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**OPTIMIZATION OF PAINT PRODUCT DISTRIBUTION COSTS
USING THE VOGEL'S APPROXIMATION METHOD AT A
NATIONAL BUILDING MATERIALS RETAIL COMPANY**

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Abstract

In the building materials retail sector, inefficient distribution practices can significantly undermine a company's profitability. If delivery routes are not planned well, logistics costs will go up and the company becomes less competitive. This study looks at how Vogel's Approximation Method (VAM) can help a national retailer save money on distributing paint products. By looking at the data for 2,700 units sent from three warehouses to three locations, the VAM method proved it could find the most economical way to ship goods. The result showed that shipping costs could be cut down to just IDR 3,903,000 per period. This proves that VAM is a reliable tool for managers to make smarter and more efficient distribution decisions.

Keywords: *distribution, cost optimization, Vogel's Approximation Method, logistics, retail building materials*

Abstract

Dalam industri ritel bahan bangunan, pengiriman barang yang tidak efisien bisa menjadi beban besar bagi perusahaan. Jika rute pengiriman asal-asalan, biaya logistik akan membengkak dan daya saing pun menurun. Penelitian ini membahas bagaimana metode Vogel's Approximation Method (VAM) membantu salah satu ritel nasional menghemat biaya distribusi produk cat. Dengan menganalisis pengiriman 2.700 unit dari tiga gudang ke tiga wilayah tujuan, metode VAM terbukti bisa menyusun rencana pengiriman yang paling hemat. Hasilnya, biaya distribusi berhasil ditekan hingga angka Rp3.903.000 per periode. Hal ini membuktikan bahwa VAM adalah solusi praktis bagi manajemen untuk mengambil keputusan distribusi yang lebih efisien.

Kata kunci: distribusi, optimasi biaya, Vogel's Approximation Method, logistik, ritel bahan bangunan

I. INTRODUCTION

Business competition in the building materials retail sector demands that companies improve operational efficiency, particularly in distribution activities. Poorly planned distribution can lead to high logistics costs, delivery delays, and decreased customer service quality.



Paint is a product category with high demand in building materials retailers. This product is characterized by large shipping volumes, a certain weight, and requires efficient distribution management to ensure timely availability across various marketing areas.

One approach that can be used to solve distribution problems is the transportation model in operational research. This model aims to determine shipping patterns from multiple sources to multiple destinations with minimum total cost. Vogel's Approximation Method (VAM) is known as a highly effective, practical method. Through a cost penalty approach, this method can immediately provide initial solutions that are very close to the optimal results.

This study aims to analyze the application of the VAM method to optimize paint product distribution costs at a national building materials retail company with a distribution network in the Greater Jakarta area.

II. THEORETICAL STUDIE

2.1 Distribution and Logistics

The distribution of commodities from supply sources to points of consumption is the core of distribution activities, which aim to ensure that consumer needs are met accurately, efficiently, and on time. As a crucial element in supply chain management, distribution effectiveness directly impacts product accessibility and customer loyalty. Implementing an optimal distribution strategy not only reduces logistics costs and shortens delivery times but also strengthens a company's bargaining position in the market (Chopra & Meindl, 2019; Heizer et al., 2020).

Meanwhile, logistics actually encompasses a broader spectrum. It involves strategic management, from the flow of goods and information to warehouse management, from the initial stage to the consumer (Bowersox et al., 2023).

2.2 Transportation Models

Within the scope of linear programming, transportation models serve as an optimization method for designing distribution schemes for goods from various sources to destinations with the lowest possible operational costs (Taha, 2017). This technique systematically aligns capacity constraints on the supplier side with the volume of demand on the recipient side. The primary focus is to formulate the most economical allocation strategy without ignoring applicable technical limitations or constraints.

The application of transportation models in business operations encompasses various aspects, from production distribution and determining shipping routes to raw material supply chain management and warehouse organization. The primary strength of this method lies in its

ability to provide a data-driven decision-making framework for management. This enables companies to reduce logistics costs while optimizing service quality to consumers (Heizer et al., 2020; Chopra & Meindl, 2019).

2.3 Vogel's Approximation Method

In distribution matters, the Vogel's Approximation Method (VAM) is a mainstay due to its ability to develop highly efficient shipping plans. Unlike conventional methods that simply seek the lowest price, VAM works more carefully, taking into account the risk of cost overruns in subsequent steps. This method is very popular in large industries because its results are close to the most efficient figures from the start (Rafi & Islam, 2020; Satakshi & Henry, 2024).

