

## **Aggregated Production Planning in Sofa Production By Preemptive Goal Programming Approach**

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### **Extensive Summary**

Production can be defined, -in the broadest sense- as the total sum of activities which enable to create goods and services that carry economical value. Serial production: Serial production is the type of production which is preferred for the products that is low in diversity but high in production volume.

Production management is planning, realizing the production, controlling and developing the material, machine, work force etc. a company has in order to produce the product in desired amount, in desired time and at minimum cost. Production planning is a very important part of manufacturing and it is one of the most challenging problems for present-days decision makers. Production planning determines what, when and how many products should be produce to meet the customers' demands and at same time provides profit for companies. Decision making is the process of selecting a possible course of action from all the available alternatives. Another characteristic of these problem is that the objectives are apparently non-commensurable. In real application, there are many decision-making subject that decision maker have to one parameter from many parameter. This decision-making problem can easily transform in to mathematical modelling. This model can be called multi-choice decision making problem.

Mathematical approach methods are one of the main methods used in production planning problems. Production planning problems with linear programming aim to maximize profit or minimize cost but decision makers want to balance the profit-cost conflict. Linear Programming is one of the most popular and well known mathematical programming methods which are used to solve optimization problems. Recent studies show us using linear programming is not suitable for real life production problems. Goal programming is the extension of linear programming. Not only it offers optimization but also it gives us more suitable answers to real production planning problems. Goal Programming is a continuation of linear programming originally formulated by A. Charnes and W. W. Cooper in 1952. They provide a model and approach for dealing with certain LP problems in which the conflicting goals of

management were inappropriately forced to be included as the constraints of LP model. The main concept of goal programming is to determinate goal for each objectives then establish an objective function. This function occur sum of deviations of these goals. After that this objective is minimized as much as possible.

Decision makers who works in furniture industry have a tendency not to prefer to use mathematical modeling. The reason for their tendency in this furniture sector; their complexity and hard to develop realistic models. Also, the furniture sector is not technology intensive sector thus the workforce variable in mathematical model needs to be approached intently. Furniture products are one of the long-established industry in Turkey. It started with limited capacity at small workshops and labor intensive products. Today production systems at furniture industry have turned to technology intensive production from labor intensive production. Production planning in furniture industry is usually more complex than the ones in other continuous processing environments. Because furniture market's needs are always unstable.

The factory, which is chosen in Trabzon Organized Industry, which has 120000m<sup>2</sup> closed area, produces many parts just like sofa, armchair, furniture, office furniture, bed base, home textile, kitchen table. Short, medium and long term production planning horizons are considered as three production planning types. In this research, medium term production planning horizon is chosen. Medium term may be as short as three months or as long as twelve months. This production planning problem can be named as an aggregate production planning, because aggregation define that similar production operations, which necessary same type of machines, are aggregated into processing types. Aggregate production planning is a mid-term production planning model ranging from three months to twelve months. Heuristic method, graphical method and mathematical approaches can be used to solve aggregate production planning problems.

In this study, preemptive goal programming model is applied to one of the biggest furniture factory in Black Sea region of Turkey. In order to use pre-emptive goal programming, we have to assume all the goals are comparable in importance also one or more goals conspicuously more important than others. Main focus is achieving as closely as possible to these first-priority goals. After finding an optimal solution to first priority goals, other priority goals are also optimized. There are two procedure based on linear programming for solving preemptive goal programming problems. They are sequential and streamlined procedures. In this study, sequential procedure was used. At the first section of sequential procedure; only first priority goal model was solved and deviation variables was determined. After that, second priority goal model was solved but first deviation variables was added to this model. Same procedure was repeated for any lower priority goals. The streamlined method finds an optimal solution for a preemptive goal programming problem with only one linear programming model. But this require a modification of simplex methodology.

In this study, some assumptions are made for explain the model with mathematical. The production time consider as deterministic. The capacity of the work stations cannot exceed the upper limits. The all raw materials are available and there isn't any problem for supply. The all objective function and technological constraints are consider as linear. All product is produced in factory so there is no sub-production. All products have their own product route and it is not changeable.

We offered two different production planning models. One of the plans have three priorities. These are profit, production size and line smoothing. Other plan has two priorities. These are profit and production size. Besides, idle times will reduce according to these plans. Pre-emptive goal programming has been used in this research which is an effective method in aggregate production planning solution. Before generating mathematical model, time study has been carried out in every step of production for each product. Effective work time has been determined for each work station. Products consisted of seven work stations.

At the end of the study two production planning model was compared. The result of mathematical model show us that, if decision makers used production planning model which have three priorities, idle times would reduce and work stations would be more balanced compared to two priority production planning model. The proposed models can be applied to other industries using different variations in objective function or constraints. In proposed model, decision makers can easily change the goals for cost minimization or profit maximization. Two and three priority production planning models include the same profit and production goals. As a result of the application, it is possible to reach 4000000 TL of profit goal and 8600 units of production goal using production facilities in two and three priority production planning model. Standard deviation of two priority model work station is 3861,50 minutes and the standard deviation of two priority model work station is 1462,26 minutes. Operation of the work stations in the three-priority model seems to be more balanced.

There are two way for increasing to profit, one of them is improve facilities other is use current facilities effectively. By the reason conditions of furniture firms, it is difficult and expensively to increase production facilities in a short time. So usage of facilities effectively has a vital role for increase to profit. In order to use facilities effectively, good production planning model is a must.

Two and three priority models are contained same profit and production levels. According to result of models, firm can reach profit and production size goals. But if firm chose three priority model, job of work stations would be more balancing if we compared to two priority model. This study will be proceed in direction of further extension of the offered model by adding fuzzy lead times. On the basis of suggested production planning model, new result can be proved by changing different product on model, working period in next research.