	0.3	43.900	41.550	41.600	42.350	43.050	43.900
		0.6	0.2	0.2	49.000	44.450	44.500	45.750	47.250	49.000
		0.6	0.3	0.1	54.100	47.350	47.400	49.150	51.450	54.100
		0.7	0.1	0.2	48.367	45.992	46.050	46.842	47.525	48.367
		0.7	0.2	0.1	53.467	48.892	48.950	50.242	51.725	53.467
		0.8	0.1	0.1	52.833	50.433	50.500	51.333	52.000	52.833
		SUM			1580.00	1313.00	1314.00	1379.00	1473.00	1580.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
28	6	0.1	0.1	0.8	21.892	19.767	19.775	20.217	21.000	21.892
		0.1	0.2	0.7	27.192	22.967	22.975	23.617	25.400	27.192
		0.1	0.3	0.6	32.492	26.167	26.175	27.417	29.800	32.492
		0.1	0.4	0.5	37.792	29.367	29.375	31.017	34.200	37.792
		0.1	0.5	0.4	43.092	32.567	32.575	34.617	38.600	43.092
		0.1	0.6	0.3	48.392	35.767	35.775	38.217	43.000	48.392
		0.1	0.7	0.2	53.692	38.967	38.975	41.817	47.400	53.692
		0.1	0.8	0.1	58.992	42.167	42.175	45.417	51.800	58.992
		0.2	0.1	0.7	26.483	24.333	24.350	24.833	25.600	26.483
		0.2	0.2	0.6	31.783	27.533	27.550	28.433	30.000	31.783
		0.2	0.3	0.5	37.083	30.733	30.750	32.033	34.400	37.083
		0.2	0.4	0.4	42.383	33.933	33.950	35.633	38.800	42.383
		0.2	0.5	0.3	47.683	37.133	37.150	39.233	43.200	47.683
		0.2	0.6	0.2	52.983	40.333	40.350	42.833	47.600	52.983
		0.2	0.7	0.1	58.283	43.533	43.550	46.433	52.000	58.283
		0.3	0.1	0.6	31.075	28.900	28.925	29.450	30.200	31.075
		0.3	0.2	0.5	36.375	32.100	32.125	33.050	34.600	36.375
		0.3	0.3	0.4	41.675	35.300	35.325	36.650	39.000	41.675
		0.3	0.4	0.3	46.975	38.500	38.525	40.250	43.400	46.975
		0.3	0.5	0.2	52.275	41.700	41.725	43.850	47.800	52.275
		0.3	0.6	0.1	57.575	44.900	44.925	47.450	52.200	57.575
		0.4	0.1	0.5	35.667	33.467	33.500	34.067	34.800	35.667
		0.4	0.2	0.4	40.967	36.667	36.700	37.667	39.200	40.967
		0.4	0.3	0.3	46.267	39.867	39.900	41.267	43.600	46.267
		0.4	0.4	0.2	51.567	43.067	43.100	44.867	48.000	51.567
		0.4	0.5	0.1	56.867	46.267	46.300	48.467	52.400	56.867
		0.5	0.1	0.4	40.258	38.033	38.075	38.683	39.400	40.258
		0.5	0.2	0.3	45.558	41.233	41.275	42.283	43.800	45.558
		0.5	0.3	0.2	50.858	44.433	44.475	45.883	48.200	50.858
		0.5	0.4	0.1	56.158	47.633	47.675	49.483	52.600	56.158
		0.6	0.1	0.3	44.850	42.600	42.650	43.300	44.000	44.850
		0.6	0.2	0.2	50.150	45.800	45.850	46.900	48.400	50.150
		0.6	0.3	0.1	55.450	49.000	49.050	50.500	52.800	55.450
		0.7	0.1	0.2	49.442	47.167	47.225	47.917	48.600	49.442
		0.7	0.2	0.1	54.742	50.367	50.425	51.517	53.000	54.742
		0.8	0.1	0.1	54.033	51.733	51.800	52.533	53.200	54.033
		SUM			1619.00	1364.00	1365.00	1418.00	1512.00	1619.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
28	7	0.1	0.1	0.8	22.217	20.192	20.200	20.542	21.325	22.217
		0.1	0.2	0.7	27.717	23.692	23.700	24.342	25.925	27.717
		0.1	0.3	0.6	33.217	27.192	27.200	28.142	30.525	33.217
		0.1	0.4	0.5	38.717	30.692	30.700	31.942	35.125	38.717
		0.1	0.5	0.4	44.217	34.192	34.200	35.742	39.725	44.217
		0.1	0.6	0.3	49.717	37.692	37.700	39.542	44.325	49.717
		0.1	0.7	0.2	55.217	41.192	41.200	43.342	48.925	55.217
		0.1	0.8	0.1	60.717	44.692	44.700	47.142	53.525	60.717
		0.2	0.1	0.7	26.933	24.883	24.900	25.283	26.050	26.933
		0.2	0.2	0.6	32.433	28.383	28.400	29.083	30.650	32.433
		0.2	0.3	0.5	37.933	31.883	31.900	32.883	35.250	37.933
		0.2	0.4	0.4	43.433	35.383	35.400	36.683	39.850	43.433
		0.2	0.5	0.3	48.933	38.883	38.900	40.483	44.450	48.933
		0.2	0.6	0.2	54.433	42.383	42.400	44.283	49.050	54.433
		0.2	0.7	0.1	59.933	45.883	45.900	48.083	53.650	59.933
		0.3	0.1	0.6	31.650	29.575	29.600	30.025	30.775	31.650
		0.3	0.2	0.5	37.150	33.075	33.100	33.825	35.375	37.150
