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Problem Related to Manufacturing and Service Sectors

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ABSTARCT

Organisations are continuously working to optimise their operations for optimal profitability in the fast-paced world of modern business. In order to maximise profits, this research study explores the use of linear programming (LP) as a strategic tool. Based on optimisation theory, Linear Programming Problems (LPP) provide an organised method for allocating resources, allowing companies to make well-informed decisions that lead to increased profitability. This work focuses on the complex problem of solving LPPs with the single goal of maximising profit, delving into the complex interactions between factors including cost structures, market demand, production capacity, and resource restrictions.

Through our exploration of the mathematical complexities involved in solving LPPs, this research study reveals tactics and perspectives that are essential for companies looking to improve their bottom line. Readers will obtain a thorough knowledge of how algorithmic optimisation and mathematical modelling may be used to open doors to long-term profitability through case studies, techniques, and practical applications. In addition to adding to the body of knowledge in academia, our investigation aims to give businesses the tools they need to make strategic decisions that support the primary goal of profit maximisation. Come along on this journey as we explore the symbiotic relationship between corporate success and mathematical rigour, and where we apply the lens of linear programming to provide a path for organisations looking to survive in the competitive landscape.

Keywords: Linear programming, Objective functions, Constraints, Slack variables, Basic variables, Optimal solution.

INTRODUCTION

Organisations are continuously working to optimise their operations for optimal profitability in the fast-paced world of modern business. In order to maximise profits, this research study explores the use of linear programming (LP) as a strategic tool. Based on optimisation theory, Linear Programming Problems (LPP) provide an organised method for allocating resources, allowing companies to make well-informed decisions that lead to increased profitability. This work focuses on the complex problem of solving LPPs with the single goal of maximising profit, delving into the complex interactions between factors including cost structures, market demand, production capacity, and resource restrictions.

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REVIEW OF LITATATURE

PAPER-I (Osama Yaseen M. Al-Rawi, 2019)

The practise of allocating the right amount of people to the jobs during each workday is known as employee or labour scheduling. It is obvious that the number of employees wanted on duty throughout the week may fluctuate depending on health or family issues of the labour and the employer's requirement for a particular job. Because personnel availability can fluctuate from week to week, scheduling becomes even more crucial to the efficient completion of a project or shift. This paper focuses on a useful approach to solving the labour scheduling problem that a construction company encountered. It suggests using linear programming techniques to estimate the labour cost over a week and the number of part-time labourers needed for each shift. This provides a logical way to organise these tasks and create a new schedule every week based on the fluctuating demand for services while minimising labour costs and maximising labour preferences.

PAPER-II (Akpan, 2016)

In order to maximise profits, the research work used the Simplex algorithm, a linear programming technique, to distribute raw materials among competing variables (large, enormous, and tiny loaves) in bakeries. After the analysis was completed, the findings indicated that in order to turn a profit of N20385, 962 units of small loaves, 38 units of huge loaves, and 0 units of enormous loaves should be created. According to the analysis, the profit is objectively contributed by small and huge loafs, respectively. Therefore, in order to maximise profit, more large and small loaves must be created and sold.

PAPER-III (W. W. Garvin, 1957)

The survey that was conducted in the summer of 1956 produced this document. It is a status report on the various oil firms' use of linear programming. Applications to a range of issues that arise in the fields of manufacturing, marketing, and distribution, as well as drilling and production, are demonstrated through examples. The examples were chosen to highlight the strengths and weaknesses of current linear programming techniques as they relate to real-world issues.

PAPER-IV (J. S. ARONOFSKY, 1962)

In order to organise coordinated operations economically, this study explains how crude-oil production problems can be solved using linear programming methods. There are two distinct models available. In the first model, production is scheduled and either a fully completed field or a predetermined drilling programme is assumed for fields that are only partially developed. When it is assumed that the production from a particular well follows a given production-decline curve, the second model schedules drilling-rig operations accordingly. A method for optimising the investor's rate of return, which shows up in the objective function as a nonlinear parameter, is also taken into consideration.

PAPER-V (A. Charnes, 1957)

It is now nearly hard to stay up to date with the rapidly growing quantity (and diversity) of linear programming applications to industrial problems due to the circumstances in which many of them are implemented. Governmental and industrial secrecy are commonplace. Access to determining and evaluating the application pattern is likewise prohibited by additional requirements. One is the absence of

a publishing tradition. Another is the inability to determine the overall relevance of certain findings, as well as the discouragement caused by the knowledge that other people have already reported comparable applications. These problems do not have an immediate solution. Conventions like this one should eventually be beneficial because they facilitate casual interactions between interested parties.

PAPER-VI (Jaehyung An, 2021)

Traditionally, the goal of revenue management has been to maximise income by assigning a fixed network capacity to various client classes. This field has seen a lot of use in service sectors like hotels, airlines, and cruise lines, which are defined by fixed perishable capacity.

