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The Transportation Method For Efficient Cost of Shipping Goods

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Abstract.
This study aims to find the lowest shipping costs by comparing several transportation methods. The methods used in calculating distribution costs are the Northwest Corner method, Minimum Cost Method, and Vogel's Approximation Method. The data source used is secondary data which is searched through the internet site cek-ongkir.com to find out the shipping cost per kilogram. The shipping cost rate data is taken from J&T, POS, and JNE, which applies in 2022. The results of this study show that implementing the transportation method using the Northwest Corner method, Minimum Cost method, and Vogel's Approximation method produces the most efficient shipping costs with the same value in overcoming the problem of goods transportation, which is IDR 3,545,000. Of the three methods, the northwest corner method is the simplest, most effective, and most efficient method of transporting the distribution of goods because it produces direct calculations with one iteration. However, it is also possible that companies can use the minimum cost method and Vogel's Approximation method because they have the same shipping cost efficiency value.

Keywords: *efficiency, shipping cost, minimization, transportation method*

1. Introduction

Technology development is relatively rapid at this time, causing more and more online businesses. This is evidenced by a large amount of public interest in shopping online. Since

2021, it is predicted that e-commerce will become a trend that will continue during the pandemic and under new normal conditions (Susanti & Akbar, 2022). Currently, the ease of doing business is very much used by many people, as seen from the many people who are starting to engage in online business, from buying and selling. This phenomenon cannot be separated from the influence of rapid technological advances (Yadav et al., 2021).

Online stores are among the most popular business models today because of their many advantages. As an alternative for novice online businesses, online shops were chosen as an alternative to buying and selling goods online (Koch et al., 2020). Not only in Indonesia, but online business development has also evolved worldwide. An online business is a business that is run by utilizing the internet network; as a whole, buying and selling activities, services to consumers to promotions are carried out online (Flyverbom et al., 2019). In these businesses, people can sell various products ranging from goods and services to different digital products with a wide range. There is no limit to where potential buyers or consumers will buy the products being sold because buyers can come from anywhere. If it is done in Indonesia, the buying and selling process can be carried out throughout the country, considering that many shipping companies deal with inter-island shipping (Setyowati et al., 2021).

A study by Frost & Sullivan stated that online business in Indonesia grew by 17% per year (Utami, 2019). This growth is supported by good management, friendly service, and timely product delivery to better consumer data security. Shipping costs are a problem often encountered in various fields, especially those engaged in the online store business (Huacuja et al., 2021). Transportation and product allocation so that it reaches consumers and optimal distribution costs are several factors that can determine the level of customer satisfaction with buyers (Tolentino & Javines, 2021). To solve this problem, an appropriate and efficient transportation model is designed. This transportation model aims to determine the number of goods that must be sent from several sources to several destinations, which will minimize the total transportation costs (Karagul & Sahin, 2020). The right decision in allocating products based on demand and supply by taking into account distribution costs so that minimizing costs is needed so that maximum profits will be achieved (Gangatharan, 2019).

The problem occurred at an online shop in the city of Pekanbaru. Currently, the marketing of its products has reached four major cities on the island of Java, namely Jakarta, Bandung, Semarang, and Surabaya. The number of requests that are not evenly distributed causes the company to manage its products' distribution properly. The company has collaborated with three shipping companies, namely J&T, JNE, and POS. While the provisions of the expedition company for sending small packages, the weight of the goods is at most 50 kilograms per shipment.

An appropriate calculation method is needed to minimize transportation costs to provide an optimal solution (Gangatharan, 2019). The transportation method is a method used to regulate distribution from source to destination, with product allocation arranged in such a way as to obtain optimal costs (Karagul & Sahin, 2020). Applying a correct and accurate transportation method can expedite distribution flow, maximize delivery from source to destination, and be an excellent business to minimize total transportation costs. By using a transportation model, unnecessary costs can be eliminated, delivery of an item can

run smoothly, increase company efficiency, and save time and energy. Thus, performing calculations by applying the transportation model can solve the problem of shipping goods from sources to be sent to destinations to get the most optimal total cost of shipping goods. Every time the distribution of goods arises, issues; therefore, it must be able to manage transportation costs that will be used for the distribution of goods so that expenses and income are maintained optimally. In line with this, planning the proper distribution of goods to ensure optimal distribution is maintained will result in losses for the company (Bhadane & Manjarekar, 2020; Hussein et al., 2020).