		0.3	0.3	0.4	42.650	36.575	36.600	37.625	39.975	42.650
		0.3	0.4	0.3	48.150	40.075	40.100	41.425	44.575	48.150
		0.3	0.5	0.2	53.650	43.575	43.600	45.225	49.175	53.650
		0.3	0.6	0.1	59.150	47.075	47.100	49.025	53.775	59.150
		0.4	0.1	0.5	36.367	34.267	34.300	34.767	35.500	36.367
		0.4	0.2	0.4	41.867	37.767	37.800	38.567	40.100	41.867
		0.4	0.3	0.3	47.367	41.267	41.300	42.367	44.700	47.367
		0.4	0.4	0.2	52.867	44.767	44.800	46.167	49.300	52.867
		0.4	0.5	0.1	58.367	48.267	48.300	49.967	53.900	58.367
		0.5	0.1	0.4	41.083	38.958	39.000	39.508	40.225	41.083
		0.5	0.2	0.3	46.583	42.458	42.500	43.308	44.825	46.583
		0.5	0.3	0.2	52.083	45.958	46.000	47.108	49.425	52.083
		0.5	0.4	0.1	57.583	49.458	49.500	50.908	54.025	57.583
		0.6	0.1	0.3	45.800	43.650	43.700	44.250	44.950	45.800
		0.6	0.2	0.2	51.300	47.150	47.200	48.050	49.550	51.300
		0.6	0.3	0.1	56.800	50.650	50.700	51.850	54.150	56.800
		0.7	0.1	0.2	50.517	48.342	48.400	48.992	49.675	50.517
		0.7	0.2	0.1	56.017	51.842	51.900	52.792	54.275	56.017
		0.8	0.1	0.1	55.233	53.033	53.100	53.733	54.400	55.233
		SUM			1658.00	1415.00	1416.00	1457.00	1551.00	1658.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
28	8	0.1	0.1	0.8	22.542	20.617	20.625	20.867	21.650	22.542
		0.1	0.2	0.7	28.242	24.417	24.425	24.867	26.450	28.242
		0.1	0.3	0.6	33.942	28.217	28.225	28.867	31.250	33.942
		0.1	0.4	0.5	39.642	32.017	32.025	32.867	36.050	39.642
		0.1	0.5	0.4	45.342	35.817	35.825	36.867	40.850	45.342
		0.1	0.6	0.3	51.042	39.617	39.625	40.867	45.650	51.042
		0.1	0.7	0.2	56.742	43.417	43.425	44.867	50.450	56.742
		0.1	0.8	0.1	62.442	47.217	47.225	48.867	55.250	62.442
		0.2	0.1	0.7	27.383	25.433	25.450	25.733	26.500	27.383
		0.2	0.2	0.6	33.083	29.233	29.250	29.733	31.300	33.083
		0.2	0.3	0.5	38.783	33.033	33.050	33.733	36.100	38.783
		0.2	0.4	0.4	44.483	36.833	36.850	37.733	40.900	44.483
		0.2	0.5	0.3	50.183	40.633	40.650	41.733	45.700	50.183
		0.2	0.6	0.2	55.883	44.433	44.450	45.733	50.500	55.883
		0.2	0.7	0.1	61.583	48.233	48.250	49.733	55.300	61.583
		0.3	0.1	0.6	32.225	30.250	30.275	30.600	31.350	32.225
		0.3	0.2	0.5	37.925	34.050	34.075	34.600	36.150	37.925
		0.3	0.3	0.4	43.625	37.850	37.875	38.600	40.950	43.625
		0.3	0.4	0.3	49.325	41.650	41.675	42.600	45.750	49.325
		0.3	0.5	0.2	55.025	45.450	45.475	46.600	50.550	55.025
		0.3	0.6	0.1	60.725	49.250	49.275	50.600	55.350	60.725
		0.4	0.1	0.5	37.067	35.067	35.100	35.467	36.200	37.067
		0.4	0.2	0.4	42.767	38.867	38.900	39.467	41.000	42.767
		0.4	0.3	0.3	48.467	42.667	42.700	43.467	45.800	48.467
		0.4	0.4	0.2	54.167	46.467	46.500	47.467	50.600	54.167
		0.4	0.5	0.1	59.867	50.267	50.300	51.467	55.400	59.867
		0.5	0.1	0.4	41.908	39.883	39.925	40.333	41.050	41.908
		0.5	0.2	0.3	47.608	43.683	43.725	44.333	45.850	47.608
		0.5	0.3	0.2	53.308	47.483	47.525	48.333	50.650	53.308
		0.5	0.4	0.1	59.008	51.283	51.325	52.333	55.450	59.008
		0.6	0.1	0.3	46.750	44.700	44.750	45.200	45.900	46.750
		0.6	0.2	0.2	52.450	48.500	48.550	49.200	50.700	52.450
		0.6	0.3	0.1	58.150	52.300	52.350	53.200	55.500	58.150
		0.7	0.1	0.2	51.592	49.517	49.575	50.067	50.750	51.592
		0.7	0.2	0.1	57.292	53.317	53.375	54.067	55.550	57.292
		0.8	0.1	0.1	56.433	54.333	54.400	54.933	55.600	56.433
		SUM			1697.00	1466.00	1467.00	1496.00	1590.00	1697.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
29	4	0.1	0.1	0.8	23.967	21.742	21.750	22.292	23.075	23.967
		0.1	0.2	0.7	28.767	24.342	24.350	25.392	26.975	28.767
		0.1	0.3	0.6	33.567	26.942	26.950	28.492	30.875	33.567