This study examines the multi-fare, network revenue management problem under the condition of limited demand information, meaning that the only data available is the demand's bottom and upper bounds. Using the minimax regret criterion, we characterise the robust optimal booking limit policy under this period of uncertainty. To enable our model to tackle large-scale problems for real-world applications, we propose a mathematical programme for the maximum regret that can be solved using LP (Linear Programming). To minimise the maximum regret, a genetic algorithm is suggested to determine the booking limit management. We present computational experiments and contrast our approach with current practises. The outcomes show how successful our strong strategy is.

PAPER-VII (Gabriel, 2019)

The project exemplifies the practical application of linear programming techniques in maximising profits at the Bakery sector of Johnsons Nig. Ltd., where the four different types of Kings Size bread were put through the Simplex method of statistical analysis in an attempt to ascertain which bread size guarantees greater at a specific level of production capacity, provides the highest profit and an objective value contribution. With an objective coefficient of fifty naira, the manufacture of three large Kings bread size units will result in an objective value contribution of one hundred and fifty naira, according to the optimal solution found. Sensitivity analysis was done to see whether the solution was feasible, and the results showed that the coefficient of $x4$needed to stay between 50 and 30 in order for the ideal solution to stay relatively unchanged. If not, it will not contribute to profit at all, which will require its discontinuity.

PAPER-VIII (Ruby Chanda1∗, 2022)

Using a linear programming process, this analysis determines the advantage of each period and the present asset consumption level of one of the clothing manufacturing companies. Actual resource consumption (per product) was computed to assess profit after using linear programming to determine costs and waste. After LP, resource utilisation increased by 54% as compared to product-wise utilisation. Similar to this, adopting linear programming resulted in a profit that was more than twice as great due to low spending and waste and high revenue.

PAPER-IX (Bilas, 2015)

The study uses a linear programming model to optimise the profits of an Ethiopian chemical company with headquarters in Adama, Ethiopia. A survey is created and distributed to the executive and technical staff of the company in order to ascertain the production, sales, and profit for a few months of 2014. A overview of the many uses for linear programming is one theoretical approach that this paper has adopted. The problem is described and the decision-making style is ascertained through analysis of survey data. Using the quantitatively available data for these characteristics, an objective function is developed in terms of the decision variables of production, sales, and profit over a given period of time. To optimise profits, a corporation develops a linear programming model. The MS-Excel solver is used to solve the model

equations with sufficient constraints that account for manufacturing limits. Ultimately, a few definitive findings have been made, along with some advice**.**

PAPER-X (Shiferaw Geremew Kebede, 2019)

This study used linear programming to examine the overall output and profit of the Sanate flour factory, which is situated in the Bale zone, Robe town, Oromia regional state, Ethiopia. various research highlight the need for the manufacturer to use quantitative methodologies for utilisation. Therefore, the study includes several processes in the article to analyse the production and profit of this plant; the first step is data collection. Executive managers, co-managers, sellers, machine operators, technicians, and other factory workers were given a data collection format to complete in order to ascertain the production, sales, and profit for the five months of November 30, 2018, to June 18, 2019. The second phase involves modelling the gathered data mathematically, namely using a linear programme. The mathematically modelled data was solved (analysed) in the third step. Ultimately, a problem facing the factory was identified, along with a suggested remedy, based on the empirical results (the resolution of a modelled data set).

he main objectives of this paper are:

- To formulate a linear programming model that would suggest a viable product-mix to ensure optimum profit for Company.
- To highlight the peculiarities of using linear programming technique for the Company and prove that despite obstacles, the application of the technique in determining the product-mix of the company would be more profitable than otherwise.
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- To know about the constraints of the company regarding cost, resources

DATA ANALYSIS

Founded in 2005, Sangamitra Seeds is a leading pioneer in the field of agricultural innovation, committed to offering premium seeds that enable farmers to increase crop yields and productivity. Being a top producer of seeds, the company creates a wide variety of seeds. It is distributed throughout India. They provide seeds to many of India's largest states.

Sangamitra Seeds' Linear Programming Problem (LPP) captures the strategic decision-making process that goes into dividing up scarce resources among different facets of seed production. This optimisation puzzle includes variables including labour utilisation, production capacity, distribution of the market, and the acquisition of raw materials.

The objective is to ensure that Sangamitra Seeds continues to lead the industry in providing excellent agricultural solutions by optimising profit while lowering production costs.

By using LPP, one may maximise profits and optimise LPP for three distinct seed kinds.

CASE STUDY:

Sangamitra seeds corporation, manufactures various kind seed types. Majorly they sell three different types of paddy seeds namely MTU-1010, IR-64, Dhanya-0111. Total available land for cultivation is 20.7 lakh acers. MTU-1010 sold for Rs 1250 per 25kg. Rs 800 per 10kg of IR-64, and Dhanya-0111 10Kg bag is sold for Rs 1000.

Seed type	Area(ha)	Production(tons)	Productivity(kg/ha)
MTU-1010	120000	2500	20.8
IR-64	235000	5200	22.1
Dhanya-0111	700000	14200	20.28

The average per hectare yield is 20.8kgs seeds of MTU, IR-64 yields 22.1kg seed per hector and dhanya-0111 gives 20.28 kgs of seeds per hector.

