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A Platform for Solving Transportation Problem Using an Interactive System for Optimal Solution

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ABSTRACT
Transportation problem is one of the major areas of application of linear programming. In this paper, we discussed the concept of transportation system and the method of solving transportation problems. We developed a model for the transportation system in Ambrose Alli University (AAU), Ekpoma though private but provides an optimal transportation framework for decision making in the University transportation division. In developing the software, we used Microsoft Visual Basic 6.0. The optimal solution arrived at showed that the management can operate at a minimum cost if they utilize the routes as presented in the study: Main campus to Alli Square conveying an average of 90 passengers per day, Main campus to Market Square with an average of 150 passengers, Basic Medical Sciences to Alli Square with an average of 15 passengers, Basic Medical Sciences to Mousco Junction with an average of 150 passengers and Basic Medical Sciences to Opoji Junction with an average of 85 passengers. Consequently, the cost of transportation on these routes are ₦30, ₦30, ₦20, ₦20, and ₦30 respectively per journey. An online application was also developed using North-West Corner (NWC) rule to automate the analysis of the System.

Keyword: Transportation problem, Route, Linear programming, Software, Optimal solution

1. PRELIMINARIES

Transportation is a vital part of the everyday life of every urban citizen. Even the very young, the very old, the sick and the shut-ins are beneficiaries of a good transportation system or victims of a poor one. Efficient transportation stimulates the economy of any state. The condition of transportation services and facilities improves or detracts from living and working conditions, enhances or harms the environment of the area, and heavily influences the general desirability of the community. In most studies of transportation, the following questions are asked for the transportation system to be in the best possible condition in an area. They are:

- do you receive numerous complaints about congestion and accidents caused by a poor transportation system?
- are industry and commerce concerned about delays in their shipments caused by inadequate transportation facilities?
- are industry and commerce rejecting your community because of a poor transportation system?
- has enough been done to take care of transportation problems in your community?
- and finally, has timely improvements been made?

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2. RELATED WORKS

Jurgen [5] noted that the main task of scheduling is the temporal assignment of activities to resources where a number of goals and constraints have to be considered. Scheduling problems can be found in several different application areas, e.g., the scheduling of production operation in manufacturing industry, computer processes in operating systems, aircraft crews, etc. Scheduling covers the creation of a schedule of the activities over a longer period (predictive scheduling) and the adaptation of an existing schedule due to actual events in the scheduling environment.

However, scheduling also has a very important interactive dimension because we always find humans involved in the scheduling process that have to decide, interact or control. Among the decisions to be taken by the human scheduler are, e.g., introducing new orders, cancelling orders, changing priorities, setting operations on specific schedule positions. These decisions have to be regarded within the scheduling process. But, Reed [7] stated that a key problem manager's face is how to allocate scarce resources among various activities or projects.

Therefore, an essential tool for doing this is the linear programming method. Thus, Linear programming, is a method of allocating resources in an optimal way. It is one of the most widely used operation research tool and has been a decision-making aid in almost all manufacturing industries and in financial and service organizations. These resources are known as decision variables.

2.1 Transportation Problem

Chung et al [2] presented a poly-log-competitive deterministic online algorithm for the online transportation problem on hierarchically separated trees when the online algorithm has one extra server per site. Using metric embedding results in the literature, one can then obtain a poly-log-competitive randomized online algorithm for the online transportation on an arbitrary metric space when the online algorithm has one extra server per site. Sheng et al [8] analyzed a transportation problem with discontinuous piecewise linear cost function and developed a genetic algorithm to solve it. Their genetic algorithm exhibits better optimization effect on solution quality and efficiency than the matrix encoding genetic algorithm. Their genetic algorithm utilizes the structure of spanning tree in the basic feasible solution and the possible values of the non-basic variables are restricted to the flow bounds.

The compact coding representing the basic feasible solution is another important factor. In addition, the genetic algorithm developed in their paper can be applied to solve the fixed charge transportation problem as well. Zijian et al [10], focused on the computing complexity dealing with hub and spoke system, proposed a new reliable combination optimization method, named ACO (ant colony optimization) algorithm, to solve the container transportation network problem for marine transport system. To prove its utility, they compared the proposed method with the result by Dijkstra algorithm through a simple example. The result shows ACO algorithms is of a credible and excellent probability accumulation searching method. In general, it's known that there exist four factors in an optimization problem of container transportation, namely economical efficiency, speediness, security and inventory cost [4]. Yuichi et al [9], considered the problem of transporting a long object such as a ladder through a degree corner in a corridor using two omni directional robots that do not necessarily have identical characteristics. A distributed algorithm is presented in which each robot computes its own motion-based on the current and goal positions of the ladder, the locations of the walls and the motion of the other robot observed indirectly through the link between the robot and the ladder. They evaluate the performance and robustness of the algorithm using extensive computer simulation by changing several parameter values that act as the key characteristics of the robots including the maximum speed the guide path