There are several reasons why VAM is considered a strong standard in supply chain management:

1. **Fast and Accurate:** Although systematic, the process is quite simple, significantly saving time (Rafi & Islam, 2020).
2. **Suitable for Extensive Networks:** Ideal for large organizations with multiple warehouses and complex shipping routes (Satakshi & Henry, 2024).
3. **More Accurate Results:** Its ability to reduce costs from the very first step makes it superior to other legacy techniques (Rafi & Islam, 2020; Satakshi & Henry, 2024).

The key secret of VAM lies in the concept of cost penalties (Taha, 2017). These penalties are calculated from the difference between the two lowest shipping costs, often referred to as "opportunity costs" (Taha, 2017; Aisyah, Purnamasari, & Nasution, 2018). By prioritizing routes with the highest penalties, companies can secure the most cost-effective route to avoid budget overruns (Taha, 2017). This step is carried out continuously until all stock in the warehouse is used up and all customer requests are perfectly fulfilled (Taha, 2017; Aisyah, Purnamasari, & Nasution, 2018).

2.4 Previous Research

Numerous studies have proven that the Vogel's Approximation Method (VAM) is a powerful solution for reducing distribution costs, from the manufacturing and trade sectors to the logistics industry. In the manufacturing sector, this method is crucial for managing shipping allocations, both for raw materials to factories and finished products from warehouses to distributors.

One concrete example of this method's effectiveness is seen in research at PT Nestlé Balikpapan. By combining the VAM and Modified Distribution (MODI) methods, the company significantly reduced transportation costs for Carnation Coffee Mate distribution:

from an initial cost of IDR 1,500,000 to IDR 837,910 after optimization. This resulted in overall savings of 44.14% efficiency (Aisyah, Purnamasari, & Nasution, 2018).

In the trade sector, the Vogel's Approximation Method (VAM) is a highly useful tool for reducing shipping costs to various branches or marketing areas. This is because the VAM method can determine distribution allocations much more efficiently.

Furthermore, in the logistics industry, this method is also relied upon for: Route Optimization: finding the most effective distribution channels; and Fleet Efficiency: ensuring maximum vehicle utilization to eliminate wasted capacity. This effectiveness can also be seen at the Sikumbang Spring Drinking Water distributor in Kampar. By implementing VAM, distribution costs, which previously reached IDR 5,050,000 per week, were reduced to IDR 4,580,485. As a result, the company was able to pocket savings of IDR 469,515 per week (Basriati, Safitri, & Sartika, 2021).

Various studies have proven that the use of the VAM method is not merely theoretical but a real solution for significantly lower distribution costs. Furthermore, this method helps make operational decision-making more measurable and systematic. Therefore, this method is relevant for application in research on paint product distribution in building materials retail companies.

III. RESEARCH METHODS

3.1 Research Type

This research uses a descriptive quantitative method with a transportation model approach.

3.2 Research Object

The research object is a national building materials retail company with distribution centers in the following areas:

- Cinere
- Pamulang
- Depok

Distribution is carried out to the following destination areas:

- North Jakarta
- West Jakarta
- South Jakarta

3.3 Supply and Demand Data

In the transportation model, supply and demand data are the main foundation for determining the most efficient distribution channels. Supply data is information regarding the amount of paint stock available at each distribution center. Demand data, on the other hand, indicates the product demand in each destination area. To ensure a smoother analysis process, the total supply and total demand in this study were adjusted to achieve a balance. This balance is crucial because it facilitates the application of Vogel's Approximation Method (VAM) to find distribution solutions with the lowest possible costs.

Supply

- Cinere = 900 units
- Pamulang = 1,100 units
- Depok = 700 units

Total supply = 2,700 units

Demand

- North Jakarta = 1,300 units
- West Jakarta = 650 units
- South Jakarta = 750 units

Total demand = 2,700 units

Because total supply equals total demand, the transportation model is in equilibrium.

3.4 Compiling the Distribution Cost Matrix

The distribution cost matrix is compiled using regional logistics cost estimates that consider:

1. Estimated distance between distribution points.
2. Fuel costs based on vehicle type.
3. Distribution team wage allocation.
4. Operational handling costs (loading and unloading).
5. Route optimization taking into account traffic density.