		0.1	0.4	0.5	38.367	29.542	29.550	31.592	34.775	38.367
		0.1	0.5	0.4	43.167	32.142	32.150	34.692	38.675	43.167
		0.1	0.6	0.3	47.967	34.742	34.750	37.792	42.575	47.967
		0.1	0.7	0.2	52.767	37.342	37.350	40.892	46.475	52.767
		0.1	0.8	0.1	57.567	39.942	39.950	43.992	50.375	57.567
		0.2	0.1	0.7	28.133	25.883	25.900	26.483	27.250	28.133
		0.2	0.2	0.6	32.933	28.483	28.500	29.583	31.150	32.933
		0.2	0.3	0.5	37.733	31.083	31.100	32.683	35.050	37.733
		0.2	0.4	0.4	42.533	33.683	33.700	35.783	38.950	42.533
		0.2	0.5	0.3	47.333	36.283	36.300	38.883	42.850	47.333
		0.2	0.6	0.2	52.133	38.883	38.900	41.983	46.750	52.133
		0.2	0.7	0.1	56.933	41.483	41.500	45.083	50.650	56.933
		0.3	0.1	0.6	32.300	30.025	30.050	30.675	31.425	32.300
		0.3	0.2	0.5	37.100	32.625	32.650	33.775	35.325	37.100
		0.3	0.3	0.4	41.900	35.225	35.250	36.875	39.225	41.900
		0.3	0.4	0.3	46.700	37.825	37.850	39.975	43.125	46.700
		0.3	0.5	0.2	51.500	40.425	40.450	43.075	47.025	51.500
		0.3	0.6	0.1	56.300	43.025	43.050	46.175	50.925	56.300
		0.4	0.1	0.5	36.467	34.167	34.200	34.867	35.600	36.467
		0.4	0.2	0.4	41.267	36.767	36.800	37.967	39.500	41.267
		0.4	0.3	0.3	46.067	39.367	39.400	41.067	43.400	46.067
		0.4	0.4	0.2	50.867	41.967	42.000	44.167	47.300	50.867
		0.4	0.5	0.1	55.667	44.567	44.600	47.267	51.200	55.667
		0.5	0.1	0.4	40.633	38.308	38.350	39.058	39.775	40.633
		0.5	0.2	0.3	45.433	40.908	40.950	42.158	43.675	45.433
		0.5	0.3	0.2	50.233	43.508	43.550	45.258	47.575	50.233
		0.5	0.4	0.1	55.033	46.108	46.150	48.358	51.475	55.033
		0.6	0.1	0.3	44.800	42.450	42.500	43.250	43.950	44.800
		0.6	0.2	0.2	49.600	45.050	45.100	46.350	47.850	49.600
		0.6	0.3	0.1	54.400	47.650	47.700	49.450	51.750	54.400
		0.7	0.1	0.2	48.967	46.592	46.650	47.442	48.125	48.967
		0.7	0.2	0.1	53.767	49.192	49.250	50.542	52.025	53.767
		0.8	0.1	0.1	53.133	50.733	50.800	51.633	52.300	53.133
		SUM			1616.00	1349.00	1350.00	1415.00	1509.00	1616.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
29	5	0.1	0.1	0.8	24.292	22.167	22.175	22.617	23.400	24.292
		0.1	0.2	0.7	29.292	25.067	25.075	25.917	27.500	29.292
		0.1	0.3	0.6	34.292	27.967	27.975	29.217	31.600	34.292
		0.1	0.4	0.5	39.292	30.867	30.875	32.517	35.700	39.292
		0.1	0.5	0.4	44.292	33.767	33.775	35.817	39.800	44.292
		0.1	0.6	0.3	49.292	36.667	36.675	39.117	43.900	49.292
		0.1	0.7	0.2	54.292	39.567	39.575	42.417	48.000	54.292
		0.1	0.8	0.1	59.292	42.467	42.475	45.717	52.100	59.292
		0.2	0.1	0.7	28.583	26.433	26.450	26.933	27.700	28.583
		0.2	0.2	0.6	33.583	29.333	29.350	30.233	31.800	33.583
		0.2	0.3	0.5	38.583	32.233	32.250	33.533	35.900	38.583
		0.2	0.4	0.4	43.583	35.133	35.150	36.833	40.000	43.583
		0.2	0.5	0.3	48.583	38.033	38.050	40.133	44.100	48.583
		0.2	0.6	0.2	53.583	40.933	40.950	43.433	48.200	53.583
		0.2	0.7	0.1	58.583	43.833	43.850	46.733	52.300	58.583
		0.3	0.1	0.6	32.875	30.700	30.725	31.250	32.000	32.875
		0.3	0.2	0.5	37.875	33.600	33.625	34.550	36.100	37.875
		0.3	0.3	0.4	42.875	36.500	36.525	37.850	40.200	42.875
		0.3	0.4	0.3	47.875	39.400	39.425	41.150	44.300	47.875
		0.3	0.5	0.2	52.875	42.300	42.325	44.450	48.400	52.875
		0.3	0.6	0.1	57.875	45.200	45.225	47.750	52.500	57.875
		0.4	0.1	0.5	37.167	34.967	35.000	35.567	36.300	37.167
		0.4	0.2	0.4	42.167	37.867	37.900	38.867	40.400	42.167
		0.4	0.3	0.3	47.167	40.767	40.800	42.167	44.500	47.167
		0.4	0.4	0.2	52.167	43.667	43.700	45.467	48.600	52.167
		0.4	0.5	0.1	57.167	46.567	46.600	48.767	52.700	57.167
		0.5	0.1	0.4	41.458	39.233	39.275	39.883	40.600	41.458
		0.5	0.2	0.3	46.458	42.133	42.175	43.183	44.700	46.458
