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Research Article

Real Life Applications Of Transportation Problem Model: A Study And Complex Analysis Of Hyundai Plants

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ARTICLE INFO | **ABSTRACT**

The transportation issue model, which was among the first linear programming models to be used in reality, has drawn interest from specialists due to its distinctive table operations approach structure. In order to improve the unique structure of the transportation model and quicken the process of resource distribution, this study thus made an effort to complete the optimization techniques and present some insightful thoughts from a critical and constructive standpoint. Ultimately, Hyundai plants physical distribution case study was examined as a model for future research i.e. we analyzed the real life application of scheduling appointments as Nepalese trade events.

1. INTRODUCTION

1. Human social practice has always included transportation activities. There are many different modes of transportation, including pipeline, air carrier, river navigation, railage, road transportation, and ocean shipping. They cannot be disregarded in terms of time or space. As transportation advances, managerial proficiency advances daily. Management history is replete with classic allusions and a vast number of optimization challenges. For instance, in the Song Dynasty, a scientist named Shen Kuo made a brilliant suggestion about the transportation of food supplies to address the army's supply issue, and a minister named Ding Wei constructed a trench around the burnt palace to transfer building materials.
This narrative clearly demonstrates both the actual success in transportation behavior and the notion of rudimentary administration. Thus far, management theories and strategies for the most efficient allocation of resources in the transportation sector have been documented in management textbooks, management works, and associated professional publications. The world community then devised and acknowledged a transportation model. The concept gave rise to the table operations approach, which has a distinct structure and is more efficient and straightforward than the simplex form method. This approach can be used to address some unique "transportation problems" in addition to the real transportation activity.
2. The idea behind the transportation problem: A Study of Paradigms In the absence of a cohesive paradigm research, a science will remain in the pre-scientific stage. As the cornerstone of scientific inquiry, normal form serves as both a consistent and specific mode of inquiry whose standard questions and solutions have already gained public acceptance [1] and a means of identifying issues that need to be resolved and selecting appropriate approaches to address them. A unique paradigm known as the "transportation problem" consists of a collection of organized ideas, definitions, and subjects that are meant to clarify, assess, incorporate, and improve actual physical distribution issues.

3. Explanations of Relevant Concepts:

1) Model: A model is an abstract representation of the real world or a reduced simulation of it. The transportation problem falls under the latter category, which has the purpose of simplifying the complex interaction between real system variables into a numerical relationship or other straightforward form. The goal is to understand the regularity of change over time and to unveil the essence of the complex system. Typically, the model study's findings can provide valuable guidance for practical tasks and generate positive expectations for future research.

2) Mathematical model: It is a technique for modeling real-world scenarios using graphs, pictures, diagrams, and mathematical equations to characterize the nature of actual systems and anticipated future behavior. Additionally, the transportation issue model consists of objective functions, constraint conditions, and decision variables that are all computed in tandem to identify the best possible solution.

3) Transportation problem model: Physical distribution and allocation problems are solved by the transportation problem model, which may be applied in a number of common scenarios such resource assignment, vehicle scheduling, collaboration in specialty, and appropriate redistribution in a manufacturing. There are several effective technologies available for analyzing picture and figure models thanks to linear programming. It may use numerical structure and visual abilities to its advantage to simplify complex situations by studying their nature. A logical analysis and computation of the transportation problem may be performed by applying the special table operations approach.