Therefore, this study aims to optimize distribution performance by saving costs and distances to produce the lowest product delivery costs. This problem still needs to be solved by the assignment method because the transportation method has limitations on supply capacity and the number of demands. In contrast to the assignment method, which is used to allocate tasks optimally, both in maximization and minimization problems, but has no limitations. The assignment method is a model related to the network (Zain & Akbar, 2022). This method is a unique linear program model similar to the transportation method. The difference between the assignment method and the transportation method is that in the assignment method, the quantity of each column edge and row edge is limited to only one unit. The method of transportation relates to the distribution of a single product from several sources, with limited supply, to several destinations with specific requests. This model's basic assumption is that the transport cost on a particular route is proportional to the number of units shipped. The transportation model must consider that the total quantity in all rows must equal the total quantity in all columns; if not, a dummy quantity needs to be added. In addition, due to the many methods of transportation, in this study, a comparison of several methods of transportation was also carried out, namely using the Northwest Corner method, Minimum Cost Method, and Vogel's Approximation Method.

2. Research Method

The research design used is applied and comparative research. The type of data used is quantitative data (Akbar, 2020). The data source used is secondary data which is searched through the internet site cek-ongkir.com to find out the shipping cost per kilogram. The shipping cost rate data is taken from J&T, POS, and JNE, which applies in 2022. The classic methods to find the initial solution to transportation problems are the Northwest Corner method, Minimum Cost Method, and Vogel's Approximation Method (Hussein & Shiker, 2020).

Data is processed using the POM-QM application. In this study, a comparison was also made of the three methods used to produce the most efficient shipping costs.

2.1. Northwest Corner Method

The Northwest Corner (NWC) method is one of the most accessible transportation methods, but the results are not necessarily optimal. In the Northwest Corner method, the source and destination locations are sorted from left to right and top to bottom in a matrix data map (Gangatharan, 2019). The rules that apply to the Northwest Corner method are to spend inventory in each row before moving to the next row below it, fulfilling the demand requirements in each column before moving to the next column to the right, and check so that all supply and demand match the amount (Bhadane & Manjarekar, 2020).

2.2. Minimum Cost Method

The working principle of this method is to prioritize allocations with the smallest unit cost (smallest cost per unit). The initial allocation is to the box in the table with the lowest price. The steps of the minimum cost method are to allocate as much as possible to the feasible box with minimum transportation costs; then, it must be adjusted to the existing needs. The steps are repeated to the next lowest minimum cost (Anandhi & Geetha, 2020).

2.3. Vogel's Approximation Method

Vogel's Approximation Method (VAM) algorithm achieves the initial feasible solution to the transportation problem (Karagul & Sahin, 2020). The steps of the VAM method are compiling the needs, the capacity of each source, and transportation costs into a matrix. The next step is to find the smallest cost difference with the next smallest cost for each column or row. Then choose the largest cost difference and allocate as much product as possible to the cell that has the smallest cost. Omits rows or columns that have been filled in because they are impossible to fill in again. Next, determine the difference (difference) costs for columns and rows that still need to be filled. Repeat these steps until all columns and rows are allocated. After filling in all, then calculate the overall transportation costs. Lastly, conducting an optimality test (Studies, 2019).

3. Results and Discussion

3.1. Results

Online shop companies make deliveries through three shipping service companies, namely J&T, POS, and JNE. In one delivery, the company can only send via the shipping service, each with a maximum weight limit of 50 kilograms. The shipping costs of each delivery service are grouped in the table.

Table 1. Shipping Cost per 1 kilogram (in Rupiah)

Delivery Service	Destination			
	Surabaya	Semarang	Jakarta	Bandung
J&T	26000	24000	21000	23000
POS	30000	26000	23000	25000
JNE	27000	23000	20000	22000

Source: cek-ongkir.com

The delivery destinations are Jakarta, with a total demand of 55 kilograms, Bandung, with a total demand of 30 kilograms, Semarang, with a total demand of 20 kilograms; and Surabaya, with a total demand of 45 kilograms. The following shows the overall supply data from the three shipping companies and demand from each market with transportation costs to each market.

Figure 1. Supply, Demand, and Shipping Cost*

Distribution

	Surabaya	Semarang	Jakarta	Bandung	SUPPLY
J&T	26	24	21	23	50
Pos	30	26	23	25	50
JNE	27	23	20	22	50
DEMAND	45	20	55	30	

(*shipping cost data in thousands of rupiah, supply, and demand in kilogram)
Source: POM QM

This study's analytical methods to solve this transportation problem are the Northwest Corner method, Minimum Cost Method, and Vogel's Approximation Method.