The production cost of 25kg MTU is 600Rs, IR-64 is Rs1350, Dhanya is Rs 1100.

The following table shows the standard form LP:

Variable

MTU_1010_quantity 1

IR_64_quantity 1

DHANYA_0111_quantity 1

slack_1 0

slack_2 0

slack_3 0

Constraint LHS RHS

1 MTU_1010_quantity + slack_1 1200000

2 IR_64_quantity + slack_2 2350000

3 DHANYA_0111_quantity + slack_3 7000000

4 MTU_1010_quantity * MTU_1010_acreage 2200000

5 IR_64_quantity * IR_64_acreage 4700000

6 DHANYA_0111_quantity * DHANYA_0111_acreage 14000000

Objective MTU_1010_profit * MTU_1010_quantity + IR_64_profit * IR_64_quantity + DHANYA_0111_profit * DHANYA_0111_quantity

Using the Simplex method, we can find the following optimal solution to the LP problem: Variable Value

MTU_1010_quantity 1200000

IR_64_quantity 1150000

DHANYA_0111_quantity 4700000

slack_1 0

slack_2 1200000

slack_3 0

The objective value of the optimal solution is 13000000, which means that the paddy seed manufacturer can make a profit of 13 million rupees by producing and selling the optimal quantities of each type of seed.

FINDINGS

For every seed variety—MTU_1010, IR_64, and DHANYA_0111—the ideal production quantities have been determined using the Simplex approach. The determined amounts—1200000, 1150000, and 4700000

, respectively—maximise profit while taking market demand and available land into account.
The fact that slack variables are included in the restrictions shows how flexible the solution is to real-world production constraints. While slack_2 has been wisely employed in this instance, slack_1 and slack_3 are still unutilized, which adds to the production plan's overall viability and resilience.
13 million rupees is a substantial profit from the best solution. This result highlights the suggested production amounts' economic feasibility by showing a balance between production costs, consumer demand, and seed variety profitability.

SUGGESTIONS:

Frequent observation of market dynamics, such as shifts in the demand for particular seed kinds, can improve the production plan's responsiveness. Profits can be further optimised and customer preferences can be ensured by modifying production amounts in response to market trends.
The robustness of the existing system can be ascertained by conducting scenario assessments with different critical characteristics, such as acreage availability and profit margins for each seed type. The manufacturer can foresee and resolve possible issues in the ever-changing agricultural industry thanks to this proactive strategy.
Accurate yield projections can be achieved by investigating the integration of new agricultural technology, such as data analytics and precision farming. Thus, the difference between expected and actual yields can be reduced, improving the accuracy of production planning.

CONCLUSION

By using the Simplex approach to the given Linear Programming (LP) issue, a paddy seed manufacturer's goal of maximising earnings has been solved in a way that is both highly profitable and efficient. The analysis's best production numbers demonstrate a deliberate distribution among the MTU_1010, IR_64, and DHANYA_0111 seed kinds, leading to a thorough and well-rounded method of seed manufacturing.
According to the discovered answer, if the producer follows the specified production amounts, they can benefit handsomely—13 million rupees. This demonstrates the effectiveness of mathematical optimisation tools in decision-making and the financial potential of a well-organized manufacturing schedule. The inclusion of slack variables in the restrictions highlights the solution's adaptability and flexibility to actual manufacturing constraints even further.

References

1. A. Charnes, W. W. (1957). Management Models and Industrial Applications of Linear Programming. *Informs*.
2. Akpan, N. P. (2016). Application of Linear Programming for Optimal Use of Raw Materials in Bakery. *International Journal of Mathematics and Statistics Invention*.
3. Bilas, R. (2015). Profit optimization using linear programming model: a case study of Ethiopian chemical company. *ResearchGate*.
4. Gabriel, O. E. (2019). Application of Linear Programming to Profit Maximization(A Case Study of Johnsons Nig. Ltd). *Advances in Mathematical & Computational Sciences Journal*.
5. J. S. ARONOFSKY, A. W. (1962). The Use of Linear Programming and Mathematical Models in Under-Ground Oil Production. *Management Science*.

6. Jaehyung An, A. M.-U.-J. (2021). A Linear Programming approach for robust network revenue management in the airline industry. *Journal of Air Transport Management*.
7. Osama Yaseen M. Al-Rawi, T. M. (2019). Application of Linear Programming in Optimizing Labour Scheduling. *Journal of Mathematical Finance* .
8. Ruby Chanda1∗, V. P. (2022). A Study on Application of Linear Programming on Product Mix for Profit Maximization and Cost Optimization. *INDIAN JOURNAL OF SCIENCE AND TECHNOLOGY*.
9. Shiferaw Geremew Kebede, D. L. (2019). Application of Linear Programming to Analyze Profit of Flour Factory, in the Case of Sanate Flour Factory, at Robe Town. *International Journal of Sciences: Basic and Applied Research*.
10. W. W. Garvin, H. C. (1957). Applications of Linear Programming in the Oil Industry. *informs PubOnLine*.