4) Distinctions Between Other LP Methods and Transportation Problem: Its use of graphics and tables to explain resource integration and transportation optimization is the only notable distinction between the transportation problem and other LP approaches; otherwise, it is straightforward, sensible, useful, and easy to understand It offers the best rationale and paradigm for the problem-solving process; In contrast, the other LP approaches create a set of decision variables only via the use of figure language in order to satisfy the linear constraint criteria and either maximize or reduce the goals [2]. Consequently, the following are the objective functions and their constraint conditions:

$$Z_{max}(\gamma_{\min}) = \gamma_1 x_1 + \gamma_2 x_2 + \cdots + \gamma_n x_n$$

Subject to:

$$\alpha_{11}x_1 + \alpha_{12}x_2 + \cdots + \alpha_{1n}x_n \le \beta_1$$
$$\alpha_{21}x_1 + \alpha_{22}x_2 + \cdots + \alpha_{2n}x_n \le \beta_2$$
$$\cdots$$
$$\alpha_{m1}x_1 + \alpha_{m2}x_2 + \cdots + \alpha_{mn}x_n \le \beta_m$$
$$x_1, x_2, \dots, x_n \ge 0$$

4. Present study on transportation problem: Due to the UK's lack of materials and products during World War II and its need for a solution to the distribution and allocation of resources, the problem of transportation took on new dimensions. The Operational Research Club was the first professional academic organization on OR to be founded in Britain in April 1948. The first International Federation of Operations Research Societies was co-founded in 1957 by the UK and the USA. Since then, scholarly articles and theses addressing the transportation issue have been released on a regular basis. Chinese Postman Problem was initially raised by Prof. Guan Meigu of Shandong Normal University in 1962 [3]. The transportation problem has evolved from the historical military material allocation problem to the contemporary transport problem, and it now affects many aspects of daily transportation administration. It can even address certain non-transportation issues that share structural similarities with transportation-related issues. As can be shown, the transportation problem model offers a broad range of problems that it can address.

5. Disadvantages of transportation problem: The table operations technique is a traditional research method that has never altered its approaches to problem solving and is always computed using paradigms, making it useful in scientific research. But after years of investigation and analysis into the instruction of OR, it is discovered that the transportation model in textbooks and related material has three issues, which are as follows:

1. It is cumbersome for table working to have the forms of the production-marketing balance and the transportation price stated separately.
2. When the check number is determined using the prospective technique, the figures and tables are given individually, which is also cumbersome for the operation.
3. Minimal Hamilton Circle is not fully exploited in solving the first workable solution.

6. Solution of the problems: The above problems can be settled down through the following methods:

1. To solve issues more quickly and improve the effectiveness of the table's operation, do integrate the transportation pricing table with the production-marketing balance table.
2. The transportation price γ_{ij} the line of the fundamental variables can be split into two parts: $\gamma_{ij} = u_i + v_j$, when computing the check number λ_{ij} using the potential technique. To make the table operations technique excellent, the computational process of u_i and v_j should be introduced [2].
3. When calculating a set of initially possible solutions using the Minimal Hamilton Circle, two requirements must be adhered to. First, there should be m+n-1 non-zero x_{ij}. Secondly, no loop circuit consisting of nonzero x_{ij} exists. A "0" must be entered in the production-marketing balance table's blank if one of the form's elements is still unfilled when the distribution proposal is received, and it won't be seen as empty like other blanks [2].

The Nepalese Tourism Commission (NTC)

Assembles international trade shows to give Nepalese vendors a platform to interact with foreign buyers of travel-related goods. At these occasions, vendors set up booths and customers pay them visits based on prearranged schedules. Because each event has a limited number of time slots available and because there might be a sizable number of customers and vendors (620 sellers and 700 purchasers attended one such event hosted in Kathmandu in B.S. 2056). NTC makes an effort to optimize preferences when scheduling seller-buyer sessions ahead of time. Both suppliers and consumers are now more satisfied as a result of the model.

Example 1

Laxmi Group Auto operates two significant distribution hubs in Biratnagar and Pokhara, in addition to three facilities in Birjung, Hetauda, and Nabalparasi. The two distribution centers' requests for the same time are 2300 and 1400 automobiles, whereas the three factories' quarterly capacity are 1000, 1500, and 1200 cars. Table 1 shows the distance chart between the factories and the distribution locations.

