

OPTIMIZING TRANSPORTATION COST BY USING LINEAR PROGRAMMING

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Abstract

Effective transportation planning is critical for businesses to reduce operational costs, improve distribution efficiency, and increase overall profitability. To optimized transportation costs in a road-based distribution system, this study applies Linear Programming (LP), a mathematical technique that produces the most effective results under specified constraints. The study used secondary data which is based on a case study of the Yusril Medan Bread Distribution business and involves two supply centers and four demand areas. The data set consists of supply capacities, demand requirements and unit transportation costs between supply and demand points. To find the most cost-effective method for distributing goods, a transportation model was created and solved with LINGO software. The results were compared with the Minimum Cell Cost Method (MCCM), a commonly used heuristic in transportation planning. The LP approach achieved a total transportation cost of RM39.05, while MCCM produced a higher cost of RM42.00. These results show how effective LP is at helping balanced supply demand fullfilment, reducing distribution costs, and enhancing resource utilisation. This study additionally illustrates how important it is to integrate optimisation tools into logistics decision-making to enhance operational performance.

Keywords: *Transportation Problem, Linear Programming, Supply Chain Management*

1. Introduction

Transportation cost plays a crucial role in supply chain efficiency and profitability, particularly in distribution networks. In the current competitive environment, companies need to priorities logistics cost while guaranteeing delivery times. This study examines the use of Linear Programming (LP) to reduce transportation expenses through a practical example from the Yusril Medan Bread Distribution business. The objective is to develop an optimized transportation plan that fullfil supply and demand constraints, while minimizing cost. Rising operational expenses, including fuel prices and inefficient routing, contribute significantly to distribute challenges. By applying LP, companies can enhance resource utilization and decision-making. Chua et al. (2025) emphasized that many Malaysian businesses incur high logistics costs due to limited planning strategies and inadequate cost structures, underscoring the need for systematic optimization approaches.

2. Methodology

This study uses Linear Programming to minimize transportation costs in a supply-demand network. Data was collected from a real case study on bread distribution in Medan, Indonesia by Harahap, L., et al., (2024) involving two supply demand and four destinations. The inputs include supply capacities, demand requirements and per unit transportation costs between sources and destination. A mathematical model was developed with the objective function aiming to minimize total cost, subject to supply and demand constraints. The model was solved using LINGO software to obtain the optimal solution. To ensure model accuracy, the results from LINGO were manually validated using direct substitution into the objective function. The final allocation plan fully utilized the available supply and satisfied all demand, confirming the feasibility and optimality of the solution. The study also compares the results with the Minimum Cell Cost Method to evaluate the cost-effectiveness.

3. Results

The Linear Programming model achieved an optimal transportation cost of RM39.05, outperforming the MCCM's RM42.00. Rahayu supplied 50 units to Medan Denai and 15 to Medan Area, while Mandala supplied 50 units to Medan Tembung, 20 to Medan Timur and 15 to Medan Area, fully utilizing both centers' capacity. The LINGO solution in directed zero infeasibility and required only one iteration, confirming model accuracy and computational efficiency. The results validate LP as a superior for cost minimization in small-to-medium scale logistics and emphasizes its practicality for distribution planning. The RM3.53 cost difference, although seemingly marginal, signifies notable's savings when scaled across multiple distribution cycles.

4. Novelty of Research

This study demonstrates the practical application of Linear Programming in logistics planning through a real-life case study. Unlike heuristic methods like MCCM, LP provides a structured, scalable, and exact optimization framework. The novelty lies in showcasing LP's superior cost efficiency using actual distribution data and validating results through both software simulation and manual calculation. The use of LINGO software facilitates rapid and reliable model solving, making the technique accessible for businesses seeking cost-effective delivery strategies. The comparison with MCCM reinforces LP's advantage in precision and adaptability to various operational constraints, making it a valuable tool in modern SCM.

5. Conclusion or Future Work

Linear Programming proved effective in minimizing transportation costs in a real-world case study. The model ensured full utilization of supply while fulfilling demand at minimum cost. Future research may incorporate dynamic variables such as fuel price changes, time windows, or product perishability. It may also explore hybrid models combining LP with AI-based approaches such as Genetic Algorithms or Goal Programming to enhance flexibility and accuracy in complex logistics networks. As highlighted by Abdirad and Krishnan (2022), integrating smart optimization techniques into supply chain planning can improve service performance and customer satisfaction, making it highly relevant for evolving logistics challenges.

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