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Optimizing Staple Supply at Parepare Using Transportation Method

Optimalisasi Pasok Bahan Pokok di Kota Parepare Menggunakan Metode Transportasi

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Abstract

This study uses transportation methods to optimize the distribution cost of staples from Parepare City to Sidrap, Barru, Pinrang, and Bone City in South Sulawesi. The three transportation methods used in this study were Least Cost (LC), Vogel's Approximation Method (VAM), and North West Corner. The data used is in the form of transportation cost data from Parepare to the four cities. The calculation results with Vogel's Approximation Method (VAM) model provide more optimal results by maximizing the delivery from the 3rd warehouse to the Sidrap, Barru, and Pinrang. These findings provide information on optimal transportation methods to save distribution costs.

Keywords*: Optimization; Transportation Methods.*

Abstrak

Penelitian ini menggunakan metode transportasi untuk mengoptimalkan biaya distribusi bahan pokok dari Kota Parepare ke Kota Sidrap, Barru, Pinrang, dan Bone di Sulawesi Selatan. Tiga metode transportasi yang digunakan pada penelitian ini adalah Least Cost (LC), Vogel's Approximation Method (VAM), dan North West Corner. Data yang digunakan berupa data biaya transportasi dari Parepare ke empat kota tersebut. Hasil perhitungan dengan model Vogel's Approximation Method (VAM) memberikan hasil yang lebih optimal dengan memaksimalkan pengiriman pasokan barang dari gudang ke-3 ke Kota Sidrap, Barru, dan Pinrang. Temuan ini memberikan informasi penggunaan metode transportasi yang optimal untuk menghemat biaya distribusi.

Kata Kunci*: Metode Transportasi; Optimalisasi.*

Introduction

Distribution plays a crucial role in the marketing cycle of a product or service[1]. The aim is to optimize the movement of goods or services from producers to the end consumers. In the era of globalization and technological advancements, distribution is no longer just about physical transportation but also involves logistic planning, supply chain management, and the implementation of information technology[2]. Efficient distribution not only ensures the availability of products in the market but also guarantees that consumers receive the products or services according to their needs and expectations.

The distribution process involves a series of complex activities, including storage, packaging, transportation, and inventory management [3]. The importance of good distribution is closely related to the success of a product in the market[4]. Companies that can manage distribution efficiently can create added value, reduce operational costs, and increase customer satisfaction[5]. Therefore, a deep understanding of market trends, consumer behavior, and the latest technology is key to developing successful distribution strategies.

One of the serious challenges in distribution is the high distribution costs, which often do not correspond to the added value provided by the distribution process. This phenomenon can be triggered by various factors, including soaring transportation costs, significant inventory costs, or other operational inefficiencies. The problem of high distribution costs can be detrimental to both producers and consumers, and can affect the competitiveness of a product or service in the market[6]. Just as Ud. Hast Pratama is currently facing, the challenge of high distribution costs that do not align with the added value provided by the distribution process

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[1] Putri Ramadhona et al., "Analisis Bauran Pemasaran Untuk Meningkatkan Volume Penjualan Produk Logam Mulia Pada PT. Pegadaian (PERSERO)," *JEMASI: Jurnal Ekonomi Manajemen dan Akuntansi* 19, no. 2 (2023): 265–279, http://www.nber.org/papers/w16019.

[2] Tajuddin Bantacut and Rahmat Fadhil, "Application of LOGISTICTS 4.0 in Rice Supply Chain Management at Perum BULOG: An Initial Idea," *Jurnal Pangan* (2018): 1–14.

[3] Immanuel Zai et al., "Analisis Pengaruh Peningkatan Kinerja, Incoterms, Transportasi, Distribusi, Keterlibatan TPL Dan Manajemen Risiko Terhadap Aktivitas Logistik," *Jurnal Sosial dan Teknologi (SOSTECH)* 2, no. 3 (2022): 225–238.

[4] Dimas Hendika Wibowo, Zainul Arifin, and Sunarti, "Analisis Strategi UMKM (Studi Pada Batik Diajeng Solo)," *Jurnal Administrasi Bisnis (JAB)* 29, no. 1 (2015): 59–66.