		0.5	0.3	0.2	51.458	45.033	45.075	46.483	48.800	51.458
		0.5	0.4	0.1	56.458	47.933	47.975	49.783	52.900	56.458
		0.6	0.1	0.3	45.750	43.500	43.550	44.200	44.900	45.750
		0.6	0.2	0.2	50.750	46.400	46.450	47.500	49.000	50.750
		0.6	0.3	0.1	55.750	49.300	49.350	50.800	53.100	55.750
		0.7	0.1	0.2	50.042	47.767	47.825	48.517	49.200	50.042
		0.7	0.2	0.1	55.042	50.667	50.725	51.817	53.300	55.042
		0.8	0.1	0.1	54.333	52.033	52.100	52.833	53.500	54.333
		SUM			1655.00	1400.00	1401.00	1454.00	1548.00	1655.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
29	6	0.1	0.1	0.8	24.617	22.592	22.600	22.942	23.725	24.617
		0.1	0.2	0.7	29.817	25.792	25.800	26.442	28.025	29.817
		0.1	0.3	0.6	35.017	28.992	29.000	29.942	32.325	35.017
		0.1	0.4	0.5	40.217	32.192	32.200	33.442	36.625	40.217
		0.1	0.5	0.4	45.417	35.392	35.400	36.942	40.925	45.417
		0.1	0.6	0.3	50.617	38.592	38.600	40.442	45.225	50.617
		0.1	0.7	0.2	55.817	41.792	41.800	43.942	49.525	55.817
		0.1	0.8	0.1	61.017	44.992	45.000	47.442	53.825	61.017
		0.2	0.1	0.7	29.033	26.983	27.000	27.383	28.150	29.033
		0.2	0.2	0.6	34.233	30.183	30.200	30.883	32.450	34.233
		0.2	0.3	0.5	39.433	33.383	33.400	34.383	36.750	39.433
		0.2	0.4	0.4	44.633	36.583	36.600	37.883	41.050	44.633
		0.2	0.5	0.3	49.833	39.783	39.800	41.383	45.350	49.833
		0.2	0.6	0.2	55.033	42.983	43.000	44.883	49.650	55.033
		0.2	0.7	0.1	60.233	46.183	46.200	48.383	53.950	60.233
		0.3	0.1	0.6	33.450	31.375	31.400	31.825	32.575	33.450
		0.3	0.2	0.5	38.650	34.575	34.600	35.325	36.875	38.650
		0.3	0.3	0.4	43.850	37.775	37.800	38.825	41.175	43.850
		0.3	0.4	0.3	49.050	40.975	41.000	42.325	45.475	49.050
		0.3	0.5	0.2	54.250	44.175	44.200	45.825	49.775	54.250
		0.3	0.6	0.1	59.450	47.375	47.400	49.325	54.075	59.450
		0.4	0.1	0.5	37.867	35.767	35.800	36.267	37.000	37.867
		0.4	0.2	0.4	43.067	38.967	39.000	39.767	41.300	43.067
		0.4	0.3	0.3	48.267	42.167	42.200	43.267	45.600	48.267
		0.4	0.4	0.2	53.467	45.367	45.400	46.767	49.900	53.467
		0.4	0.5	0.1	58.667	48.567	48.600	50.267	54.200	58.667
		0.5	0.1	0.4	42.283	40.158	40.200	40.708	41.425	42.283
		0.5	0.2	0.3	47.483	43.358	43.400	44.208	45.725	47.483
		0.5	0.3	0.2	52.683	46.558	46.600	47.708	50.025	52.683
		0.5	0.4	0.1	57.883	49.758	49.800	51.208	54.325	57.883
		0.6	0.1	0.3	46.700	44.550	44.600	45.150	45.850	46.700
		0.6	0.2	0.2	51.900	47.750	47.800	48.650	50.150	51.900
		0.6	0.3	0.1	57.100	50.950	51.000	52.150	54.450	57.100
		0.7	0.1	0.2	51.117	48.942	49.000	49.592	50.275	51.117
		0.7	0.2	0.1	56.317	52.142	52.200	53.092	54.575	56.317
		0.8	0.1	0.1	55.533	53.333	53.400	54.033	54.700	55.533
		SUM			1694.00	1451.00	1452.00	1493.00	1587.00	1694.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
29	7	0.1	0.1	0.8	24.942	23.017	23.025	23.267	24.050	24.942
		0.1	0.2	0.7	30.342	26.517	26.525	26.967	28.550	30.342
		0.1	0.3	0.6	35.742	30.017	30.025	30.667	33.050	35.742
		0.1	0.4	0.5	41.142	33.517	33.525	34.367	37.550	41.142
		0.1	0.5	0.4	46.542	37.017	37.025	38.067	42.050	46.542
		0.1	0.6	0.3	51.942	40.517	40.525	41.767	46.550	51.942
		0.1	0.7	0.2	57.342	44.017	44.025	45.467	51.050	57.342
		0.1	0.8	0.1	62.742	47.517	47.525	49.167	55.550	62.742
		0.2	0.1	0.7	29.483	27.533	27.550	27.833	28.600	29.483
		0.2	0.2	0.6	34.883	31.033	31.050	31.533	33.100	34.883
		0.2	0.3	0.5	40.283	34.533	34.550	35.233	37.600	40.283
		0.2	0.4	0.4	45.683	38.033	38.050	38.933	42.100	45.683
		0.2	0.5	0.3	51.083	41.533	41.550	42.633	46.600	51.083
		0.2	0.6	0.2	56.483	45.033	45.050	46.333	51.100	56.483
		0.2	0.7	0.1	61.883	48.533	48.550	50.033	55.600	61.883