Distribution costs are expressed in rupiah per unit of product.

Sumber	Jakarta Utara	Jakarta Barat	Jakarta Selatan
Cinere	1.540	1.490	1.460
Pamulang	1.410	1.470	1.510
Depok	1.410	1.400	1.330

3.5 Analysis Techniques

The primary objective of this research is to find the most cost-effective way to organize the delivery of goods from supply centers to various destination areas. To achieve this, Vogel's Approximation Method (VAM) is used as the primary analysis technique.

In the world of operational research, VAM is known as an intelligent approach specifically designed to find the most reasonable initial solution with the lowest possible total cost. With this method, shipment allocation is no longer random, but rather requires careful calculation to ensure efficiency in each distribution channel.

In this research, steps to minimize logistics costs were implemented using Vogel's Approximation Method (VAM). This method was chosen because of its ability to develop an initial distribution plan that is closer to the lowest cost compared to other methods. The main focus is to systematically determine the allocation of units from supply centers to destination areas to avoid wasted budget. The calculation process is carried out in stages, following the following standard procedures (Taha, 2017; Aisyah, Purnamasari, & Nasution, 2018):

1. **Calculating the Cost Difference (Penalty):** For each row and column, the difference between the two lowest shipping costs is calculated. This difference is an indicator of the risk of additional costs that arise if the cheapest route is not used.
2. **Determining Shipping Priority:** The row or column with the largest difference (penalty) is selected for priority. This is done to avoid using expensive routes late in the process.
3. **Allocating Goods:** As many units of paint as possible are shipped via the route with the lowest rate in the prioritized row or column.
4. **Data Update:** Once capacity at a point is reached, that row or column is crossed off the calculation list. Remaining stock and remaining demand are then updated for the next stage.
5. **Iteration:** All the above steps are repeated continuously until all paint stock in the warehouse has been distributed to all destination stores.

IV. RESEARCH RESULTS

4.1 Distribution Allocation Results

Based on the application of steps 1 through 5 of the VAM method in the first iteration, the initial allocation results were obtained to meet demand in the South Jakarta area. The total shipment was divided into two sources: 50 units of paint came from the Cinere outlet and 700 units from the Depok outlet. Details can be seen below:

RITEL	TOKO BANGUNAN						Penawaran	
	Jakarta Utara		Jakarta Barat		Jakarta Selatan			
Cinere		1.540		1.490		1.460	900	=1490-1460=30
					50			
Pamulang		1.410		1.470		1.510	1.100	=1470-1410=60
					X			
Depok		1.410		1.400		1.330	700	=1400-1330=70
	X		X		700			
Permintaan		1.300		650		750	2.700	

$$1410 - 1410 = 0 \quad 1470 - 1400 = 70 \quad 1460 - 1330 = 130$$

(selisih terbesar 1)

Next, by repeating the penalty calculation procedure (steps 1 through 5) in the second iteration, the allocation results for meeting West Jakarta's demand are obtained. West Jakarta's entire demand for 650 units of paint is met through deliveries from the Pamulang outlet, as shown in the table below:

RITEL	TOKO BANGUNAN						Penawaran	
	Jakarta Utara		Jakarta Barat		Jakarta Selatan			
Cinere		1.540		1.490		1.460	900	1490 - 1460 = 30
			X		50			
Pamulang		1.410		1.470		1.510	1.100	1470 - 1410 = 60
			650		X			
Depok		1.410		1.400		1.330	700	
	X		X		700			
Permintaan		1.300		650		750	2.700	

$$1410 - 1410 = 0 \quad 1470 - 1400 = 70$$

(selisih Terbesar 2)

In the final iteration, the VAM method steps were repeated to meet the remaining demand in the North Jakarta area. To meet this demand, 850 units of paint were shipped from the Cinere store and 450 units were supplied from the Pamulang store, as follows:

RITEL	TOKO BANGUNAN						Penawaran	
	Jakarta Utara		Jakarta Barat		Jakarta Selatan			
Cinere		1.540		1.490		1.460	900	1490 - 1460 = 30
	850		X		50			
Pamulang		1.410		1.470		1.510	1.100	1470 - 1410 = 60
	450		650		X			Selisih terbesar 3
Depok		1.410		1.400		1.330	700	
	X		X		700			
Permintaan		1.300		650		750	2.700	

$$1410 - 1410 = 0$$

After all iterations were completed, all demand from the three building materials store locations had been met, and all supply from the retail outlets had been allocated. Based on the final results of the VAM calculation, the distribution allocation summary was as follows:

1. Cinere → North Jakarta = 850 units
2. Cinere → South Jakarta = 50 units
3. Pamulang → North Jakarta = 450 units
4. Pamulang → West Jakarta = 650 units
5. Depok → South Jakarta = 700 units

4.2 Calculating Total Distribution Costs

After all unit allocations have been determined using the VAM method, the final step is to calculate the total logistics costs. This total cost is obtained by multiplying the number of units allocated to each route by the applicable shipping cost per unit for that route.