Northwest Corner Method

How to calculate transportation costs using the northwest corner method, as the name implies, starts from the top left side, then moves left or down according to the production capacity of the source (supply) and the demand for the destination (demand).

Table 2. Solving Steps Using the Northwest Corner Method

Iteration 1

J&T	45	5	(0)	(0)
Pos	(2)	15	35	(0)
JNE	(2)	(0)	20	30

Source: POM QM

From one iteration, the northwest corner method analysis produces a distribution solution, namely shipping using J&T for Surabaya with a weight of 45 kilograms and Semarang with a weight of 5 kilograms, shipping using POS for Semarang with a weight of 15 kilograms and Jakarta with a weight of 35 kilograms, shipping using JNE for Jakarta with a weight of 20 kilograms, for Bandung with a weight of 30 kilograms.

Figure 2. Distribution Solution

solution value = $3545	Surabaya	Semarang	Jakarta	Bandung
J&T	45	5		
Pos		15	35	
JNE			20	30

Source: POM QM

Calculation of shipping costs using the minimum cost method produces an optimal total price of IDR 3,545,000, - with details: shipping using J&T for Surabaya destinations with a fee of IDR 1,170,000 (45 kilograms x IDR 26,000), for Semarang destinations with a price of Rp.120,000, - (5 kilograms x IDR 24,000), delivery using POS for Semarang destinations with a fee of IDR 390,000 - (15 kilograms x IDR 26,000), for Jakarta destinations with a price of IDR 805,000 (35 kilograms x IDR 23,000), shipping using JNE for Jakarta destinations with a fee of IDR 400,000 (20 kilograms x IDR 20,000)), for Bandung destinations with a price of IDR 660,000 (30 kilograms x IDR 22,000).

Figure 3. Shipping List

From	To	Shipment	Cost per unit	Shipment cost
J&T	Surabaya	45	26	1170
J&T	Semarang	5	24	120
Pos	Semarang	15	26	390
Pos	Jakarta	35	23	805
JNE	Jakarta	20	20	400
JNE	Bandung	30	22	660

Source: POM QM

Minimum Cost Method

Solving the problem using the minimum cost method, as the name implies, begins by selecting the allocation or cell with the lowest shipping or transportation costs.

Table 3. Solving Steps Using the Minimum Cost Method

Iteration 1

J&T	(-2)	15	5	30
Pos	45	5	(0)	(0)
JNE	(0)	(0)	50	(0)

Iteration 2

J&T	15	(2)	5	30
Pos	30	20	(-2)	(-2)
JNE	(2)	(2)	50	(0)

Iteration 3

J&T	20	(2)	(2)	30
Pos	25	20	5	(-2)
JNE	(0)	(0)	50	(-2)

Iteration 4

J&T	45	(0)	(0)	5
Pos	(2)	20	5	25
JNE	(2)	(0)	50	(0)

Source: POM QM

From several iterations, the minimum cost method analysis produces a distribution solution, namely shipping using J&T for Surabaya with a weight of 45 kilograms and Bandung with a weight of 5 kilograms, shipping using POS for Semarang with a weight of 20 kilograms, for Jakarta with a weight of 5 kilograms, for Bandung with a weight of 25 kilograms, shipping using JNE for Jakarta with a weight of 50 kilograms.

Figure 4. Distribution Solution

solution value = $3545	Surabaya	Semarang	Jakarta	Bandung
J&T	45			5
Pos		20	5	25
JNE			50	

Source: POM QM

Calculation of shipping costs using the minimum cost method produces an optimal total price of IDR 3,545,000, - with details: shipping using J&T for Surabaya destinations with a fee of IDR 1,170,000 (45 kilograms x IDR 26,000) for Bandung destinations with a price of Rp.115,000, - (5 kilograms x IDR 23,000), delivery using POS for Semarang destinations with a fee of IDR 520,000 - (5 kilograms x IDR 23,000), for Bandung destinations with a price of IDR 625,000 (25 kilograms x IDR 25,000), shipping using JNE for Surabaya destinations with a fee of IDR 1,000,000 (50 kilograms x IDR 20,000).