		0.3	0.1	0.6	34.025	32.050	32.075	32.400	33.150	34.025
		0.3	0.2	0.5	39.425	35.550	35.575	36.100	37.650	39.425
		0.3	0.3	0.4	44.825	39.050	39.075	39.800	42.150	44.825
		0.3	0.4	0.3	50.225	42.550	42.575	43.500	46.650	50.225
		0.3	0.5	0.2	55.625	46.050	46.075	47.200	51.150	55.625
		0.3	0.6	0.1	61.025	49.550	49.575	50.900	55.650	61.025
		0.4	0.1	0.5	38.567	36.567	36.600	36.967	37.700	38.567
		0.4	0.2	0.4	43.967	40.067	40.100	40.667	42.200	43.967
		0.4	0.3	0.3	49.367	43.567	43.600	44.367	46.700	49.367
		0.4	0.4	0.2	54.767	47.067	47.100	48.067	51.200	54.767
		0.4	0.5	0.1	60.167	50.567	50.600	51.767	55.700	60.167
		0.5	0.1	0.4	43.108	41.083	41.125	41.533	42.250	43.108
		0.5	0.2	0.3	48.508	44.583	44.625	45.233	46.750	48.508
		0.5	0.3	0.2	53.908	48.083	48.125	48.933	51.250	53.908
		0.5	0.4	0.1	59.308	51.583	51.625	52.633	55.750	59.308
		0.6	0.1	0.3	47.650	45.600	45.650	46.100	46.800	47.650
		0.6	0.2	0.2	53.050	49.100	49.150	49.600	51.300	53.050
		0.6	0.3	0.1	58.450	52.600	52.650	53.500	55.800	58.450
		0.7	0.1	0.2	52.192	50.117	50.175	50.667	51.350	52.192
		0.7	0.2	0.1	57.592	53.617	53.675	54.367	55.850	57.592
		0.8	0.1	0.1	56.733	54.633	54.700	55.233	55.900	56.733
		SUM			1733.00	1502.00	1503.00	1532.00	1626.00	1733.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
29	6	0.1	0.1	0.8	25.267	23.442	23.450	23.592	24.375	25.267
		0.1	0.2	0.7	30.867	27.242	27.250	27.492	29.075	30.867
		0.1	0.3	0.6	36.467	31.042	31.050	31.392	33.775	36.467
		0.1	0.4	0.5	42.067	34.842	34.850	35.292	38.475	42.067
		0.1	0.5	0.4	47.667	38.642	38.650	39.192	43.175	47.667
		0.1	0.6	0.3	53.267	42.442	42.450	43.092	47.875	53.267
		0.1	0.7	0.2	58.867	46.242	46.250	46.992	52.575	58.867
		0.1	0.8	0.1	64.467	50.042	50.050	50.892	57.275	64.467
		0.2	0.1	0.7	29.933	28.083	28.100	28.283	29.050	29.933
		0.2	0.2	0.6	35.533	31.883	31.900	32.183	33.750	35.533
		0.2	0.3	0.5	41.133	35.683	35.700	36.083	38.450	41.133
		0.2	0.4	0.4	46.733	39.483	39.500	39.983	43.150	46.733
		0.2	0.5	0.3	52.333	43.283	43.300	43.883	47.850	52.333
		0.2	0.6	0.2	57.933	47.083	47.100	47.783	52.550	57.933
		0.2	0.7	0.1	63.533	50.883	50.900	51.683	57.250	63.533
		0.3	0.1	0.6	34.600	32.725	32.750	32.975	33.725	34.600
		0.3	0.2	0.5	40.200	36.525	36.550	36.875	38.425	40.200
		0.3	0.3	0.4	45.800	40.325	40.350	40.775	43.125	45.800
		0.3	0.4	0.3	51.400	44.125	44.150	44.675	47.825	51.400
		0.3	0.5	0.2	57.000	47.925	47.950	48.575	52.525	57.000
		0.3	0.6	0.1	62.600	51.725	51.750	52.475	57.225	62.600
		0.4	0.1	0.5	39.267	37.367	37.400	37.667	38.400	39.267
		0.4	0.2	0.4	44.867	41.167	41.200	41.567	43.100	44.867
		0.4	0.3	0.3	50.467	44.967	45.000	45.467	47.800	50.467
		0.4	0.4	0.2	56.067	48.767	48.800	49.367	52.500	56.067
		0.4	0.5	0.1	61.667	52.567	52.600	53.267	57.200	61.667
		0.5	0.1	0.4	43.933	42.008	42.050	42.358	43.075	43.933
		0.5	0.2	0.3	49.533	45.808	45.850	46.258	47.775	49.533
		0.5	0.3	0.2	55.133	49.608	49.650	50.158	52.475	55.133
		0.5	0.4	0.1	60.733	53.408	53.450	54.058	57.175	60.733
		0.6	0.1	0.3	48.600	46.650	46.700	47.050	47.750	48.600
		0.6	0.2	0.2	54.200	50.450	50.500	50.950	52.450	54.200
		0.6	0.3	0.1	59.800	54.250	54.300	54.850	57.150	59.800
		0.7	0.1	0.2	53.267	51.292	51.350	51.742	52.425	53.267
		0.7	0.2	0.1	58.867	55.092	55.150	55.642	57.125	58.867
		0.8	0.1	0.1	57.933	55.933	56.000	56.433	57.100	57.933
		SUM			1772.00	1553.00	1554.00	1571.00	1665.00	1772.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
30	4	0.1	0.1	0.8	25.392	12.983	12.975	12.942	24.500	25.392
