

TITLE PAGE

COMPUTERIZED TRANSPORTATION SYSTEM

CASE STUDY OF KWARA EXPRESS

BY

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CERTIFICATION

This Project is certified to have been carried out by AMUSAT AKEEM ADETUNJI and found to be adequate in scope and quality for the partial fulfillment of the requirement for award of Post-Graduate Diploma (PGD) in Computer Science in Mathematics/Computer Science Department at Federal University of Technology Minna, Niger State.

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DEDICATION

The project is dedicated to my Spiritual Master SHEIKH ALHAJI
IBRAHIM IBN ABDULAHY NIYAS KAOLAQ (R.T.A)

ACKNOWLEDGEMENT

It is highly important to express my sincere gratitude to the following people who have contributed in one way or the other in writing this project and during my course of study in Federal University of Technology, Minna.

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I would like to thank Mr. Danjuma A. and the staffs of Prudent Computer Centre for their friendly assistance. Words of appreciation to Mr. Tijani and Mr. A.A. Ahmed of Kwara Express for their co-operation during my visit to their office at Ilorin.

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ABSTRACT

This project is designed to examine and solve transportation problem with a view of minimizing transportation cost and maximizing the profit.

Linear programming was employed to address transportation problem taking a case study of Kwara Express.

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CHAPTER ONE

TRANSPORTATION AND SOCIETY

1.0 INTRODUCTION

Transportation which is the movement of people and goods is as old as humanity itself. Transportation is an essential part of today's life, it has been an essential of the past generation and it shall be in the society of the future.

1.1 ROLE OF TRANSPORTATION

Transportation is essential to social progress. To be exact, transportation is social progress because it has been throughout history the way in which not only goods and services but ideals as well were exchanged among people.

The Train, The Car and The Aircraft, all means of transportation, together have an enormous capacity for promoting economic growth, raising standard of living, and creating good society.

Transportation provides the connecting link between residence units and work opportunities. About fifty percent or more of all urban travel is likely to be work trips. Shopping, entertainments, travel to and fro school and variety other reasons for making trips depend on transportation.

Also, transportation service calls for the use of streets (road), highways, buses, car parks and other form of transits in most efficient manner.

1.3 TRANSPORTATION SYSTEM CONCEPT

A system can be defined as a group or assemblage part or elements used for a common purpose so interrelated that a change in one component has an effect or feedbacks upon other components.

System may consist of numerous subsystems, each of which has elements, interactions and objectives. System perform specialized tasks related to the overall objective of the total system.

However, transportation system ~~if the above~~ is a subsystem of the socioeconomic system if the above characteristic of a system is applied. In other words, transportation system is only one of several subsystems of socioeconomic system. Among other subsystems of socioeconomic system are sewage, water supply, electricity, etc.

Nigeria Airways, State transportation Cooperation, Urban Mass Transit are examples of transportation system.

Components of Transportation

A transportation system is composed of five major components namely:

1. Vehicle
1. Traffic
3. Terminal
4. Way link
5. Control System.

The table below gives examples of selected basic components of transportation system.

Examples of basic components of transportation system

COMPONENTS	RAILROAD	ROADWAY	AIRLINE
Traffic	Merchandise freight	Passenger	Passenger
Terminal	Terminus	Motor Park	Airport
Vehicle	Train	Buses, Car	Aircraft
Way - link	Rail Track	Road line	Airline
Control system	Schedule	Schedule	Schedule

1.4 COMPUTER IN TRANSPORTATION SYSTEM

Computer are integral part of the transportation system, and advances in the field have invariably been parallel by the evolution of digital computer technology.

Without the aid of computer, analysis of large quantities of data collected would be so laborious and time consuming. Among other functions of computer in transportation system are:

It is used to evaluate traffic assignment.

It is used to solve the problem of trip distribution.

Microcomputer is used in transport system analysis and forecasting computer solves the problem of trip generation as well.

Standard Programs for Transportation Planning

Numerous Standard transportation program were developed to produce solution to a given problem in a quick and efficient way, and to save non-expert programmer struggling to write an inefficient program to solve the same problem. Examples of this standard program are:

1. MICROTRIPS – Is a comprehensive transport planning package developed by SYSTEMATICAL. It consist of sixteen core programs which can be subdivided into four main groups i.e. Highways, model, Public transit and matrix handling.

2. MINITRAMP – Is another comprehensive suite of program for transportation studies. It was developed by WOTTON IEFRIES PLC. It consists of fifteen different programs to enhance transportation system planning.

1.5 SCOPE AND LIMITATION

Usually when designing a project, there are things one must put into consideration. These includes the extent and limit at which the design is made to perform. This leads to the scope and limitation of the project.

Transportation as a system is very wide and have many branches. Therefore, this project cannot be a perfect reference or solution to all this branches of transportation.

Hence, the scope and limitation of this piece of work is within road transportation in which the transporters were dealing with goods and passengers maintenance of vehicles and good road are not included in this project. But both the transporters and their customers will be benefited interms of maximizing the profit, reducing the cost of transportation and improved good services.

1.6 AIMS AND OBJECTIVES

The aims of this project is primarily t improve the method of finding the cheapest means of transporting good and passengers from one place to another at KWARA EXPRESS (a transportation company). Detail analysis of transportation model using linear programming will be treated.