[5] Silvya L. Karundeng, Thessa Natasya Mandey and Jacky S.B. Sumarauw, "Analisis Saluran Distribusi Kayu (Studi Kasus Di Cv. Karya Abadi, Manado)," *Jurnal EMBA: Jurnal Riset Ekonomi, Manajemen, Bisnis dan Akuntansi* 6, no. 3 (2018): 1748–1757.

[6] Kristina Sedyastuti, "Analisis Pemberdayaan UMKM Dan Peningkatan Daya Saing Dalam Kancah Pasar Global," *INOBIS: Jurnal Inovasi Bisnis dan Manajemen Indonesia* 2, no. 1 (2018): 117–127.

Mathematics, especially in the field of Linear Programming, can provide a significant contribution to solving high distribution cost problems. Linear Programming is an effective mathematical optimization method for identifying the best solution by minimizing or maximizing an objective function, while considering a set of constraints[7]. In the context of distribution, Linear Programming can be used to design an optimal distribution plan that minimizes overall costs[8]. For example, by modeling variables such as transportation costs, inventory costs, and other operational expenses, and incorporating constraints such as transportation capacity or time requirements, Linear Programming can provide the best solution that optimizes resource utilization. The application of Linear Programming in supply chain management can help companies identify areas where costs can be reduced without sacrificing efficiency[9]. Additionally, this method can assist in making more accurate decisions, such as scheduling optimal delivery routes or efficient inventory management."

One application of Linear Programming that can address this issue is the Transportation Method. The transportation method is a mathematical tool used to plan and optimize the distribution patterns of products from sources to destinations by minimizing the total distribution cost[10]. Its goal is to achieve a balance between supply and demand while ensuring efficient resource utilization.

In the transportation method, products are shipped from various sources to various destinations, and the distribution costs between sources and destinations are taken into account. The decision variables include the quantity of products to be shipped from each source to each destination[11]. Constraints such as source capacities, destination capacities, and other limitations are also incorporated into the model. Through mathematical approaches, the transportation model can provide optimal solutions to distribution problems by identifying the most economical product shipping

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[7] Indah Purnama Sari, Rianita Puspa Sari, and Ida Rinjani, "Optimalisasi Pendistribusian Susu Nasional Dengan Menggunakan Metode Assignment (Hungarian) Dan Metode Networking Spanning Tree" VI, no. 3 (2021).

[8] Widya Astuti, "Optimalisasi Biaya Transportasi Pendistribusian Produk Black Parfume Menggunakan Pendekatan Model Transportasi" 1, no. 3 (2023): 95–102.

[9] Yekti Condro Winursito et al., "Optimalisasi Produksi Warung Makan Menggunakan Model Linear Programming Dengan Metode Simplex," *Waluyo Jatmiko Proceeding* 16, no. 1 (2023): 271–280.

[10] V S Adoe, "Model Transportasi Dalam Meminimumkan Biaya Distribusi Beras Kemasan," *Jurnal Ilmiah Matematika Dan Terapan* 18, no. 1 (2021): 11–20.

[11] Wisnu Arimurti et al., "Optimasi Biaya Transportasi Pengiriman Produk Mainan Menggunakan Vogel's Approximation Method Dan Stepping Stone Method (Studi Kasus: Toko Sumber Mainan)," *Jurnal Sains, Teknologi dan Industri* 20, no. 1 (2022): 365–374.

routes[12]. This helps companies save transportation costs, improve supply chain efficiency, and ensure that products reach destinations according to market demand.

The advantages of the transportation method are highlighted in the research conducted by Lasman Ajat who concludes that distribution is closely related to adequate transportation activities [13]. Distribution issues are aspects that need to be considered because they have a significant impact on costs and the level of service to consumers. Therefore, a method for addressing distribution issues using transportation methods is needed in order to minimize total distribution costs.

The selection of transportation methods in the context of linear programming can play a crucial role in formulating optimal solutions for distribution problems. Among the eight theoretical methods commonly used, this research focuses on three main methods: the Least Cost Approach (LC), Vogel's Approximation Method (VAM), and the North West Corner method. The LC approach focuses on selecting shipping routes with the lowest cost, with the initial step being to choose the cell with the lowest cost and allocate capacity as much as possible[14]. The VAM method considers the comparison of costs from the two lowest cells in each row and column, identifies cost imbalances, and selects the cell with the highest cost difference for allocation[15]. Meanwhile, the North West Corner Method starts allocation from the northwest corner of the distribution table, allocating capacity from that cell and moving on to the next cell until demand or supply is met[16].