Table 1: Passengers

Locations/ Services	Alli Square	Market Square	Mousco Junction	Opoji Junction	Supply
Main Campus	60	100	30	50	240
Basic Medical Sciences	45	50	20	35	150
Demand	105	150	50	85	

For the above problem, all units available must be supplied. How likely it is that supply always will equal demand? For practical purposes, it doesn't matter as long as supply is adequate to meet demand. We can ignore the surplus and treat the total supply as equal to the requirement.

3. PROBLEM STATEMENT

In Ambrose Alli University, (AAU) Ekpoma the transportation unit is faced with the optimal administration of transportation solution in a bid to reducing the cost of transportation for staff and students to and from campus while in the process considering the convenience of the passengers. In this paper, we model the transportation system in Ambrose Alli University, (AAU) Ekpoma, The outcome of the model was finally automated with the process of analysis of the system. The study used the North-West Corner (NWC) rule to obtain the initial basic feasible solution of the system that can serve as a guide for the unit.

3.1 Research Direction

This paper reported the findings of a result in an undergraduate research, that developed an automated transportation problem using AAU Ekpoma as a case study, the purpose which focused on the following;

- to aid administration minimize the total transportation cost within the school environment
- to help administration analyze the various transportation situation at a very fast rate
- to facilitate the decision making process on transportation at all levels

4. MATERIALS AND METHOD

We considered some routes and collected data from the routes. The collection of data was done for some period of time after which average of the observations was determined. This idea was to enable us know the routes to include in our modelling. The modelling of the transportation took effect as soon as the data collection was completed. The model was used to develop an algorithm that eventually transformed into the use of visual basic programming language at the end to design software that is usable in solving problems related to the transportation matters in the university. The available routes include Main campus to Alli square, Main campus to Market Square, Main campus to Mousco junction, Main campus to Opoji junction, Basic Medical Sciences to Alli square, Basic Medical Sciences to Market Square, Basic Medical Sciences to Mousco junction, and Basic Medical Sciences to Opoji junction.

4.1 Mathematical model of the transportation problem

The mathematical modelling of this transportation problem is nothing but a special linear programming problem in which the objective function is a minimize cost of transportation subjected to the demand and supply constraints.

Let d_i = Number of passengers (staff and students) available to be transportation from the origin i.
Si = Number of passengers that is required to be at a destination i.
C_{ij} = The transportation cost per passenger from the origin i to destination j.
X_{ij} = Number of passenger from origin to destination j. Mathematically, the problem is i.

Minimize $\sum\sum x_{ij} C_{ij}$

$\sum x_{ij}$ d_i, i = 1,2,…,m

$\sum x_{ij}$ S_j, $_j$ = 1,2,…,n ……..(1)

$x_{ij} \geq 0$ for all i and j

From equation 1, it can be understood that we have two sources of supply namely main campus and Basic Medical Sciences to four demand destination namely; Alli square, Market square, Mousco junction and Opoji junction. With this in mind, we now formulate transportation problem.

Table 2: Cost of transportation

Routes	Alli Square	Market Square	Mousco Junction	Opoji Junction	Supply
Main Campus	30	3	3	4	240
Basic Medical Sciences	20	30	20	30	150
Demand	105	150	50	85	

The problem is to determine the number of passengers to be transported from each origin to various destinations at minimized cost. Table 3 below shows the possible number of passengers that can be transported from each of the origin to their various destinations.

Table 3. The Complete Transportation Problem

Routes	Alli Square	Market Square	Mousco Junction	Opoji Junction	Supply
Main Campus	X_{11} 30	X_{12} 30	X_{13} 30	X_{14} 40	240
Basic Medical Sciences	X_{21} 20	X_{22} 30	X_{23} 20	X_{24} 30	150
Demand	105	150	50	85	

The total transportation cost:
Minimize $z = 30\ x_{11} + 30\ x_2 + 30\ x_3 + 40\ x_{14} + 20\ x_{21} + 30\ x_{22} + 20\ x_{23} + 30x_{24}$
Subject to:

$x_{11}+x_{12}+x_{13}+x_{14} = 240$
$x_{21}+x_{22}+x_{23}+x_{24} = 150$
$x_{11} + x_{21} = 105$
$x_{21} + x_{22} = 150$
$x_{31} + x_{32} = 50$
$x_{41} + x_{42} = 85$

Xij > 0

5. DESIGN IMPLEMENTATION

The software design for the model used Microsoft Visual basic 6.0. The development was possible due to the proper understanding of the formulation as well as the development of the mathematical model of the problem. The major step that was followed to solve the problem also played a vital role in the development, but the key issue is actually the process of translating mathematical algorithm into visual basic symbolic instruction code and the design of the interface to achieve the goal of the study. System analysis approach was followed and sample data presented in our methodology was used to test run the software developed. The results for input and output during testing are presented in Figures 1to 4.