Figure 5. Shipping List

From	To	Shipment	Cost per unit	Shipment cost
J&T	Surabaya	45	26	1170
J&T	Bandung	5	23	115
Pos	Semarang	20	26	520
Pos	Jakarta	5	23	115
Pos	Bandung	25	25	625
JNE	Jakarta	50	20	1000

Source: POM QM

Vogel's Approximation Method

Problem analysis in Vogel's Approximation Method can be defined as the decomposition of a complete information system into its parts to identify and evaluate problems, opportunities, obstacles that occur, and the expected needs so that improvements are proposed.

Table 3. Solving Steps Using the Vogel's Approximation Method

Iteration 1

J&T	(-2)	(0)	50	(0)
Pos	(0)	15	5	30
JNE	45	5	(0)	(0)

Iteration 2

J&T	15	(2)	35	(0)
Pos	(2)	(2)	20	30
JNE	30	20	(-2)	(-2)

Iteration 3

J&T	45	(0)	5	(0)
Pos	(2)	(0)	20	30
JNE	(2)	20	30	(0)

Source: POM QM

From several iterations, Vogel's Approximation Method analysis produces a distribution solution, namely shipping using J&T for Surabaya with a weight of 45 kilograms and Jakarta with a weight of 5 kilograms, shipping using POS for Jakarta with a weight of 20 kilograms and Bandung with a weight of 30 kilograms, shipping using JNE for Semarang with a weight of 20 kilograms and Jakarta with a weight of 30 kilograms.

Figure 6. Distribution Solution

solution value = $3545	Surabaya	Semarang	Jakarta	Bandung
J&T	45		5	
Pos			20	30
JNE		20	30	

Source: POM QM

Calculation of shipping costs using Vogel's Approximation Method produces an optimal total price of IDR 3,545,000, - with details: shipping using J&T for Surabaya

destinations with a fee of IDR 1,170,000 (45 kilograms x IDR 26,000), for Jakarta destinations with a price of Rp.105,000, - (5 kilograms x IDR 21,000), delivery using POS for Jakarta destinations with a fee of IDR 460,000 - (20 kilograms x IDR 23,000), for Bandung destinations with a price of IDR 750,000 (30 kilograms x IDR 25,000), shipping using JNE for Surabaya destinations with a fee of IDR 460,000 (20 kilograms x IDR 23,000) for Jakarta destinations with a price of IDR 600,000 (30 kilograms x IDR 20,000).

Figure 7. Shipping List

From	To	Shipment	Cost per unit	Shipment cost
J&T	Surabaya	45	26	1170
J&T	Jakarta	5	21	105
Pos	Jakarta	20	23	460
Pos	Bandung	30	25	750
JNE	Semarang	20	23	460
JNE	Jakarta	30	20	600

Source: POM QM

3.2. Discussion

The transportation problem is a linear program that can be solved using the simplex method. But its unique structure allows the development of a solving procedure called a transport technique that is more efficient in computation (Hussein et al., 2020). Transportation problems are related to the distribution of several commodities from several supply centers, called sources, to several receiving centers, which are called destinations, to minimize the total distribution cost (Bhadane et al., 2021).

Of the three transportation methods, the most optimal transportation and delivery costs are the same: IDR 3,545,000. This cost is the most cost-efficient. The difference in the calculation method is in the iteration. The northwest corner method produces 1 iteration. The minimum cost method has 4 iterations. Vogel's Approximation Method makes 3 iterations. This shows that, in this case, the northwest corner method is the simplest, most effective, and most efficient method of transporting the distribution of goods.

The results of this study support previous research (Anandhi & Geetha, 2020; Bhadane et al., 2021; Gangatharan, 2019; Hussein & Shiker, 2020; Karagul & Sahin, 2020; Studies, 2019; Tolentino & Javines, 2021) which found that the use of the transportation method in distribution can save costs.

4. Conclusion

From the results of the analysis carried out through the three transportation methods used, it can be concluded that the northwest corner method, minimum cost method, and Vogel's approximation method produce the most efficient shipping costs with the same value in overcoming the problem of goods transportation, which is IDR 3,545,000.-. Of the three methods, the northwest corner method is the simplest, most effective, and most efficient method of transporting the distribution of goods because it produces direct calculations with one iteration. However, it is also possible for companies to use the minimum cost method and Vogel's approximation method because of the value of cost efficiency same delivery.

References

Akbar, Y. R. (2020). *Analisis Kuantitatif: Pengolahan Data Statistik Menggunakan SPSS dan Pengumpulan Data Survei Google Form/ Survey Monkey* (Vol. 1). Pena Persada.