		0.1	0.2	0.7	29.292	15.283	15.475	15.442	27.500	29.292
		0.1	0.3	0.6	33.192	17.583	17.975	17.942	30.500	33.192
		0.1	0.4	0.5	37.092	19.883	20.475	20.442	33.500	37.092
		0.1	0.5	0.4	40.992	22.183	22.975	22.942	36.500	40.992
		0.1	0.6	0.3	44.892	24.483	25.475	25.442	39.500	44.892
		0.1	0.7	0.2	48.792	26.783	27.975	27.942	42.500	48.792
		0.1	0.8	0.1	52.692	29.083	30.475	30.442	45.500	52.692
		0.2	0.1	0.7	28.883	17.667	17.450	17.383	28.000	28.883
		0.2	0.2	0.6	32.783	19.967	19.950	19.883	31.000	32.783
		0.2	0.3	0.5	36.683	22.267	22.450	22.383	34.000	36.683
		0.2	0.4	0.4	40.583	24.567	24.950	24.883	37.000	40.583
		0.2	0.5	0.3	44.483	26.867	27.450	27.383	40.000	44.483
		0.2	0.6	0.2	48.383	29.167	29.950	29.883	43.000	48.383
		0.2	0.7	0.1	52.283	31.467	32.450	32.383	46.000	52.283
		0.3	0.1	0.6	32.375	22.350	21.925	21.825	31.500	32.375
		0.3	0.2	0.5	36.275	24.650	24.425	24.325	34.500	36.275
		0.3	0.3	0.4	40.175	26.950	26.925	26.825	37.500	40.175
		0.3	0.4	0.3	44.075	29.250	29.425	29.325	40.500	44.075
		0.3	0.5	0.2	47.975	31.550	31.925	31.825	43.500	47.975
		0.3	0.6	0.1	51.875	33.850	34.425	34.325	46.500	51.875
		0.4	0.1	0.5	35.867	27.033	26.400	26.267	35.000	35.867
		0.4	0.2	0.4	39.767	29.333	28.900	28.767	38.000	39.767
		0.4	0.3	0.3	43.667	31.633	31.400	31.267	41.000	43.667
		0.4	0.4	0.2	47.567	33.933	33.900	33.767	44.000	47.567
		0.4	0.5	0.1	51.467	36.233	36.400	36.267	47.000	51.467
		0.5	0.1	0.4	39.358	31.717	30.875	30.708	38.500	39.358
		0.5	0.2	0.3	43.258	34.017	33.375	33.208	41.500	43.258
		0.5	0.3	0.2	47.158	36.317	35.875	35.708	44.500	47.158
		0.5	0.4	0.1	51.058	38.617	38.375	38.208	47.500	51.058
		0.6	0.1	0.3	42.850	36.400	35.350	35.150	42.000	42.850
		0.6	0.2	0.2	46.750	38.700	37.850	37.650	45.000	46.750
		0.6	0.3	0.1	50.650	41.000	40.350	40.150	48.000	50.650
		0.7	0.1	0.2	46.342	41.083	39.825	39.592	45.500	46.342
		0.7	0.2	0.1	50.242	43.383	42.325	42.092	48.500	50.242
		0.8	0.1	0.1	49.833	45.767	44.300	44.033	49.000	49.833
		SUM			1535.00	1054.00	1053.00	1049.00	1428.00	1535.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
30	5	0 1	0 1	0 8	25 700	13.392	13 275	13.242	24 808	25.700
		0 1	0.2	0.7	29 800	15.992	15.975	15 942	28 008	29 800
		0 1	0.3	0 6	33.900	18 592	18.675	18 642	31 208	33 900
		0 1	0 4	0 5	38 000	21 192	21 375	21.342	34.408	38 000
		0 1	0.5	0 4	42 100	23 792	24 075	24.042	37 608	42.100
		0.1	0 6	0 3	46 200	26.392	26 775	26 742	40 808	46.200
		0.1	0 7	0 2	50 300	28 992	29 475	29 442	44.008	50 300
		0 1	0 8	0.1	54 400	31 592	32 175	32.142	47.208	54 400
		0 2	0 1	0 7	29.300	18.183	17 850	17 783	28 417	29.300
		0 2	0 2	0 6	33.400	20 783	20 550	20 483	31.617	33 400
		0 2	0.3	0 5	37 500	23 383	23 250	23.183	34.817	37 500
		0 2	0 4	0 4	41 600	25 983	25.950	25 883	38 017	41 600
		0 2	0 5	0 3	45.700	28 583	28 650	28 583	41 217	45.700
		0 2	0 6	0.2	49.800	31 183	31.350	31 283	44.417	49 800
		0 2	0.7	0 1	53 900	33 783	34 050	33 983	47.617	53 900
		0 3	0.1	0 6	32 900	22 975	22 425	22.325	32 025	32.900
		0 3	0 2	0.5	37 000	25 575	25 125	25.025	35.225	37.000
		0 3	0 3	0 4	41.100	28.175	27.825	27.725	38.425	41.100
		0 3	0.4	0 3	45 200	30.775	30.525	30 425	41.625	45 200
		0 3	0 5	0.2	49 300	33 375	33 225	33 125	44 825	49.300
		0.3	0 6	0.1	53 400	35 975	35.925	35 825	48 025	53 400
		0 4	0 1	0 5	36.500	27.767	27.000	26 867	35.633	36 500
		0 4	0 2	0 4	40 600	30 367	29 700	29 567	38.833	40 600
		0 4	0 3	0 3	44 700	32 967	32 400	32.267	42.033	44 700
		0 4	0 4	0 2	48 800	35 567	35 100	34.967	45 233	48 800
		0 4	0 5	0 1	52.900	38 167	37 800	37 667	48 433	52 900
