



# “Optimising Profit for JSR Furniture: A Comparative Analysis of Graphical Method and Excel Solver in Operations Research”

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## ABSTRACT

A popular operational research method for determining and improving management decisions is linear programming. Businesses are encouraged to boost their output via its implementation. JSR Company is a furniture-based company in Bengaluru, they must strategically allocate resources and take smart decisions in order to maximize the profit of the company. This research helps and examines the effectiveness and precision of Excel Solver and Graphical method in resolving challenging optimisation issues related to JSR Furniture's operating procedure.

**Key Word:** Linear Programming, Solver, Graphical Method, Maximize profit, efficiency, Operational Research

## INTRODUCTION

In the global age, the use of the Operation Research (OR) strategy needs to keep up with the aforementioned changes. It is said that the OR method falls short of what business and the industry requires. Lack of an implementation procedure is frequently the cause of failure. According to, a mathematical method for figuring out how to optimally distribute a company's limited resource in order to accomplish its objectives is known as linear programming or LP. Additionally, it may be described as an optimisation tool for analysing constrained optimisation issues, where the goal function is a linear function that can be maximized or minimized while taking linear constraints into account. In operations research and management sciences, linear programming is a mathematical approach used to handle certain issues. Examples of these problems are allocation, transportation, and assignment problems that provide a choice or options between various courses of action. To ensure its continuous existence and competitiveness, any firm or organisation has to make a profit. The furniture industry plays a vital sector of any economy, occupying a central place in the manufacturing process raw materials and labour hours.

JSR Furniture's is a family business it was established in the year 2005 by Mr. Ramesh and later this business is continued by their son's. It is located in outskirts of Bengaluru, Karnataka. A lot of items are manufactured in this company such as chair, different sizes of tables, cots and wooden slabs. According Mr Ramesh's son when interviewed informed us that tables are the fast-moving products in his company and they outsource them to office so wooden tables has a lot of demand when compared to other products. In this paper we are focusing on two types of tables namely Table A and Table B. Table A is of medium quality and Table B is of a superior quality. The prices for each table will differ respectively. There are almost around 250 workers working in the factory as this company produces a lot of items. For producing Table 1 they require at-least 12 workers but for

preparing Table 2 they at-least require 15 workers. This company hires only skilled labour's they do not hire any semi-skilled labour's because semi-skilled or unskilled labours takes extra time to manufacture a table than a skilled labour and they are a small-scale business so they do not have enough time and resources to provide training.

There are two types methods that this study has used in this paper and help JSR Furniture Company to maximize profit for the company graphical method and excel solver method. Graphical methods are straightforward and natural method for resolving linear programming issues involving two variables is the Graphical Method. This can be one of the strategies used by JSR Furniture in order to maximize profit by taking objective functions and restrictions into account. For the purpose of solving optimisation problems, particularly those involving several choice variables in linear programming, Excel Solver is a highly effective tool. By comparing two methods we have crossed check and found solution.

## OBJECTIVE OF STUDY

### Primary Objective

- The main aim of this study is to help understand the decision maker of the company which kind of table in his manufacturing firm will give him more benefit and on which item he should concentrate so as to increase his profit.
- In order to figure out which approach maximize profit for JSR Furniture under various circumstances, compare the efficiency of the Graphical method and Excel Solver.

### Secondary Objective

- According two types method assessing which type of LP method is user-friendly.
- To find out which of two solutions is most affordable and feasible for JSR Furniture, do a cost-benefit analysis of using two types of method.

## REVIEW OF LITERATURE

### 1) Using Simplex Method to Solve Linear Programming Maximization Problems:

A popular operations research technique for the best use of resource allocation in a variety of sectors, including financial and service companies, is linear programming (LP). Using the objective function as the criterion for choosing the optimal values, it entails distributing choice variables in a way that maximizes profits or minimizes expenses. (Leavengood, 1998, October)

2) Application of linear programming by graphical method - with referenced to a furniture manufacturing company: LPP is an effective method for resolving issues related to similar mathematics, including the difficulty of dividing resources among conflicting activities. By using LPP practically, we may determine that commercial organisations can logically optimise their resources to maximize revenues or minimize costs by utilising graphic model techniques. (PRIYA, 2018)