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[12] Fikri Husin Batubara and Rina Widyasari, "Penerapan Metode Transportasi Dan Transhipment Menggunakan Linear Programming Dalam Efisiensi Biaya Distribusi Barang" 7, no. 1 (2023): 128–137.

[13] Ajat Lasmana, "Metode Transportasi Pada Program Linear Untuk Pendistribusian Barang," *Jurnal Matematika* 20, no. 1 (2021): 35–41.

[14] Dimasuharto Nugrogo and Ade Momon Subagyo, "Optimization Of Distribution Cost Of 3kg Gas Cylinder at Pt. Gemilang Putra Sejati Using The North West Corner, Least Cost, And Vogel Approximation Method," *International Journal of Economics, Business and Accounting Research (IJEBAR)* 2021, no. 2 (2021): 541–550.

[15] Arnita Manurung, "Analisis Penerapan Model Transportasi Dengan Metode Vogel Approximation (VAM) Dengan Uji Modified Distribution (MODI) (Studi Kasus: PT Multi Ganda Scoteknik)" (2019): 1–71, http://repositori.usu.ac.id/handle/123456789/13879.

[16] Imelda Dua Reja et al., "Analisis Penerapan Model Transportasi Dalam Optimasi Biaya Distribusi Barang Dengan North West Corner Method (Nwcm) Pada Pt. Unilever Indonesia,Tbk Cabang Maumere" 4 (2018): 25–29.

Several previous national studies have applied transportation models to minimize transportation costs, such as the research conducted by Tuti Apriani [17] that the VAM method is more optimal for use in Gardenia company. Similar research was conducted by Ardhayani[18] with the research titled "Optimization of Distribution Costs and Product Allocation Using Transportation Methods." The results of this study showed that the application of transportation methods using POM - QM software can optimize distribution costs and allocate the distribution of Tetra Pak packaged tea products.

Based on that, this research aims to offer a highly relevant and practical approach in addressing the distribution issues of staple goods in the company. In this context, the researcher conducted a study by applying transportation methods such as Least Cost, Vogel's Approximation Method, and North West Corner to find optimal solutions for the distribution of staple goods at Ud. Hast Pratama company, Parepare City.

Method

This research employs a quantitative descriptive research method. Descriptive research aims to describe an ongoing situation. This study utilizes a quantitative approach by collecting data, interpreting the gathered data, and presenting the data processing results using numerical values. Primary data is obtained from the research subjects through interviews with employees who are relevant to the research problem. Secondary data consists of information obtained from the company, such as papers, archives, reports, or other sources related to the research problem. The research location is Ud. Hast Pratama, Parepare City, a company that provides staple goods such as rice, flour, wheat flour, sugar, oil, and others distributed to several districts/cities such as Sidrap, Barru, Pinrang, and Bone. Ud. Hast has 3 warehouse branches: Bulu Nippon Soreang Warehouse, Makassar Warehouse, and Lumpue Warehouse. The transportation cost incurred by UD. Hast Pratama company annually is Rp 360,000,000 (Observation data obtained from interviews with UD. Hast Pratama company employees). The research roadmap is as Figure 1.

[17] Tuti Apriani, "Penerapan Model Transportasi Distribusi Pada Perusahaan Roti Dengan Menggunakan Metode Pendekatan Vogel, Metode Pendekatan Russel, Dan Metode NWC (Sudut Barat Laut) Studi Kasus: PT. Gardenia" (UIN Alauddin Makassar, 2016).

[18] Ika Widya Ardhyani, "Mengoptimalkan Biaya Distribusi Pakan Ternak dengan Menggunakan Metode Transportasi (Studi Kasus Di PT. X Krian)," *Teknika: Engineering and Sains Journal* 1, no. 2 (2017): 95.