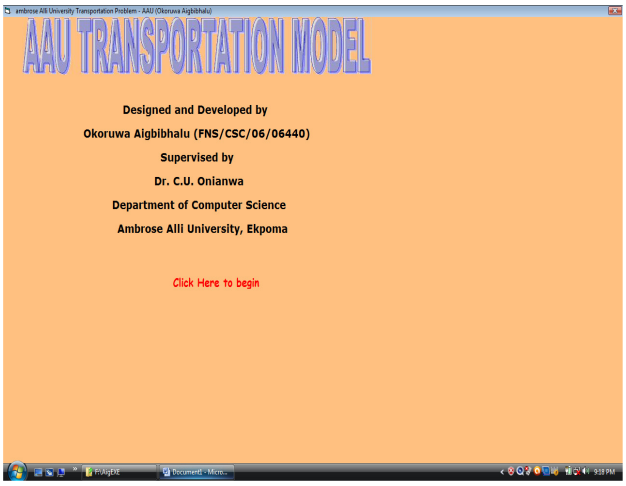

Fig 1: Transportation problem software introduction page
Source: Okoruwa [6]

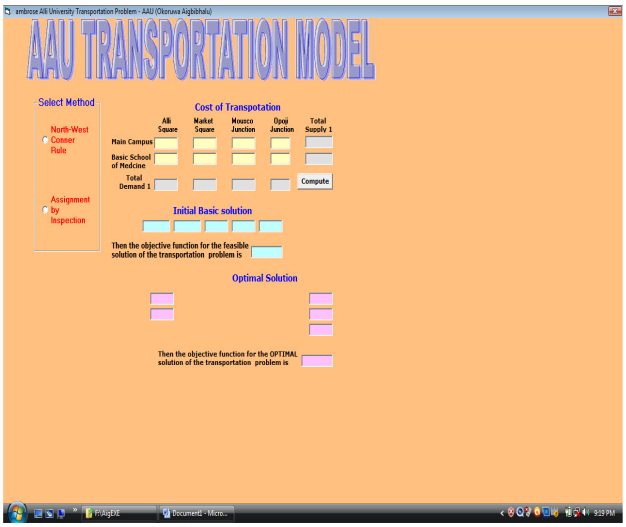

Fig 2: The transportation problem input page
Source: Okoruwa [6]

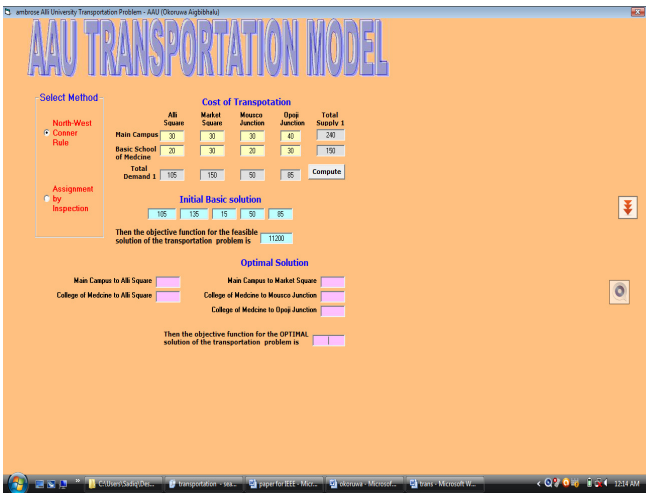

Fig 3: Transportation problem with test data with (NWC).
Source: Okoruwa [6]

