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B.Sc Mathematics

PROJECT TOPIC:

TRANSPORTATION PROBLEM FOR THREE NIGERIAN TRANSPORTING COMPANIES

0.1 Certification

I certify that this work by AJIBOLA SEGUN EMMANUEL with matriculation number 180551012 under my supervision in the Department of Mathematics, Lagos State University, Ojo, Lagos.

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0.2 Dedication

I dedicate this seminar work to God Almighty for his protection over my course of study, and also to my family, the family of Mr and Mrs Ajibola, my relatives and friends. Thanks for all the support.

0.3 Acknowledgement

I am grateful to God for giving me the ability to work on this project. I also thank my supervisor, Mr Oni, for his guidance along this project work.

My gratitude also goes to my parents, relatives, course mates, and friends for their sincere love and support during my time in school. May God bless you all.

0.4 Abstract

Operation Research is a field that deals with the development and application of analytical methods to improve decision making.

It is used to solve complex problems ranging from business to art through mathematical analysis.

In this project work, I will be working on optimizing transportation system of three pure water companies using the North West Corner Method, Least Cost Cell Method and the Vogel Approximation Method to find the optimal solution.

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1 INTRODUCTION

CHAPTER 1

Transportation problem is a special kind of Linear Programming Problem also known as LPP. LPP is a mathematical technique for maximizing or minimizing linear functions of cost and other variables. Goods that are transported from a set of locations to another set of destinations are subjected to the supply and demand of the sources and destination respectively and the usage of LPP through transportation problem is to minimize the total cost of transportation.

Finding solution to transportation problems has been crucial to various disciplines. An Initial Basic Feasible Solution(IBFS) for the transportation problem will be obtained by using one of the methods of solving transportation problems. The best optimal condition will be selected. Transportation problem uses different techniques of solving it's problem, they are North-West corner rule, Minimum Cost Method and Vogel's Approximation Method. The idea is to get all the data about the goods leaving a location or origin and using that data to optimize the cost of transporting it to another destination. In this project work, the first location will be the area of production (origins) and the second location will be the destinations.

Bjarke Bundgaard Ingels, a Danish architect of Bjarke Ingels Group said "In Copenhagen, there's a long-term commitment to creating a well-functioning pedestrian city where all forms of movement - pedestrian, bicycles, cars, public transportation - are accommodated with equal priority". Elon Musk said "If we drive down the cost of transportation in space, we can do great things". This two great quotes from experienced people in different fields shows the importance of transportation in our daily lives and businesses.

During the administration of President Olusegun Obasanjo in Nigeria, the National Poverty Eradication Programme (NAPEP) program was created in 2001 by

the Nigerian government aiming to reduce poverty and provide economic empowerment to the citizen of the country. This prompted the high use of the popular tricyle known as Keke Maruwa and soon called Keke Napep. The development was used to reduce the cost of transportation. It was attributed to the widespread National Poverty Eradication Programme NAPEP.

According to Worlddata.info, the distance travelled in Nigeria is over two hundred thousand kilometres in road, rail, water ways, commercial harbours and airports sector. Without any doubt, transportation is one of most important functions in all countries. It is one of the core activity necessary for the advancement of human life and growth in the industrial sector.

1.1 Statement of Problem

Industries moving their goods from one place to another brings risks and cost problems, thus transportation is very important in the day-to-day activities of a company, but it's disadvantages poses a threat.

Millions of money can be lost in a day and in worst cases, human lives can be lost. When I studied the transport system in the pure water Industry, I noticed that:

1. There are no optimized decision-making strategy
2. Transportation cost is not properly documented
3. Transporation is unbalanced, supply can be more than demand

1.2 Scope of Study

This project will highlight the transportation problem in the sector. It will use an operation research called transportation problem to analyse a transport system and enumerates ways that cost of bad transportation problems can be reduced, thus increasing income.

Linear programming will be used in this project, the type of the programming used is called transportation problem. It is a type of linear programming where the objective helps to minimize transportation cost of goods from a place to different locations.

Three (3) pure water factories in Nigeria will be used as examples, the transportation details will be stated and optimisation system will be used to reduce cost of transportation to get the maximum profits.

1.3 Objectives of Study

The objectives of this project is stated below:

1. Enumerate the importance of optimized transport system
2. Review the Transportation Problem of Linear Programming
3. Use the application of Linear Programming to optimize the transportation problem for three(3) pure water factories in Nigeria from different states.