3) Optimization of production and benefits of using linear programming in the Linggarjati furniture business: Focusing on 10 180 x 200 cm beds, 4 dining tables with 6 seats, and 3 door wardrobe furniture would help Linggar Jati Furniture's furniture business reach a profit optimisation point each month, with an ideal profit of Rp 33,518,275. (FoEh, February 2022)

4) Production planning of a furniture manufacturing company with random demand and production capacity using stochastic programming: Two stochastic linear programming models—one with a discrete distribution and the other using the optimisation programme Lingo 17.0—are presented in this article. The models underwent comparison and analysis, including sensitivity analysis that took into account changes in stochastic parameters and service level. (José Emmanuel Gómez-Rocha, 2021 Jun 14)

5) Optimization of Teak Wood Furniture Production Using Linear Programming Method at Sumenep East Java Indonesia: Inadequate resource management causes the 3R Furniture firm to struggle with both cost reduction and output maximisation. To maximize the company's gains, the simplex approach and linear programming were applied. According to the data, tables in quantities of thirty were the most lucrative item. (Siti Nurul Afiyah1, Juni 2022)

- 6) A Study on Linear Programming Problems In Real Life Applications: As a mathematical technique to help individuals conduct scientific management, linear programming is a significant area of operational research. A mathematical technique for solving specific kinds of optimisation issues is called linear programming. The primary aim of this study is to comprehend the straightforward use of the Graphical and Simplicity methods to maximize profits for goldsmiths and furniture manufacturers. (J.Sandhiya, 5 May 2023 )
- 7) Optimal Mix of Two or More products to Maximize the Contribution of Linear Programming Problem: This study introduces a mathematical model for finding optimum mixes of products via graphical approaches in order to optimise linear programming problems (LPPs). The Excel solver is user-friendly and yields precise answers. (Bhawna Agrawal, Apr. 2023))
- 8) Linear Programming Technique to Minimize the Production Cost in a Manufacturing Company: This study presents an optimisation of the production cost of cartons at Shree Lakshmi Craft using the linear programming approach. Additionally, the LPP was solved with the help of an Excel solver and the graphical and simplex methods. The findings indicated that in order to reduce manufacturing costs, the corporation needed produce 3,60,000 cartons each month (Anurag Sharma, February, 2023)
- 9) Application of linear programming in small mechanical based industry for profit maximization: The main goal of this paper is to apply LP to the production of small ayurvedic products in order to find the best production schedule for creating ayurvedic mixtures or pastes that boost human immunity and meet vitamin needs while generating the highest profit. (Amit Kumar Jain .Sarla Chouhan, 2021)
- 10) Profit Maximization in a Product Mix Bakery Using Linear Programming Technique:  
This study attempted to establish the quantity of bread that the company should produce in a day which will give higher profits. Data on the amount of the main raw materials needed daily to produce large, medium, and small size loaves of bread. (Kayode Olakunle Oluwaseyi, Published: Mar. 06, 2020)
- 11) Linear Programming Problem and Post Optimality Analyses in Fuzzy Space: A Case Study of a Bakery Industry: In this study, recent methods for linear programming problem optimization are examined. Multiple-goal programming or probabilistic programming techniques are frequently used to tackle problems in practice where all of the decision parameters are ambiguous integers. In this study, a very efficient solution for handling these problems is given using the concept of fuzzy number comparison. (Pattnaik, June 15,2013)
- 12) A Linear Programming Model for Product Mix Profit Maximization in A Small Medium Enterprise Company: This paper employs an LP model to maximize profits for a Malaysian SME Company. The goals of this paper are to determine the production line's present process and to create an LPP model that recommends a workable product mix to ensure the company's maximum profitability. (Safwa Mohd Baki, 2021)
- 13) Solving Linear Programming Problems By Using Excel's Solver: This study tells us the expansion of the Solver included with Microsoft Excel, an advanced method for locating verified global optimum solutions. It also discusses the underlying techniques that make it possible to use Excel sheets with linear information and perform quick optimization calculations. (Saleh, April 2019)
- 14) This paper employs an LP model to maximize profits for a Malaysian SME Company. The goals of this paper are to determine the production line's present process and to create an LPP model that recommends a workable product mix to ensure the company's maximum profitability: This paper employs an LP model to maximize profits for a Malaysian SME Company. The goals of this paper are to determine the production line's present process and to create an LPP model that recommends a workable product mix to ensure the company's maximum profitability (Jolayemi, September 2012)
- 15) Optimizing the Cost Effectiveness in a Manufacturing sector: A Linear Programming Approach for Simple Furniture: In this paper helps us understand how simple furniture company to minimize the cost and the goal of the LP model was to give administration data driven suggestions for effective production scheduling and budgeting which would there be utilised to guide the decision making process. (Tia Soni, November-2023)

## RESEARCH METHODOLOGY

### Research Design

This study includes two types of methodology using quantitative data using Graphical method and Excel Solver method. Both the methods are used in order to maximize the profit and know which method is user's friendly.