Based on the calculations, a summary of the distribution routes and their accumulated costs can be seen in the table below:

Rute	Unit	Biaya/Unit	Total
Cinere → Jakarta Utara	850	1.540	1.309.000
Cinere → Jakarta Selatan	50	1.460	73.000
Pamulang → Jakarta Utara	450	1.410	634.500
Pamulang → Jakarta Barat	650	1.470	955.500
Depok → Jakarta Selatan	700	1.330	931.000

Total distribution cost = IDR 3,903,000

Based on the table above, the total cost of shipping paint products across the entire coverage area is IDR 3,903,000. This figure reflects the most optimal cost achieved through the VAM method, which aims to minimize the company's logistics expenses.

4.3 Discussion

The results of this study demonstrate that the VAM method is highly effective in developing distribution patterns. The strategy prioritizes routes with the lowest costs. A concrete example is seen in the distribution route from Depok to South Jakarta; because it has the lowest costs, this route is immediately maximized to ship the entire available supply capacity, which is 700 units.

By calculating cost penalties, the VAM method ensures that each route is selected based on sound economic considerations. The results are clear: total distribution costs can be reduced

to IDR 3,903,000, or the equivalent of IDR 1,445 per unit for 2,700 units of paint shipped. Structured distribution planning like this is far more reliable and accountable than inaccurate manual allocations.

The tangible benefits experienced by retail companies include:

1. **More Efficient Operations:** The capacity of each store (Cinere, Pamulang, and Depok) is fully utilized according to targets without any wastage.
2. **No More Guesswork:** Clear guidelines are in place to prioritize the most economical routes, resulting in significantly faster decision-making.
3. **Better Stock and Demand Management:** Maintaining a balance between the quantity of goods in stores and consumer demand in Jakarta, ensuring synchronization.

V. CONCLUSION

The calculations show that the implementation of VAM has had a positive impact on the company's distribution efficiency. This method allows management to map the allocation of goods from three source locations to three destination areas, with results very close to ideal.

The main conclusions are:

1. The company can save logistics costs by up to Rp3,903,000 per period.
2. The capacity of 2,700 units of paint is perfectly distributed without any stock being held back, accurately meeting customer needs.
3. As a decision-making tool, VAM helps the company maintain long-term efficiency, especially in the face of competition in the building materials retail market.

REFERENCE

- Aisyah, S., Purnamasari, I., & Nasution, Y. N. (2018). Optimasi Biaya Distribusi Produk Menggunakan Vogel's Approximation Method (VAM) dan Modified Distribution (MODI) (Studi Kasus: PT. Nestle Balikpapan). *Jurnal Eksponensial*, 9(1).
- Basriati, S., Safitri, S., & Sartika, S. (2021). Optimasi Biaya Distribusi Air Minum dengan Menggunakan Metode Vogel's Approximation Method (VAM). *Jurnal Sains Matematika dan Statistika*, 7(1).
- Bowersox, D. J., Closs, D. J., Cooper, M. B., & Bowersox, J. C. (2023). *Supply Chain Logistics Management*. McGraw-Hill Education.
- Chopra, S., & Meindl, P. (2019). *Supply Chain Management: Strategy, Planning, and Operation*. Pearson.
- Heizer, J., Render, B., & Munson, C. (2020). *Operations Management: Sustainability and Supply Chain Management*. Pearson.

Rafi, M. A., & Islam, M. S. (2020). Comparison of Initial Basic Feasible Solution of a Transportation Problem: North-West Corner, Least Cost and Vogel's Approximation Method. *International Journal of Scientific & Engineering Research*.

Satakshi, S., & Henry, J. (2024). *Advanced Transportation Models in Operations Research*. Academic Press.

Taha, H. A. (2017). *Operations Research: An Introduction*. Pearson Education Limited.