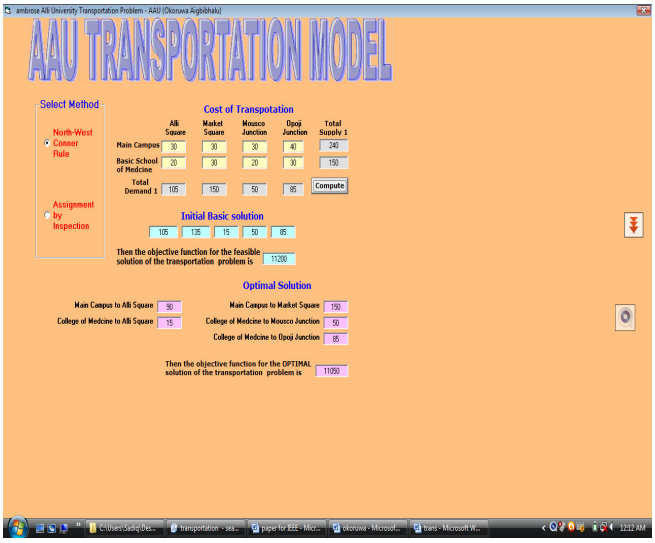

Fig 4: The transportation problem output on computation using the test data.
Source: Okoruwa [6]

5.1 System Installation

Before the software can be used, the executable file name "aigbibhalu.exe" need to be installed having installed visual basic programming language 6.0, for the application to effectively run, the system must met the following requirements;

Minimum hardware requirements

a. Pentium III computer system or more
b. 233 MHZ processor clock speed
c. 64 MB RAM or more
d. 200MB free hard disk space or more

Minimum software requirements

The software will work well on Microsoft Windows 2000, XP, Vista operating systems. No additional framework is needed on any of this operating system for the application to run effectively.

6. FINDINGS

The transportation problem in all the routes from campus to various locations such as Basic Medical Sciences, Alli Square, Market Square etc, are often computed by estimation but the data collected were entered into the interface and the results obtained. More accurate results were equally obtained using the North West Corner rule that gave the optimal solution of 11050.

Based on our findings, it is recommended that the management in transportation unit should always carryout survey periodically to find out if there are variations in the distributions of passengers in their routes. Data obtained in surveys should be analyzed with this application to obtain current optimal solution for the current transportation situation and compare it with previous one. If any alteration is made to the number of routes, then the system will need to be modified to meet the specified routes.

7. CONCLUSION

This study on the transportation problem in Ambrose Alli University Ekpoma was mainly to identify the transportation routes and then structure the system to obtain a model that will enable the management to operate at minimal cost. We went further to develop an application that will help the management to analyze the AAU transportation problem as fast and effectively as possible. As a result of this the management can operate at a minimum cost.

REFERENCES

1. Chen, L., Qin, L., Chen, H.J. and Xu, X.H. (2003) Ant Colony Algorithm with Characteristics of Sensation and Consciousness, Journal of System Simulation, Vol. 15, No. 10, 1418 – 1425.
2. Chung Christine Pruns Kirk Uthaisombut Patchrawat (2006), The Online Transportation Problem: On the Exponential Boost of One Extra lServer. Computer Science Department, University of Pittsburgh.
3. Dorigo, M., Maniezzo, V. and Colorni, A. (1996) The ant system: optimization by a colony of cooperating agents, IEEE Trans. Systems Man Cybernet. Vol. 26, 29-42).
4. Ikpotokin F.O. (2003), Introduction to the study of operation research technique Tide Publishers, Benin City Edo State Nigeria.
5. Jurgen Sauer, Hans-Jurgen Appeirath (2000), Integrating Transportation in a Multi-Site Scheduling Environment. University of Oldenburg Dept. of Computer Science Escherweg 2, D-26121 Oldenburg Germany.
6. Okoruwa A. (2010), A Web-Based System for Solving Transportation System: A Case Study of AAU, Ekpoma, Undergraduate Research Work submitted to the Department of Computer Science, AAU, Ekpoma, Unpublished.
7. Reed J. and Leaven Good S. (2002): Transportation Problem: A special case for linear programming problems EM8779. Corvallis Oregun State University Extension service.
8. Sheng, Su Dechen Zhan, Xu Xiaofeit (2006), Genetic Algorithm for the Transportation Problem with Discontinuous Piecewise Linear Cost Function. International Journal of Computer Science and Network Security, Vol. 6 No. 7A. Harbin, China.
9. Yuichi Asahiroy, Eric Chung-Hui Changz, Amol Maliz, Ichiro Suzukiz, Masafumi Yamashita (2003), A Distributed Ladder Transportation Algorithm for Two Robots in a Corridor. Department of Computer Science and Communication Engineering Kyushu University Fukuoka Japan.
10. Zijian GUO, Xiangqun SONG, Peng ZHANG (2005), THE ACO ALGORITHM FOR CONTAINER TRANSPORTATION NETWORK OF SEAPORTS Proceedings of the Eastern Asia Society for Transportation Studies, Vol. 5, pp. 581 – 591,. School of Civil and Hydraulic Engineering Dalian University of Technology 2 Linggong Road, Ganjingzi District, Dalian 116024, Liaoning, P.R. China.

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