### Data Collection

Quantitative data was collected by interviewing the owner of JSR Furniture company. This data includes raw materials the min raw material used here is wood and screw to fit the tables. These quantitative data was used as constraints in JSR Furniture Company.

### Data sources

Primary data was collected by the owner of the company to accurately know how much raw material was required to manufacture tables.

## DATA ANALYSIS

There are a lot of Furniture manufacturing company in and around Bengaluru. "JSR" makes a decent number of profits and it is running successfully from past few years but during covid the business had slowed down they were not able to make profits like before. This company sells a lot of products such as Dining table, chairs, different types of cots, slabs and different types of tables with different types of quality at different prices. This paper has collected data on sales and manufacturing of Tables in this company from the owner of the company. Considering variable as x, y (Table A, Table B) respectively.

Maximize = Revenue – Cost

Revenue generated from Table A (medium quality) and Table B (high quality) selling price of these are  $45000x + 68000y$

Cost of Production required for manufacturing two types of Tables (A& B)  $30000x + 50000y$

Profit =  $15000x + 18000y$

**Max(P) =  $150x + 180y$  (00's)**

The main raw material required every month for manufacturing wooden tables are wood since we have taken two types tables are Table A requires a less wood whereas Table B requires more wood. Table (A) requires 2 units of woods per unit (00's) and Table (B) requires 3 units of wood's (00's), the total availability of the wood is 1000 units every month.

**$2x + 3y \leq 10$  (00's)**

Other than wood the other main important raw material required to manufacture these two types of wood are screws the availability of screw for Table A and Table B are same so 100 units and the total availability of screws for a company are 400 units every month

**$x + y \leq 4$  (00's)**

Maximum production capacity for the JSR Furniture company to produce to tables are 1000 units for Table A and 800 units for Table B. The constraints are:

**$x \leq 10$  (00's)**

**$y \leq 8$  (00's)**

The non negative constraint as the number units produced cannot be zero, hence:

**$x \geq 0, y \geq 0$**

## LINEAR PROGRAMMING PROBLEM TO MAXIMIZE THE PROFITS

$$\text{Maximize (P)} = 150x + 180y$$

Subjected to:

$$2x + 3y \leq 10$$

$$x + y \leq 4$$

$$x \leq 10$$

$$y \leq 8$$

$$x \geq 0, y \geq 0 \text{ (non-negative constraints)}$$

This study was done based on two types methods they are:

- 1) Graphical method
- 2) Simplex Method

## INTERPRETATION

### FIRST METHOD GRAPHICAL METHOD

Converting equalities by changing values of x and y to zero.

1) Raw Material (Wood):

$$2x + 3y \leq 10$$

Conversion

$$2x + 3y = 10$$

x	0	3.3
y	5	0

2) Raw Material (Screws)