1.4 Significance of the Project

The significance of this project is to use the methods of transportation problem in mathematical operation research to know the best ways to transport goods and also record the lowest cases of loss.

Companies have to decide on when and how they will transport their goods and the outcome of their choices can result in transportation accidents or loss of money. If companies are aware of the best possible ways to transport goods to places, they will be able to record the lowest number of accidents when travelling and also make the highest amount of profit.

2 LITERATURE REVIEW

CHAPTER 2

2.1 Literature Review

The transportation of rice from different location to different locations was examined and the problem was formulated as a LPP model.

We obtained an IBFS to the problem by NORTH-WEST CORNER METHOD (NWCM) and EASY QUICK METHOD (EQM) and compared the results and displayed in the tables. The key idea in EQM is to minimize the best combinations of the solution to reach the optimal solution. This obtained the best initial feasible solution to the transportation problem and performs faster than the existing methods with a minimal computation time and less complexity.

The proposed method is an attractive alternative to traditional problem solution methods. MODI method has applied for optimal solution for the effectiveness of the proposed method.

Industries require planning in transportation with small transporting cost to maximize profit. Transportation problem can be used in many fields such as scheduling, personnel assignment, product mix problems. In the solution procedure of transportation problem, finding an Initial Basic Feasible Solution (IBFS) is the prerequisite to obtain the optimal solution.

This research aims to propose an algorithm "EQM" to obtain an IBFS for the transportation problems. Obtained results show that the proposed algorithm is effective in solving transportation problems. Transportation model provides a greater impact on the transportation of the commodities from the manufacturing places. The basic Transportation problem was initially proposed by Hitch Cock. A day's transportation problem has become a standard application for industrial organizations

having several manufacturing units, warehouses and distribution centers.

Description of a classical transportation problem can be given as follows. A certain amount of homogeneous commodity is available at number of sources/origins and a fixed amount is required to meet the demand at each number of destinations/distribution centers. Then finding an optimal schedule of shipment of the commodity with the satisfaction of demands at each destination is the main goal of the problem. The transportation problem in which the objective is to minimize the total cost of shipping a single commodity from a number of sources (m) to a number of destinations or sinks (n). The most important and successful applications in the optimization refers to transportation problem (TP).

The basic steps for obtaining an optimum solution to a transportation problem are: (P.K. Gupta and Man Mohan, (2003).

Step 1: Mathematical model of the problem.

Step 2: Finding an Initial Basic Feasible Solution (IBFS).

Step 3: To test whether the solution is an optimal one or not. If not, improve it further till the optimality is achieved.

Most of the time the initial basic feasible solution of transportation problem is calculated by using the methods of NorthWest Corner Method or Least-Cost Method or Vogel's Approximation Method, and then finally the optimality is checked by MODI (Modified Distribution Method).

In this paper, we considered a transportation problem of an essential item, rice, from the different origins to different destinations and formulated the problem as a LPP model. We obtained an IBFS to the problem by NWCM and EQM and compared the results and displayed in the tables. The key idea in EQM is to minimize the combinations of the solution by choosing the best least cells to reach the optimal solution. Comparatively, applying the EQM in the proposed method obtains the best Initial Basic Feasible Solution to a transportation problem and performs faster

than the existing methods with a minimal computation time and less complexity.

There are several different algorithms to solve transportation problem that represented as LP model like the algebraic procedures of the simplex method. The standard scenario for solving transportation problems is working by sending units of a product across a network of highways that connect a given set of cities. Each city is considered as a source in that units will be shipped out from, while units are demanded there when the city is considered as a sink. In this scenario, each sink has a given demand, the source has a given supply, and the airway that connects source with sink as a pair has a given transportation cost/(shipment unit). The problem is to determine an optimal transportation scheme that is to minimize the total of the shipments cost between the nodes in the network model, subject to supply and demand constraints. As well as, this structure arises in many applications such as; the sources represent warehouses and the sinks represent retail outlets. Moreover, Ad-hoc networks are designed dynamically by group of mobile devices. In Ad-hoc network, nodes between source and destination act as a routers so that source node can communicate with the destination node.

North-West Corner method (NWCM) is one of the conventional methods that give better Initial Basic Feasible Solution (IBFS) of a Transportation Problem (TP). This method is very effective as it provides step by step solution and it is very simple to find IBFS through this method.