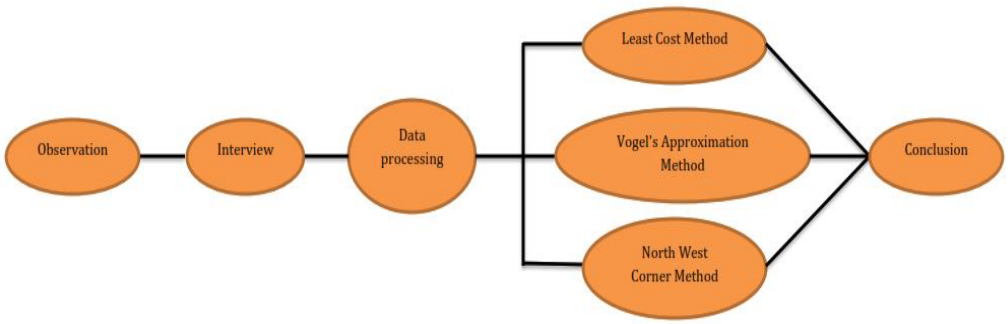

Figure 1. Research Roadmap

To calculate the optimal cost, the following objective function equation is used.

$$z = \sum_{i=1}^{m} \left(\sum_{j}^{n} (x_{ij}\, b_{ij} \right)$$

Results and Discussion

At UD. Hast Pratama company, there are 3 warehouse branches: Bulu Nippon Soreang Warehouse, Makassar Warehouse, and Lumpue Warehouse. Each warehouse has a different capacity, adjusted to the needs of each branch. Similarly, each branch also has varying demand quantities, tailored to the needs of individual consumers. This study also obtained information about the types of transportation used and the transportation costs incurred for Canvas trucks, Trucks, and Pick-Up trucks. The transportation costs incurred are as Tabel 1.

Table 1. Transportation Costs incurred by Ud. Hast Pratama

	Sidrap	Pinrang	Barru	Bone
Warehouse 1	150	200	125	215
Warehouse 2	125	250	175	300
Warehouse 3	200	325	250	500

Source: Transportation cost data from Ud. Hast Pratama

The research procedure will be conducted in several stages, including: gathering data from the company, creating the mathematical model, organizing the data into Transportation matrix form, finding initial solutions using the VAM method, finding initial solutions using the LC method, finding initial solutions using the NWC method, and finally comparing the three

initial solutions to determine which one is the most optimal among the three methods.

1. Analysis Using the North West Corner Method

Calculating the minimum total distribution cost of shipping using the North West Corner method. The existing data is input into the transportation matrix to form the initial table as Tabel 2.

Table 2. Initial Data for the North West Corner Method

	Sidrap	Pinrang	Barru	Bone	Suplay
Warehouse 1	150	200	125	215	200
Warehouse 2	125	250	175	300	100
Warehouse 3	200	325	250	500	500
Demand	175	300	200	125	800

Source: Data Processing

From the Table 2, it is important to note whether the demand quantity (P_i) is equal to the supply quantity (S_i). To determine this value, you can use the following equation:

$$\sum_{i=1}^{3} Si = S_1 + S_2 + S_3 \quad \leftrightarrow \quad \sum_{i=1}^{4} Pi = P_1 + P_2 + P_3 + P_4$$
$$= 200 + 100 + 500 \quad \leftrightarrow \quad = 175 + 300 + 200 + 125$$
$$= 800 \quad \leftrightarrow \quad = 800$$

The supply and demand quantities are equal, so there is no need to add dummy variables.

Table 3. The Calculation Process Uses the North West Corner Method

	Sidrap	Pinrang	Barru	Bone	Suplay
Warehouse 1	150 175	200 25	125	215	200
Warehouse 2	125	250 100	175	300	100
Warehouse 3	200	325 175	250 200	500 125	500
Demand	175	300	200	125	800

Source: Data Processing

Based on Table 3, the description of transportation costs incurred from each warehouse is as follows

1) Shipping cost from Warehouse 1 to Sidrap = 175 x Rp150,000 = Rp26,250,000,-
2) Shipping cost from Warehouse 1 to Pinrang = 25 x Rp200,000 = Rp5,000,000,-
3) Shipping cost from Warehouse 2 to Pinrang = 100 x Rp250,000 = Rp25,000,000,-
4) Shipping cost from Warehouse 3 to Pinrang = 175 x Rp325,000 = Rp56,875,000,-
5) Shipping cost from Warehouse 3 to Barru = 200 x Rp250,000 = Rp50,000,000,-
6) Shipping cost from Warehouse 3 to Bone = 125 x Rp500,000 = Rp62,500,000,-

The total transportation cost for distributing from a warehouse to a branch obtained using the North West Corner (NWC) method is Rp225.625.000,-