$$x + y \leq 4$$

Conversion

$$x + y = 4$$

x	0	4
y	4	0

3) Maximum Production for Table A

$$2x \leq 10$$

Conversion

$$2x = 10$$

x	0	0
y	5	0

4) Maximum Production for Table B

$$y \leq 8$$

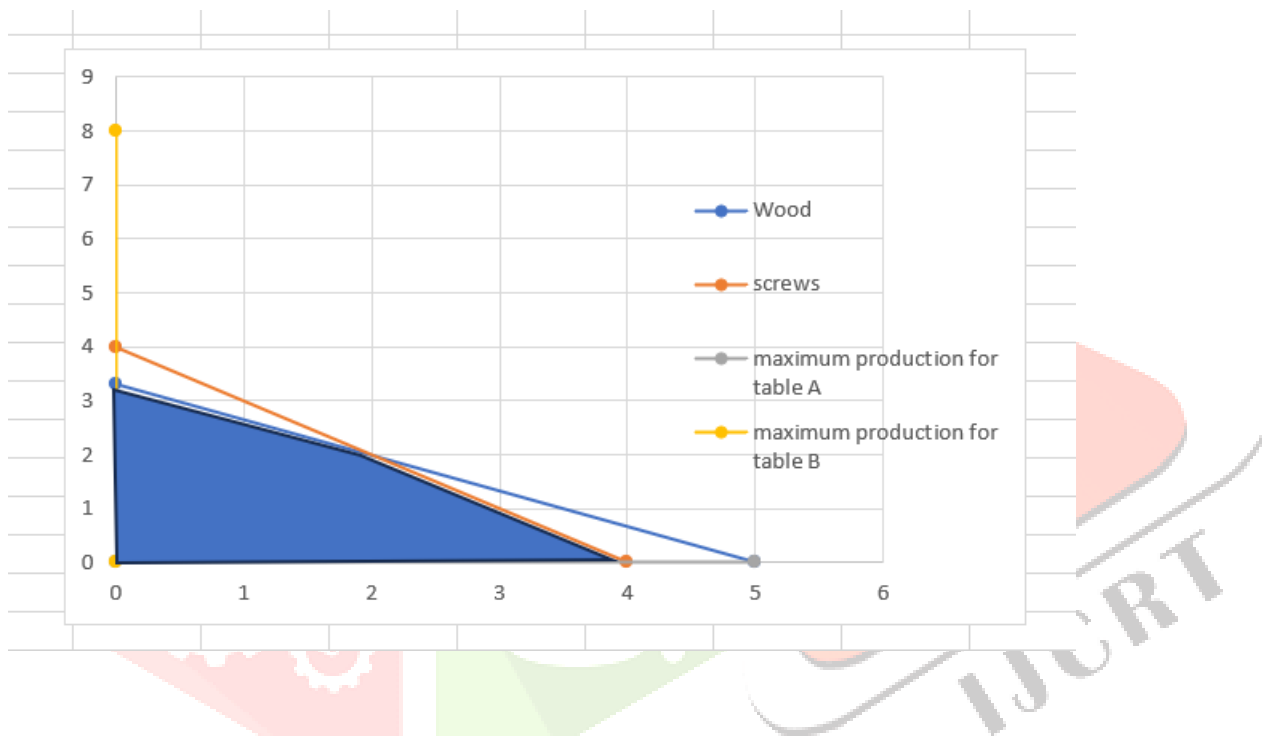
Conversion

$$y = 8$$

x	0	8
y	0	0

**STEP-2**

**GRAPHICAL METHOD**



Graph 1 shows us the Feasible region points that are obtained by solving the problems graphically

Table 1: Feasible Region Points from Graphical Method

FEASIBLE REGION POINTS	Max(P)= 150x+180y
(0,0)	0
(0,3.3)	594
(2,2)	660
(4,0)	600

According to the Graph we can tell that

$$\text{Max}(P)=660$$

When  $x= 2, y=2$

The graph suggests that in order to maximize profit, the JSFR should produce 200 units of Table A and 200 units of Table B, with a monthly production cost of Rs 66,000.

## SECOND METHOD EXCEL SOLVER METHOD

	Decision Values	x	y			
	Variable	2	2	660		
	Co-efficient	150	180			
				LHS		RHS
	wood	2	3	10 ≤		10
	screw	1	1	4 ≤		4
	Maximum production for table A	2		4 ≤		10
	Maximum production for table B		1	2 ≤		8

Table 2 shows us that the constraints solved by the data solver in excel.

The simplex method is:

Max(P)=66,000

When  $x=200$  units,  $y=200$  units per month

As the values of the graphical method and simplex method similar, it can be deduced that the value of  $x=2$  and value of  $y=2$

From the simplex method we get exact values of the problem where the company should manufacture 200 units of Table A and 200 units of Table B where the cost of production will be Rs. 60,00 per month.

## CONCLUSION

In this research, we have analysed how Linear programming helps company in real life. JSR Furniture who were struggling to make profits and they were unable to analyse which product would increase more profit. JSR Company can now effectively manage their profit by producing both the tables at the same quantity. According to this research we have found out that if JSR Furniture company uses Excel's Solver method to increase profit maximization they can reduce a lot of time and it is very users friendly as it can be easily understood. The concepts and the methods covered here have real-world application potential; and provide helpful guidance to companies seeking to cut expenses and boost output in an increasingly competitive sector.

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