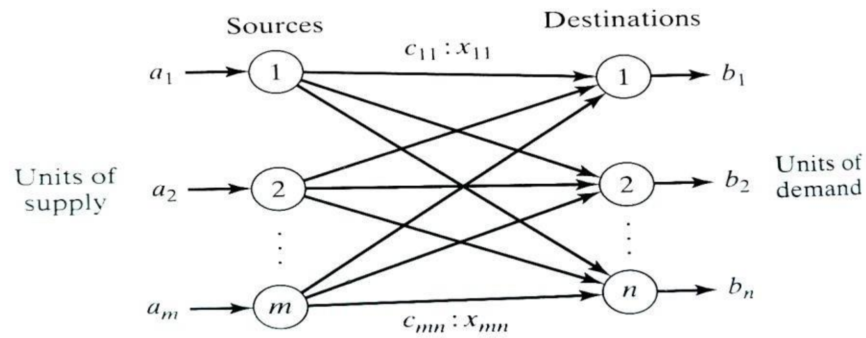

FIGURE 1: Representation of the transportation Model with nodes and arcs

TABLE 1 Mileage chart

	Biratnagar	Pokhara
Birjung	1000	2960
Hetauda	1250	1350
Nabalparasi	1275	850

The trucking company in charge of transporting the cars charges 8 cents per mile per car. The transportation costs per car on the different routes, rounded to the closet dollar, are given in Table 2.
The LP model of the problem is
Minimize $z = 80x_{11} + 215x_{12} + 100x_{21} + 108x_{22} + 102x_{31} + 68x_{32}$
subject to

$$\begin{aligned}
&x_{11} + x_{12} && = 1000 \text{ (Birjung)}\\
&x_{21} + x_{22} && = 1500 \text{ (Hetauda)}\\
&+x_{31} + x_{32} && = 1200 \text{ (Nabalparasi)}\\
&x_{11} \quad +x_{21} \quad +x_{31} && = 2300 \text{ (Biratnagar)}\\
&x_{12} \quad +x_{22} \quad +x_{32} && = 1400 \text{(Pokara)}\\
&x_{ij} \geq 0, i = 1, 2, 3, j = 1, 2
\end{aligned}$$

These constraints are all equations because the total supply from the three sources ($= 1000 + 1500 + 1200 = 3700$ cars) equals the total demand at the two destinations ($= 2300 + 1400 = 3700$ cars).

TABLE 2 Transportation Cost per Car

	Biratnagar	Pokhara
Birjung	$80	$215
Hetauda	$100	$108
Nabalparasi	$102	$68

TABLE 3 Laxmi Transportation Model

	Biratnagar		Pokhara		Supply
Birjung	x_{11}	80	x_{12}	215	1000
Hetauda	x_{21}	100	x_{22}	108	1500
Nabalparasi	x_{31}	102	x_{32}	68	1200
Demand	**2300**		**1400**		

Table 3's transportation tableau style provides a condensed picture of the transportation problem due to its unique layout. As the examples in Section 2 illustrate, this structure is useful for simulating a wide range of scenarios that do not involve the transportation of commodities.
The optimal solution in Figure 2 (obtained by TORA[1]) ships 1000 cars from Birjung to Biratnagar ($x_{11} = 1000$), 1300 from Hetauda to Biratnagar ($x_{21} = 1300$), 200 from Birjung to Pokhara ($x_{22} = 200$), and 1200 from Nabalparasi to Pokhara ($x_{32} = 1000$). The associated minimum transportation cost is computed as $1000 \times \$80 + 1300 \times \$100 + 200 \times \$108 + 1200 \times \$68 = \$313{,}200$.
The transportation model's balance: The transportation tableau representation makes the assumption that the model is balanced, i.e., that total supply and total demand are equal. To correct an imbalanced model, we might add a dummy source or dummy destination.