2. Analysis Using Least Cost Method

Calculating the minimum total distribution cost of shipping using the least cost method. The data has been input into the transportation matrix, resulting in the following initial table:

Table 4. Initial Data for the Least Cost Transportation Method

	Sidrap	Pinrang	Barru	Bone	Suplay
Warehouse 1	150	200	125	215	200
Warehouse 2	125	250	175	300	100
Warehouse 3	200	325	250	500	500
Demand	175	300	200	125	800

Source: Data Processing

The basic principle of obtaining an initial feasible solution with the least cost method is not much different from the northwest corner method. It's just that the filling is not done from the northwest corner, but from the cell with the lowest shipping cost. In that cell, we fill in as much cargo as possible. If there are several cells with the same lowest cost, then any of them can be chosen. The least cost method is often also referred to as the greedy method because it always starts the solution from the small cost without considering

its effects on the overall process. Although it always starts from the cell with the lowest cost, the least cost method does not necessarily produce an optimal solution.

Logically, the results obtained with the least cost method would be better than with the northwest corner method because the northwest corner method does not consider the shipping costs for each cell in detail. As a result, the total shipping costs tend to be sub optimal.

Table 5. The Calculation Process Uses the Least Cost Method

	Sidrap	Pinrang	Barru	Bone	Suplay
Warehouse 1	150	200	125 200	215	200
Warehouse 2	125 100	250	175	300	100
Warehouse 3	200 75	325 300	250	500 125	500
Demand	175	300	200	125	800

Source: Data Processing

Based on Table 5, the description of transportation costs incurred from each warehouse is as follows

1) Shipping cost from Warehouse 1 to Barru = 200 x Rp125,000 = Rp25,000,000,-
2) Shipping cost from Warehouse 2 to Sidrap = 100 x Rp125,000 = Rp12,500,000,-
3) Shipping cost from Warehouse 3 to Sidrap = 75 x Rp200,000 = Rp15,000,000,-
4) Shipping cost from Warehouse 3 to Pinrang = 300 x Rp325,000 = Rp97,500,000,-
5) Shipping cost from Warehouse 3 to Bone = 125 x Rp500,000 = Rp62,500,000,-

The total transportation cost for distributing from a warehouse to a branch obtained using the Least Cost method is Rp212.500.000 ,-

3. Analysis Using Vogel's Approximation Method (VAM)

Calculating the minimum total distribution cost of shipping using the Vogel's Approximation Method (VAM) approach. The data has been input into the transportation matrix, resulting in the following Tabel 6.

Table 6. Initial Data for the Vogel's Approximation Method"

	Sidrap	Pinrang	Barru	Bone	Suplay
Warehouse 1	150	200	125	215	200
Warehouse 2	125	250	175	300	100
Warehouse 3	200	325	250	500	500
Demand	175	300	200	125	800

Source: Data Processing

The difference between the two smallest costs is find then namely the first smallest cost and the second smallest cost for each row and column. Choose the largest difference value among all difference values in the columns and rows. If there are two difference values that are equal, then choose the row or column with the lowest cost. Then fill in one of the cells that belongs to the selected column or row, which is the cell with the lowest cost. Fill in as many as possible. And if there is already a row or column that has reached its capacity, then remove that row or column because it cannot be filled anymore. Then determine the cost difference again for the rows and columns that have not been filled. Repeat these steps until all rows and columns are fully allocated.

Table 7. The Calculation Process Uses the Vogel's Approximation Method

	Sidrap	Pinrang	Barru	Bone	Suplay	Different Row
Warehouse 1	150	200	125 75	215 125	200	25
Warehouse 2	125 100	250	175	300	100	50
Warehouse 3	200 75	325 300	250 125	500	500	50
Demand	175	300	200	125	800	
Different Column	25	50	50	85		

Source: Data Processing

Based on Table 3, the description of transportation costs incurred from each warehouse is as follows

1) Shipping cost from Warehouse 1 to Barru = 75 x Rp125,000 = Rp9,375,000,-
2) Shipping cost from Warehouse 1 to Bone = 125 x Rp215,000 = Rp26,875,000,-
3) Shipping cost from Warehouse 2 to Sidrap = 100 x Rp125,000 = Rp12,500,000,-
4) Shipping cost from Warehouse 3 to Sidrap = 75 x Rp200,000 = Rp15,000,000,-
5) Shipping cost from Warehouse 3 to Barru = 125 x Rp250,000 = Rp31,250,000,-
6) Shipping cost from Warehouse 3 to Pinrang = 300 x Rp325,000 = Rp97,500,000,-

The total transportation cost for distributing from a warehouse to a branch obtained using the VAM method is Rp192.500.000,-.

