Abstract

At present transportation acting vital role for financial development of the country. Mixture of transportation and mobility are directly involved with development of financial system of the country and for that mature transportation infrastructure required. Not only that, alteration in basic mathematical formation of transportation is necessary like simple objective function can be modified by multi objective function. This paper analyzes multi-objective transportation problem, its dissimilar solution with limitation and provide improved Information Communication Technology (ICT) based solution to avoid some limitation of multi-objective TP. It also analyzes issues when multi-objective transportation associate with technology and its solution.

Keywords: Data Collection, Mathematical and Statistical Techniques & Tools, Knowledge mining

1. Introduction

The 21st century is built upon the word “transportation”. Mobility has made life fast progressive. Life in tune with the changing trends is impossible in the traditional, slow fashion. International connectivity and information technology have changed the whole life of mankind. It is unthinkable today for families to produce food, clothing and other essential requirements. The markets have a wide range of novelties to offer to their customers which minimize the need of self production. Goods are produced in large scale in factories and farms and they reach the consumers within no time. The whole structure of modern society involves a trade-off between economies, group activities and transporting men and material from place to place. A problem that occurs in this kind of a society is that of transportation. The transportation problem is a classic operations research problem where the objective is to determine the schedule for transporting goods from source to destination in a way that minimizes shipping cost, satisfying demand and supply constraints. Though this problem can be solved as a linear programming problem, other methods can also be used for bringing in an effective solution.

The Transportation Problem (TP) was first developed propounded by F.L. Hitchcock in 1941[1], [2]. It aims at minimizing the total transportation cost [3]-[7]. Other objectives can be minimization of total delivery time and maximization of profit. The Hitchcock – Koopman’s TP is expressed as a linear transportation model as follows:

\[ \text{Minimize } Z = \sum_{i=1}^{m} \sum_{j=1}^{n} c_{ij} x_{ij} \]

Subject to \[ \sum_{j=1}^{n} x_{ij} = a_i, i = 1,2,\ldots,m \quad (\text{Supply}) \]

\[ \sum_{i=1}^{m} x_{ij} = b_j, j = 1,2,\ldots,n \quad (\text{Demand}) \]

\[ x_{ij} \geq 0 \quad \text{for all } i \text{ and } j \]

Where,

\[ x_{ij} = \text{the amount of goods moved from origin } i \text{ to destination } j \]

\[ c_{ij} = \text{the cost of moving a unit amount goods from origin } i \text{ to destination } j \]

\[ a_i = \text{the supply available at each origin } i \]

\[ b_j = \text{the demand at each destination } j \]
\( b_j \) = the demand available at each destination \( j \)
\( m \) = total number of origins (Sources)
\( n \) = total number of destinations (Sinks)

This problem can be solved by classical transportation methods [17].

The Transportation Problem has a direct impact on real life which may be good or bad. For example, minimization of total cost, consumption of scarce resources like energy, deterioration of goods during transportation and vehicle scheduling in public transit influence day to day life. In the investigation the entire objective of single objective transportation models are represented by quantitative information. But in this process some crucial points are likely to be neglected as they cannot be described in quantitative data [12], [13]. Decision-making takes into account multiple and often conflicting criteria. For example, a cyclist aims to reach his destination in minimum time along a safe path [9].

Various factors influence the route choice (road traffic, condition of the road, and availability of cycling facilities). Therefore, it is reasonable to formulate cyclists’ route choice as a bi objective problem with travel time as one objective and all other route choice factors together as a second objective which may be termed as attractiveness. It is therefore evident that one has to consider both objectives for arriving at a practical optimal solution. The Decision Maker has to take into account several objectives at the same time in order to overcome the limitation of single objective TP. This limitation can be sought out by generating multi – objective TP.

2. MULTI-OBJECTIVE TRANSPORTATION PROBLEM (MOTP)

The multi – objective transportation model is set in association with various objectives to solve the transportation problem. In normal situations the existing multi objective transportation models use a minimization of the total cost objective as one of their objectives while the other objectives may concern about delivery time, quantity of goods delivered, under used capacity, reliability of delivery, energy consumption, safety of delivery, etc. The multi – objective transportation problem with \( k \) objectives can be represented as [8]

\[
\text{min } f_i(x) = \sum_{j=1}^{m} \sum_{j=1}^{n} c_{ij} x_{ij} \\
\text{min } f_k(x) = \sum_{j=1}^{m} \sum_{j=1}^{n} c_{ij} x_{ij} \\
\sum_{j=1}^{n} x_{ij} \leq a_i, i = 1,2,\ldots,m \quad \text{for all } i. \]
\[
\sum_{i=1}^{m} x_{ij} = b_j, j = 1,2,\ldots,n \quad \text{for all } j. \]
\[
\sum_{i=1}^{m} a_i = \sum_{j=1}^{n} b_j \text{ and } x_{ij} \geq 0 \quad \text{for all } i \text{ and } j
\]

Where \( c_{ij} \) represents the coefficients related to \( x_{ij} \) variable for objective \( k \).

This model is being adopted by many researchers for their computational researches [11],[4],[16] and many applications of MOTP are used in real life problems. For example, the cyclists’ route problem [9]. MOTP is found to be applicable in urban transportation as transportation and its environmental impacts form a major component of urban environmental management. At the same time transportation and mobility are an important part of urban economics and the quality of life. A comprehensive, interdisciplinary approach is needed for analyzing urban transportation and its environmental impacts. A wide range of spatial and temporal scales and processes are involved in it and no single model can cover the entire range. Naturally, one has to adopt a multi - tiered approach and a series of models to describe alternative urban development and transportation scenarios and their multi – criteria assessment and comparative analysis.