Initial Basic Feasible Solution using easy quick method (EQM) is done by checking if the matrix balanced or not, if the total supply is equal to the total demand, then the matrix is balanced. If the total supply is not equal to the total demand, then we add a dummy row or column as needed to make supply is equal to the demand.

In moving towards optimality, to verify whether the above IBFS using NQM is optimal solution or not, we can apply MODI (Modified Distribution method) or u-v method.

In this study, we proposed EQM for finding the IBFS to the transportation problem. It refers to choose the best distribution of cost and time from the all combinations. The EQM obtained the optimal solution or the closest to optimal solution with a minimum computation time. As well as, use of EQM reduces the complexity of the problems.

3 METHODOLOGY

CHAPTER 3

This chapter explains the methodology for optimizing the transportation problem of the three pure water companies, x, x and x. The aim of the solution is to reduce the transportation costs by finding solutions to minimize costs of transporting goods from one location to another location.

In the next paragrapgh, we will look at the foundation of Transportation problem, what it is and how it works.

MATHEMATICAL MODELLING

A pure water company production's location is denoted by (m). Each bags of pure water will be transported or supplied to different retail shops depending on the retail shop's demand. The retail shops is denoted by (n).

Transportation model deal with getting the minimum cost plan to transport bags of pure water from a number of production places(m) to number of destination(n).

THE DESICION VARIABLES

- m = Number of sources (i = 1 ... m)
- n = Number of destinations (j = 1 ... n)
- Si = The number of supply unit required at source i, (i=1, 2, 3..... a).
- Dj = The number of demand unit required at destination j, (j=1, 2,3..... b)
- Cij = The transportation unit cost for transporting the units from sources i to destination j.
- Xij = The number of pure water bags transported from i to j.
- Cij = The transportation cost for transporting bags of pure water from sources i to destination j.

To determine the optimal number of units or goods that can be transported from

the sources i to destination j, we get the objective function using linear programming principle.

THE OBJECTIVE FUNCTION

The objective function is the target variable. It is the cost function or the total amount spent for transporting the goods from the source to the destination. The idea is to use the function to minimize the cost of transporting while also satisfying all the supply and demand restrictions.

The objective function is gotten by the sum product of the cost per unit per km and the decision variables, the total cost is directly proportional to the sum product of the number of units shipped and cost of transport per unit per Km.

The objective function to minimize is denoted by M in this project work.

$$M = \sum_{i=1}^{m} \sum_{j=1}^{n} CijXij$$

Subject to

$$M = \sum_{j=1}^{n} Xij = Sij.Fori = 1, 2, ...m$$

$$M = \sum_{i=1}^{m} Xij = Dij.Forj = 1, 2, ...n$$

THE CONSTRAINTS

The constraints means that you must meet some the required conditions or demand and not exceed supply at each supply center.

The constraints are formulated concerning the demand and supply.. The importance of constraints is to ensure they the solution satisfy all the supply and demand restrictions.

TYPES OF TRANSPORTAION PROBLEM

There are two types of transportation problems based on the problem:

1. Balanced Transportation Problems: The Transportation problem is balanced when the total supply is equal to the total demand. For example, if a retail outlet demands for 50 bags of purewater, and 50 bags was transported, the optimization method used will be balanced.

$$\sum_{i=1}^{m} Ai = \sum_{j=1}^{n} Bj$$

2. Unbalanced Transportation Problems: The Transportation problem is not balanced when the total supply is not equal to the total demand. For example, 50 bags of water is demanded and 40 or 60 bags is supplied.

To proceed with the solution of transportation problems, the first step is to check if it is balanced or not.

$$\sum_{i=1}^{m} Ai \neq \sum_{j=1}^{n} Bj$$

$$\sum_{i=1}^{m} Ai > \sum_{j=1}^{n} Bj$$

$$\sum_{i=1}^{m} Ai < \sum_{j=1}^{n} Bj$$

When the supply is higher than the demand, a dummy destination is introduced in the equation to make it equal to the supply (with 0 shipping costs) and when the demand is higher than the supply, a dummy source is introduced in the equation to make it equal to the demand.

4 TRANSPORTATION PROBLEM

5 SUMMARY

5.1 Summary

5.2 Conclusion

6 REFERENCE

https://www.worlddata.info/africa/nigeria/transport.php

Introduction