From the results of this study, the comparison of transportation costs that the company will incur when using the Least Cost Approach (LC) method, Vogel's Approximation Method (VAM), and the North West Corner (NWC) method can be seen in the Table 8.

Table 8. Transportation Cost by NWC, LC, and VAM

Method	Transportation Costs
North West Corner (Sudut Barat Laut)	Rp225.625.000,-
Least Cost (LC)	Rp212.500.000,-
Vogel's Approximation method (VAM)	Rp192.500.000,-

By the Table 8, the method that is closest to optimizing transportation costs to get maximum profits is the Vogel's Approximation method (VAM) by the comparison of costs from the two lowest place. The delivery from the 3rd warehouse to the Sidrap, Barru, and Pinrang can be maximized to reduce transportation costs.

Conclusion

Based on the results and discussions obtained, it can be concluded that the *Vogel's Approximation Method* (VAM) has proven to provide more optimal results for UD. Hast Pratama in managing their transportation costs. By minimizing transportation costs by Rp 167,000,000 or 46% of the total annual transportation costs, VAM has demonstrated its effectiveness in improving efficiency and optimizing cost savings in distribution. In practical terms, these findings provide valuable insights for UD. Hast Pratama in designing and implementing more efficient transportation strategies. The implementation of this transportation method has shown that the optimal distribution strategy to be carried out to reduce transportation costs is such as maximized the delivery from the 3rd warehouse to the Sidrap, Barru, and Pinrang to reduce transportation costs.

Bibliography

Adoe, V S. "Model Transportasi Dalam Meminimumkan Biaya Distribusi Beras Kemasan." *Jurnal Ilmiah Matematika Dan Terapan* 18, no. 1 (2021): 11–20. https://doi.org/10.22487/2540766X.2021.v18.i1.15496.

Apriani, Tuti. "Penerapan Model Transportasi Distribusi Pada Perusahaan Roti Dengan Menggunakan Metode Pendekatan Vogel, Metode Pendekatan Russel, Dan Metode NWC (Sudut Barat Laut) Studi Kasus: PT. Gardenia." UIN Alauddin Makassar, 2016.

Ardhyani, Ika Widya. "Mengoptimalkan Biaya Distribusi Pakan Ternak Dengan Menggunakan Metode Transportasi (Studi Kasus Di PT. X Krian)." *Teknika: Engineering and Sains Journal* 1, no. 2 (2017): 95.

Arimurti, Wisnu, Rianita Puspa Sari, Dene Herwanto, and Chairul Falah. "Optimasi Biaya Transportasi Pengiriman Produk Mainan Menggunakan Vogel's Approximation Method Dan Stepping Stone Method (Studi Kasus: Toko Sumber Mainan)." *Jurnal Sains, Teknologi dan Industri* 20, no. 1 (2022): 365–374. http://dx.doi.org/10.24014/sitekin.v20i1.20059.

Astuti, Widya. "Optimalisasi Biaya Transportasi Pendistribusian Produk Black Parfume Menggunakan Pendekatan Model Transportasi" 1, no. 3 (2023): 95–102. https://doi.org/10.62017/jemb.v1i3.598.

Aulia, Siti, Dwi Maulidah, Andung Rokhmat Hudaya, and Bobby Rachmat. "Model Pemrograman Linier Untuk Memaksimalkan Laba Disertai Analisis Dual : Sebuah Kasus Pada Agroindustri Kreatif Roti Di Desa Keduanan Kecamatan Depok Kabupaten Cirebon PENDAHULUAN Dalam Kerangka Sistem Agribisnis , Agroindustri Ialah Subsistem Yang Berk" 1, no. 02 (2021): 130–154. https://doi.org/10.32627/agritekh.v1i02.47.

Bantacut, Tajuddin, and Rahmat Fadhil. "Application of LOGISTICTS 4.0 in Rice Supply Chain Management at Perum BULOG: An Initial Idea." *Jurnal Pangan* (2018): 1–14. https://doi.org/10.33964/jp.v27i2.371.