Research works of transportation problems generally consider depot – customer relationship. But it should not be forgotten that the relationship between customer and customer is also critical because the vehicle route for each depot does not move from depot to customer and then from customer to depot. On the contrary, it moves from depot to customer and then moves further to other customers. Therefore it is essential to consider customer to customer relationship. Apparently two objectives are considered. The first is to minimize the total transportation cost which is
the fundamental objective for all transportation models. It is the depot – customer relationship using quantitative data. The second objective is to minimize the overall independence value between customer and customer, i.e., the consideration of customer to customer relationship. Finally, this problem introduces an important MOTP to real world. There have been many recent studies to solve multi objective transportation problem. Michalewicz and others applied Genetic Algorithm (GM) to solve MOTP. L Li and K K Lai and others applied the fuzzy approach. Mistuo Gen and others used the spanning tree concept. The solutions obtained by different approaches depend on the accuracy of past data collected. Thus, solution of MOTP is accurate if the data is accurate. Sometimes the solution to transportation problem fails due to data error. If, for example, our multi objective transportation problem has two parameters of time and cost, and our objective is to optimize both, then these two parameters depend several other parameters like vehicle type, condition of the road, climate, traffic volume, RTO PWD, etc.

Data related to cost and time from the origin to the destination is a key factor for the solution of MOTP. But the data may not be correct always due to some of the earlier mentioned factors and so it is difficult to find actual optimum cost and time in practical world and in this case the solution to our transportation problem fails. Such situations can be avoided by using Information and Communication Technology and a knowledge based system which will provide accurate data with its tools and techniques. So, the main objective of this paper is to develop a set of mathematical techniques which are useful in finding an accurate solution of multi objective as well as simple objective transportation problem with ICT. This research also discusses the ways for improving the condition of roads. For this purpose the researcher has developed a mathematical technique on the basis of past study which may be highly beneficial for the road management sector. This work also discusses a prediction technique which finds the traffic volume on the road so that people can easily get an idea about the cost and time of travelling.

3. THE PROPOSED ICT BASED MODULE

3.1 Transportation Data Collection Module:
The process of decision making depends mainly on correct data. Incorrect data will lead to false conclusion. Transportation data is too complex as it includes parameters like road condition, season wise time differences, climatic conditions, traffic conditions, RTO rules, etc. Thus the following method is suggested for data collection:

![Transportation data collection module](image)

Figure 1 Transportation data collection module
Different users are interacting with the system for data entry according to the above module and the users are required to enter data with the interface of the system. It is necessary that all users very good at data entry. They should also have good knowledge of transportation so that the data entry can be carried out in a proper way. Experts are also connected with the system and they store/edit useful information related to transportation, like which route is the best with time and cost for a user in a specific season with respect to the road condition, traffic volume, climatic conditions PWD operations, etc. There also exist in the system other sources of data which can affect decision making. A data accuracy model will be established based on the above mentioned transportation data collection module to obtain a better solution of MOTP.

Figure 2 Processing Frame Work

3.2 Set of Tools and Mathematical and Statistical Techniques
For find the batter knowledge a set of technique is required discussed as follows
1) Fake data detection tool: This module can easily recognize the fake data and eliminate from the data base. e.g suppose user add new data of Traffic or a number of electronics device or sensor gather the data but suppose data is improper then with this tools easily recognized such data and thereafter eliminate from the data base.
2) Predictive Mathematical Model and Numerical Technique: These mathematical and statistical techniques play significant role for find trends of data like: Road situation or Traffic situation data having some fixed trend. Such data can be converted in numerical form thereafter easily predict trend of traffic condition season wise and time wise on the road. Similar about road situation.
3) Road Situation: This technique find road irregularity index which is useful to identify which road is batter to travel as well as enhancement time of road condition.
4) Developed Database and data warehousing equipment (M. A. King, J. F. Elder IV et al. (1998)) can be used for to store and retrieve huge amounts of data; it can be in form of both text and image.
5) Transportation Algorithm: Simple and Multi-objective system and algorithm can straight used according to users problem.
6) For discover the most favourable pattern from large amount of data here we use Data mining techniques (Cheng Soon Ong, MIMOS Berhad (2000)), (S. Lawrence, K. Bollacker et al., (1999)) which could give potential useful advice. Also, modelling and simulation technology can be used for prediction.

7) For discover the risk in two or more finest way researcher have developed risk analysis tools, which can be useful for selecting optimum pattern for users.

8) Internet Technology played an vital role for communication between users, experts-and our system. Note that users can have Internet connectivity M. A. King, J. F. Elder IV et al. (1998), if he has a telephone. In fact, under Optimum system, it is sufficient for a village to have a phone connection so that Internet could be accessed.

9) A template is a set of styles and page layout settings that determine the appearance of a document. This template matches the printer settings that will be used in the proceeding and the CD-Rom. The use of the template is mandatory.

A user and task - centred view, focusing on the nature of interactions between humans that lead to a discovery of knowledge, is essential for successful application of knowledge discovery. Knowledge discovery has been described as the process of identifying and extracting useful data and comprehensive information from large data sets. This methodology aims to process on past data and to extract knowledge through it. After data collection from users the database would contain valuable information for knowledge based system to make decision for extracting best knowledge for the transportation problem. Here, we use application (Multi – objective) domain knowledge to describe the process model. Though we focus on selection of route for multi objective transportation in day to day life the same selection model can be applied for selecting fertilizer, irrigation method, etc. As the first step of knowledge discovery the domain experts should use their domain knowledge and convert it to most basic general rules so that useful data can be identified for further processing.

4. CONCLUSION

It will be highly beneficial to users and operators of transportation system if the proposed transportation model based system is developed with the discussed mathematical technique.

![Figure 3 System tools](image-url)
Figure 4 Knowledge discovery

REFERENCE

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