Anandhi, N., & Geetha, T. (2020). Maximum average with minimum cost method for solving assignment problem and comparative analysis of traditional method. *Malaya Journal of Matematik*, *S*(1), 259–263. https://doi.org/10.26637/mjm0s20/0049

Bhadane, A. P., & Manjarekar, S. D. (2020). APB's Statistical Quartile method for IBFS of a Transportation Problem and comparison with North-West Corner Method. *International Journal of Engineering Research and Applications Www.Ijera.Com*, *10*(12), 19–21. https://doi.org/10.9790/9622-1012021921

Bhadane, A. P., Manjarekar, S. D., & Dighavkar, C. G. (2021). APBs method for the IBFS of a Transportation Problem and comparison with North West Corner Method. *Ganita*, *71*(1), 109–114. https://bharataganitaparisad.com/wp-content/uploads/2021/10/711-ch011.pdf

Flyverbom, M., Deibert, R., & Matten, D. (2019). The Governance of Digital Technology, Big Data, and the Internet: New Roles and Responsibilities for Business. *Business and Society*, *58*(1), 3–19. https://doi.org/10.1177/0007650317727540

Gangatharan, S. (2019). Optimal Solution of North West Corner and Least Cost Method Fuzzy Transportation Problem By Using Decagon Fuzzy Numbers. *International Journal of Scientific Development and Research*, *4*(10), 142–145.

Huacuja, H. J. F., Morales, M. Á. G., Locés, M. C. L., Santillán, C. G. G., Reyes, L. C., & Rodríguez, M. L. M. (2021). Optimization of the Internet Shopping Problem with Shipping Costs. In *Fuzzy Logic Hybrid Extensions of Neural and Optimization Algorithms: Theory and Applications* (pp. 249–255). Springer.

Hussein, H. A., & Shiker, M. A. K. (2020). A Modification to Vogel's Approximation Method to Solve Transportation Problems. *Journal of Physics: Conference Series*, *1591*(1). https://doi.org/10.1088/1742-6596/1591/1/012029

Hussein, H. A., Shiker, M. A. K., & Zabiba, M. S. M. (2020). A New Revised Efficient of VAM to Find the Initial Solution for the Transportation Problem. *Journal of Physics: Conference Series*, *1591*(1). https://doi.org/10.1088/1742-6596/1591/1/012032

Karagul, K., & Sahin, Y. (2020). A novel approximation method to obtain initial basic feasible solution of transportation problem. *Journal of King Saud University - Engineering Sciences*, *32*(3), 211–218. https://doi.org/10.1016/j.jksues.2019.03.003

Koch, J., Frommeyer, B., & Schewe, G. (2020). Online shopping motives during the COVID-19 pandemic—lessons from the crisis. *Sustainability (Switzerland)*, *12*(24), 1–20. https://doi.org/10.3390/su122410247

Setyowati, W., Widayanti, R., & Supriyanti, D. (2021). Implementation Of E-Business Information System In Indonesia : Prospects And Challenges. *International Journal of Cyber and IT Service Management*, *1*(2), 180–188. https://doi.org/10.34306/ijcitsm.v1i2.49

Studies. (2019). Analysis of Minimizing the Transportation Cost using Least Cost and Vogel ' s Approximation Methods. *National Journal of Parallel and Soft Computing*, *01*(01), 151–156.

Susanti, D., & Akbar, Y. R. (2022). Determination of a Promotional Strategy for E-Commerce

Competition in Indonesia Using Game Theory. *SULTANIST: Jurnal Manajemen Dan Keuangan*, *10*(1), 25–38. https://doi.org/10.37403/sultanist.v10i1.402

Tolentino, R. C., & Javines, M. L. C. (2021). Cost-Penalty Method in Solving for an Initial Feasible. *International Journal of Management & IT*, *12*(2), 80–85. https://doi.org/10.46360/globus.mgt.120211012

Utami, P. (2019). Optimization of utilization of E-commerce on halal products in Indonesia. *Eastern Journal of Economics and Finance*, *4*(1), 14–23.

Yadav, J., Misra, M., & Ranjan, A. (2021). Online Shopping Behavior during COVID-19 Pandemic: An Indian Perspective. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3874348

Zain, I., & Akbar, Y. R. (2022). Division of Tasks Using the Hungarian Method. *Journal of Business and Management Review*, *3*(8), 502–514. https://doi.org/10.47153/jbmr38.4032022