Husin Batubara, Fikri, and Rina Widyasari. "Penerapan Metode Transportasi Dan Transhipment Menggunakan Linear Programming Dalam Efisiensi Biaya Distribusi Barang" 7, no. 1 (2023): 128–137.

Karundeng, Thessa Natasya Mandey, Silvya L., and Jacky S.B. Sumarauw. "Analisis Saluran Distribusi Kayu (Studi Kasus Di Cv. Karya Abadi, Manado)." *Jurnal EMBA: Jurnal Riset Ekonomi, Manajemen, Bisnis dan Akuntansi* 6, no. 3 (2018): 1748–1757. https://doi.org/10.35794/emba.v6i3.20444.

Lasmana, Ajat. "Metode Transportasi Pada Program Linear Untuk Pendistribusian Barang." *Jurnal Matematika* 20, no. 1 (2021): 35–41.

Manurung, Arnita. "Analisis Penerapan Model Transportasi Dengan Metode Vogel Approximation (VAM) Dengan Uji Modified Distribution (MODI) (Studi Kasus: PT Multi Ganda Scoteknik)" (2019): 1–71.

Nugrogo, Dimasuharto, and Ade Momon Subagyo. "Optimization of Distribution Cost of 3kg Gas Cylinder at PT. Gemilang Putra Sejati Using the North West Corner, Least Cost, And Vogel Approximation Method." *International Journal of Economics, Business and Accounting Research (IJEBAR)* 2021, no. 2 (2021): 541–550. http://dx.doi.org/10.29040/ijebar.v8i1

Ramadhona, Putri, Nenny Octarinie, Zubaidah, and Pantani Dahlan. "Analisis Bauran Pemasaran Untuk Meningkatkan Volume Penjualan Produk Logam Mulia Pada PT. Pegadaian (PERSERO)." *JEMASI: Jurnal Ekonomi Manajemen dan Akuntansi* 19, no. 2 (2023): 265–279. https://doi.org/10.35449/jemasi.v19i2.658

Reja, Imelda Dua, Yosafat Pati Koten, Patrisius Migu Hekin, Program Studi, Teknik Informatika, and Universitas Nusa. "Analisis Penerapan Model Transportasi Dalam Optimasi Biaya Distribusi Barang Dengan North West Corner Method (Nwcm) Pada Pt. Unilever Indonesia,Tbk Cabang Maumere" 4 (2018): 25–29.

Sari, Indah Purnama, Rianita Puspa Sari, and Ida Rinjani. "Optimalisasi Pendistribusian Susu Nasional Dengan Menggunakan Metode Assignment (Hungarian) Dan Metode Networking Spanning Tree" VI, no. 3 (2021).

Sedyastuti, Kristina. "Analisis Pemberdayaan UMKM Dan Peningkatan Daya Saing Dalam Kancah Pasar Global." *INOBIS: Jurnal Inovasi Bisnis dan Manajemen Indonesia* 2, no. 1 (2018): 117–127. https://doi.org/10.31842/jurnal-inobis.v2i1.65.

Wibowo, Dimas Hendika, Zainul Arifin, and Sunarti. "Analisis Strategi UMKM (Studi Pada Batik Diajeng Solo)." *Jurnal Administrasi Bisnis (JAB)* 29, no. 1 (2015): 59–66. https://doi.org/10.35797/jab.v4.i012.%25p

Winursito, Yekti Condro, Erwan Adi Saputro Semnasti, Mega Cattleya PA Islami Semnasti, and Aida Kurnia Sari Semnasti. "Optimalisasi Produksi Warung Makan Menggunakan Model Linear Programming Dengan Metode Simplex." *Waluyo Jatmiko Proceeding* 16, no. 1 (2023): 271–280.

Zai, Immanuel, Shirley Feblicia, Alifia Lisda, Zetty Aqmi, and Ayu Fauzia. "Analisis Pengaruh Peningkatan Kinerja, Incoterms, Transportasi,

Distribusi, Keterlibatan TPL Dan Manajemen Risiko Terhadap Aktivitas Logistik." *Jurnal Sosial dan Teknologi (SOSTECH)* 2, no. 3 (2022): 225–238. https://doi.org/10.59188/jurnalsostech.v2i3.304.