		0.5	0 1	0 4	40 100	32 558	31 575	31 408	39.242	40.100
		0 5	0 2	0 3	44 200	35.158	34.275	34 108	42.442	44 200
		0 5	0 3	0.2	48 300	37 758	36 975	36 808	45 642	48 300
		0.5	0 4	0.1	52 400	40 358	39 675	39 508	48 842	52.400
		0 6	0 1	0 3	43 700	37 350	36 150	35 950	42 850	43 700
		0 6	0 2	0 2	47 800	39 950	38 850	38 650	46 050	47.800
		0 6	0 3	0 1	51 900	42 550	41 550	41 350	49 250	51 900
		0 7	0 1	0 2	47.300	42.142	40 725	40 492	46 458	47 300
		0 7	0 2	0 1	51.400	44.742	43 425	43 192	49 658	51.400
		0 8	0 1	0.1	50 900	46.933	45 300	45.033	50 067	50 900
		SUM			1572.00	1103 00	1089.00	1085 00	1465 00	1572 00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
30	6	0 1	0 1	0 8	26 008	13 800	13 575	13 542	25 117	26 008
		0 1	0 2	0 7	30 308	16 700	16 475	16 442	28 517	30.308
		0 1	0 3	0 6	34 608	19 600	19.375	19 342	31 917	34 608
		0 1	0 4	0.5	38.908	22.500	22.275	22 242	35 317	38 908
		0 1	0 5	0 4	43 208	25 400	25 175	25.142	38 717	43 208
		0 1	0 6	0 3	47 508	28 300	28 075	28 042	42 117	47 508
		0 1	0.7	0 2	51 808	31 200	30.975	30 942	45 517	51.808
		0.1	0 8	0 1	56.108	34 100	33 875	33 842	48 917	56 108
		0 2	0 1	0 7	29 717	18 700	18 250	18.183	28 833	29 717
		0 2	0 2	0 6	34 017	21 600	21 150	21 083	32 233	34 017
		0 2	0 3	0 5	38 317	24 500	24 050	23 983	35 633	38 317
		0 2	0 4	0 4	42 617	27.400	26 950	26 883	39 033	42.617
		0 2	0 5	0 3	46.917	30 300	29 850	29.783	42.433	46 917
		0 2	0 6	0 2	51.217	33 200	32.750	32 683	45 833	51 217
		0 2	0 7	0 1	55 517	36 100	35 650	35 583	49 233	55 517
		0 3	0 1	0 6	33 425	23 600	22 925	22.825	32 550	33 425
		0 3	0 2	0 5	37 725	26 500	25 825	25 725	35 950	37 725
		0 3	0 3	0.4	42.025	29.400	28.725	28 625	39 350	42.025
		0 3	0 4	0 3	46 325	32 300	31 625	31 525	42 750	46 325
		0 3	0 5	0 2	50 625	35 200	34 525	34.425	46 150	50 625
		0 3	0 6	0 1	54.925	38.100	37.425	37.325	49 550	54.925
		0 4	0 1	0 5	37 133	28 500	27 600	27 467	36 267	37 133
		0 4	0 2	0 4	41 433	31 400	30 500	30 367	39 667	41 433
		0 4	0.3	0 3	45 733	34 300	33 400	33 267	43 067	45 733
		0 4	0 4	0 2	50 033	37 200	36 300	36 167	46 467	50 033
		0 4	0 5	0 1	54 333	40.100	39 200	39.067	49.867	54.333
		0 5	0 1	0 4	40 842	33 400	32 275	32.108	39.983	40 842
		0.5	0.2	0.3	45 142	36 300	35 175	35 008	43 383	45 142
		0 5	0 3	0 2	49 442	39 200	38 075	37.908	46.783	49.442
		0 5	0 4	0 1	53 742	42.100	40 975	40.808	50.183	53.742
		0 6	0 1	0 3	44 550	38 300	36 950	36 750	43 700	44 550
		0 6	0 2	0 2	48 850	41 200	39 850	39 650	47 100	48 850
		0 6	0 3	0 1	53 150	44 100	42 750	42 550	50 500	53 150
		0 7	0 1	0.2	48.258	43 200	41.625	41.392	47.417	48.258
		0 7	0 2	0 1	52 558	46 100	44 525	44 292	50 817	52 558
		0 8	0 1	0 1	51 967	48 100	46 300	46 033	51 133	51 967
		SUM			1609 00	1152 00	1125 00	1121.00	1502 00	1609 00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
30	7	0.1	0.1	0.8	26.317	14.208	13.975	13.942	25.425	26.317
		0.1	0.2	0.7	30.817	17.408	17.175	17.142	29.025	30.817
		0.1	0.3	0.6	35.317	20.608	20.375	20.342	32.625	35.317
		0.1	0.4	0.5	39.817	23.808	23.575	23.542	36.225	39.817
		0.1	0.5	0.4	44.317	27.008	26.775	26.742	39.825	44.317
		0.1	0.6	0.3	48.817	30.208	29.975	29.942	43.425	48.817
		0.1	0.7	0.2	53.317	33.408	33.175	33.142	47.025	53.317
		0.1	0.8	0.1	57.817	36.608	36.375	36.342	50.625	57.817
		0.2	0.1	0.7	30.133	19.217	18.750	18.683	29.250	30.133
		0.2	0.2	0.6	34.633	22.417	21.950	21.883	32.850	34.633
		0.2	0.3	0.5	39.133	25.617	25.150	25.083	36.450	39.133
		0.2	0.4	0.4	43.633	28.817	28.350	28.283	40.050	43.633