Example 2

In the Laxmi model, suppose that the Hetauda plant capacity is 1300 cars (instead if 1500). The total sypply (=3500 cars) is less than the total demand ($= 3700$ cars), meaning that part of the demand at Biratnagar and Pokhara will not be satisfied. Because the demand exceeds the supply, a dummy source (plant) with a capacity of 200 cars ($= 3700 - 3500$) is added to balance the transportation model. The unit

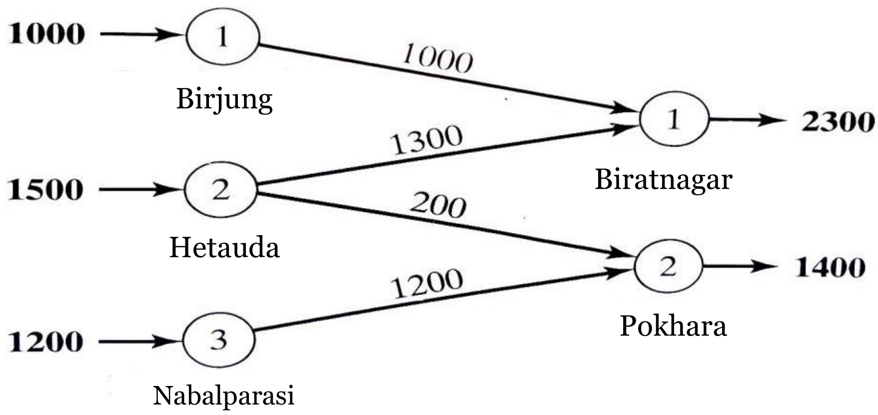

FIGURE 2 : Optimal solution of Laxmi Auto model

TABLE 4 Laxmi Model with Dummy plant

	Biratnagar	Pokhara	Supply
Birjung	1000 80	215	1000
Hetauda	1300 100	108	1500
Nabalparasi	102	68	1200
Dummy Plant	0	200 0	200
Demand	**2300**	**1400**	

TABLE 5 Laxmi Model with Dummy Destination

	Biratnagar	Pokhara	Dummy
Birjung	1000 80	215	0
Hetauda	900 100	200 108	400 0
Nabalparasi	102	1200 68	0
Demand	**1900**	**1400**	400

Transportation cost from the dummy plant to the two destinations is zero because the plant does not exist.
The balanced model and its ideal solution are shown in Table 4. According to the answer, the fake factory exports 200 vehicles to Pokhara, which implies that Pokhara would fall 200 cars short of meeting its 1400 car need.
By allocating a very high unit transportation cost from the fake source to a certain destination, we may ensure that shortages do not occur there. For instance, a $1000 fine in the fictitious Pokhara jail will stop shortages there. Of course, there must be a scarcity someplace, so we are unable to apply this "trick" to every trip.
Assuming that there are only 1900 automobiles in demand at Biratnagar, it is possible to illustrate the situation when the supply surpasses the demand. In this instance, in order to "receive" the excess supply, we must create a false distribution center. Again, unless we need a factory to "ship out" fully, there is no unit transportation cost to the fictitious distribution center. From the chosen factory to the fictitious destination, a high unit transportation cost is attributed in this instance.
Table 5 gives the new model and its optimal solution (obtained by TORA). The solution shows that the Hetauda plants will have a surplus of 400 cars.

CONCLUSION:

If issues are systematically categorized based on their characteristics, it can help to organize and systematize them. Numerous specialists have demonstrated that: Darwin proposed the notion of Mendeleev precisely predicted the new chemical element by organizing the elements into a periodic table and researching evolution through zootaxy. In other words, the challenge may be made easier by classifying and integrating the problem scientifically.

Technology and managerial expertise are key components of the transportation challenge. It employs a collection of methodical ideas and approaches to clarify the actual transportation issues. The theory derives its logic from ongoing practice-based research, and the paradigm that emerges from that research may be seen as a single, cohesive norm for resolving resource allocation and optimal issues.

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