		0.2	0.5	0.3	48.133	32.017	31.550	31.483	43.650	48.133
		0.2	0.6	0.2	52.633	35.217	34.750	34.683	47.250	52.633
		0.2	0.7	0.1	57.133	38.417	37.950	37.883	50.850	57.133
		0.3	0.1	0.6	33.950	24.225	23.525	23.425	33.075	33.950
		0.3	0.2	0.5	38.450	27.425	26.725	26.625	36.675	38.450
		0.3	0.3	0.4	42.950	30.625	29.925	29.825	40.275	42.950
		0.3	0.4	0.3	47.450	33.825	33.125	33.025	43.875	47.450
		0.3	0.5	0.2	51.950	37.025	36.325	36.225	47.475	51.950
		0.3	0.6	0.1	56.450	40.225	39.525	39.425	51.075	56.450
		0.4	0.1	0.5	37.767	29.233	28.300	28.167	36.900	37.767
		0.4	0.2	0.4	42.267	32.433	31.500	31.367	40.500	42.267
		0.4	0.3	0.3	46.767	35.633	34.700	34.567	44.100	46.767
		0.4	0.4	0.2	51.267	38.833	37.900	37.767	47.700	51.267
		0.4	0.5	0.1	55.767	42.033	41.100	40.967	51.300	55.767
		0.5	0.1	0.4	41.583	34.242	33.075	32.908	40.725	41.583
		0.5	0.2	0.3	46.083	37.442	36.275	36.108	44.325	46.083
		0.5	0.3	0.2	50.583	40.642	39.475	39.308	47.925	50.583
		0.5	0.4	0.1	55.083	43.842	42.675	42.508	51.525	55.083
		0.6	0.1	0.3	45.400	39.250	37.850	37.650	44.550	45.400
		0.6	0.2	0.2	49.900	42.450	41.050	40.850	48.150	49.900
		0.6	0.3	0.1	54.400	45.650	44.250	44.050	51.750	54.400
		0.7	0.1	0.2	49.217	44.258	42.625	42.392	48.375	49.217
		0.7	0.2	0.1	53.717	47.458	45.825	45.592	51.975	53.717
		0.8	0.1	0.1	53.033	49.267	47.400	47.133	52.200	53.033
		SUM			1646.00	1201.00	1173.00	1169.00	1539.00	1646.00

T	M	W1	W2	W3	SPT/EDD	EDD/SPT	S[1]	S[2]	S[3]	S[4]
30	8	0.1	0.1	0.8	26.625	14.617	14.375	14.342	25.733	26.625
		0.1	0.2	0.7	31.325	18.117	17.875	17.842	29.533	31.325
		0.1	0.3	0.6	36.025	21.617	21.375	21.342	33.333	36.025
		0.1	0.4	0.5	40.725	25.117	24.875	24.842	37.133	40.725
		0.1	0.5	0.4	45.425	28.617	28.375	28.342	40.933	45.425
		0.1	0.6	0.3	50.125	32.117	31.875	31.842	44.733	50.125
		0.1	0.7	0.2	54.825	35.617	35.375	35.342	48.533	54.825
		0.1	0.8	0.1	59.525	39.117	38.875	38.842	52.333	59.525
		0.2	0.1	0.7	30.550	19.733	19.250	19.183	29.667	30.550
		0.2	0.2	0.6	35.250	23.233	22.750	22.683	33.467	35.250
		0.2	0.3	0.5	39.950	26.733	26.250	26.183	37.267	39.950
		0.2	0.4	0.4	44.650	30.233	29.750	29.683	41.067	44.650
		0.2	0.5	0.3	49.350	33.733	33.250	33.183	44.867	49.350
		0.2	0.6	0.2	54.050	37.233	36.750	36.683	48.667	54.050
		0.2	0.7	0.1	58.750	40.733	40.250	40.183	52.467	58.750
		0.3	0.1	0.6	34.475	24.850	24.125	24.025	33.600	34.475
		0.3	0.2	0.5	39.175	28.350	27.625	27.525	37.400	39.175
		0.3	0.3	0.4	43.875	31.850	31.125	31.025	41.200	43.875
		0.3	0.4	0.3	48.575	35.350	34.625	34.525	45.000	48.575
		0.3	0.5	0.2	53.275	38.850	38.125	38.025	48.800	53.275
		0.3	0.6	0.1	57.975	42.350	41.625	41.525	52.600	57.975
		0.4	0.1	0.5	38.400	29.967	29.000	28.867	37.533	38.400
		0.4	0.2	0.4	43.100	33.467	32.500	32.367	41.333	43.100
		0.4	0.3	0.3	47.800	36.967	36.000	35.867	45.133	47.800
		0.4	0.4	0.2	52.500	40.467	39.500	39.367	48.933	52.500
		0.4	0.5	0.1	57.200	43.967	43.000	42.867	52.733	57.200
		0.5	0.1	0.4	42.325	35.083	33.875	33.708	41.467	42.325
		0.5	0.2	0.3	47.025	38.583	37.375	37.208	45.267	47.025
		0.5	0.3	0.2	51.725	42.083	40.875	40.708	49.067	51.725
		0.5	0.4	0.1	56.425	45.583	44.375	44.208	52.867	56.425
		0.6	0.1	0.3	46.250	40.200	38.750	38.550	45.400	46.250
		0.6	0.2	0.2	50.950	43.700	42.250	42.050	49.200	50.950
		0.6	0.3	0.1	55.650	47.200	45.750	45.550	53.000	55.650
		0.7	0.1	0.2	50.175	45.317	43.625	43.392	49.333	50.175
		0.7	0.2	0.1	54.875	48.817	47.125	46.892	53.133	54.875
		0.8	0.1	0.1	54.100	50.433	48.500	48.233	53.267	54.100
		SUM			1683.00	1250.00	1221.00	1217.00	1576.00	1683.00