The project also intend to improve the quality of the report generated by KWARA EXPREFSS and make the job more interesting for the workers. The objective is to minimizing the cost of transportation and maximizing profit for the organisation.

A computerize system will be introduce to the company and this will partially replace the current system of operation been used. The new computerized system will involve use of personnel Computers (PC) and other peripheral devices to assist the staff in keeping of records and producing intended result in a shorter time and more accurately.

1.7 DEFINITION OF TERMS

Freight – Loads of any kind carried from one place to another by train, ships, aeroplane etc.

Passenger – It can be wayfarer or commuter i.e. someone who travels on a bus, car, ship etc.

Traffic – Movement (i.e. coming and going) of people, cars etc. along road and streets. Also of the ships on the sea and aeroplanes in the sky.

Highways – Is a rubber-tired wheel on a smooth, firm roadway features used by automobiles, trucks buses etc.

Railways – This is a mode of transportation which utilizes the flanged wheel on rail technology. The rail may be either conventionally rigid or flexible.

Waterways – Natural or artificial channel and bodies of water serve as roadways. It is use by ship, car floats, hydroplane, submarine etc.

Airways – It is the use of airspace at a more than nominal height above the ground. Examples of technology that uses airways are helicopter, parachute, aircraft etc.

CHAPTER TWO

LINEAR PROGRAMMING

2.1 WHAT IS LINEAR PROGRAMMING

Linear programming is one of the few mathematics models used in decision making management. The word linear means involving a direct relation between products or processes. Linear Programming is used to find the optimal solution (which may be maximizing or minimizing) from a large number of possible alternatives.

The Linear Programming of optimization problem was first recognized in 1930s by Economists while developing methods for the optimal allocation of resources. Since then, mathematicians have been doing a lot of work on the topic. In 1941, Frank Hitchcock formulated the transportation problem of determining an adequate diet for an individual at minimum cost. During world War II, George B. Dantzig, who was a member of the United State Air force, formulated the general linear programming problem and derived the simplex method of solution in 1947.

There are three types of linear programming problems. Namely:

1. **Resources Allocation Problem** – i.e. to determine how to use limited assets to maximize gain or minimize loss.
2. **Diet Problem** – i.e. Finding the best food mix that would result in maximization of profit and/or minimize cost of services.
3. **Transportation Problem** – i.e. Finding cheapest means of shipping or transport freight or passengers from a center to their destination.

2.2 STANDARD FORM OF LINEAR PROGRAMMING

The general formation of linear programming is to maximize or minimize.

Given a set of M linear equation in N variable we wish to find non-negative values of these variable which satisfy the constants and extremize of some linear function of the variable.

i.e.

Minimize

$$Z = C_1X_1 + C_2X_2 + \dots + C_nX_n$$

Subject to are constraints

$$a_{11}X_1 + a_{12}X_2 + \dots + a_{1n}X_n = b_1$$

$$a_{21}X_1 + a_{22}X_2 + \dots + a_{2n}X_n = b_2$$

$$a_{m1}X_1 + a_{m2}X_2 + \dots + a_{mn}X_n = b_m$$

G

Generally, it can be written as

Minimize.

$$Z = \sum_{j=1}^n C_{ij}X_j$$

Subject to the constraints

$$\sum a_{ij}X_j = b_i$$

When $i = 1, 2, 3 \dots m$ and $X_j \geq 0$

$j = 1, 2, 3 \dots n$

Z is a linear combination of some variable

N is the number of variables, m is the number of constraints

a_{ij} per unit consumption of constraint i by activity j

c_{ij} per unit effect of activity j on the effective function i

X_j are the decision variables.

The matrix of linear programming is given as.

$$\text{Minimize : } Z = C^T X$$

Subject to the constraints $AX = b$ and $x \geq 0$

Where A is an $M \times N$ constraints matrix and superscript

T is to indicate the transpose

$$\text{i.e. } x = \begin{pmatrix} X_1 \\ X_2 \\ \cdot \\ \cdot \\ X_n \end{pmatrix} \quad b = \begin{pmatrix} b_1 \\ b_2 \\ \cdot \\ \cdot \\ b_n \end{pmatrix} \quad C = \begin{pmatrix} c_1 \\ c_2 \\ \cdot \\ \cdot \\ c_n \end{pmatrix}$$

NOTES

1. If a constant appear in the form of LESS THAN (inequality) as:

$a_{k1} X_1 + a_{k2} X_2 + \dots + a_{kn} X_n \leq b_k$ it can be converted into equality from by adding non-negative SLACK variable X_{n+1} as:

$$a_{k1} X_1 + a_{k2} X_2 + \dots + a_{kn} X_n + X_{n+1} = b_k$$

This is usually occur when we are maximizing and it is of standard linear programming.

2. Also, if a constant appear in the form GREATER THAN (inequality) as:

$$a_{k1} X_1 + a_{k2} X_2 + \dots + a_{kn} X_n \geq b_k$$

It can be converted into equality from by subtracting SURPLUS variable X_{n+1} as:

$$a_{k1} X_1 + a_{k2} X_2 + \dots + a_{kn} X_n - X_{n+1} = b_k$$

is usually occur when we are minimizing and it is of non-standard linear programming.

3. All the variable involve in both standard and non-standard (i.e. 1 & 2 above) linear programming are non-negative.

An Example of standard linear programming

Maximize

$$C(x, y) = 7x + 10y$$

Subject to the constraints

$$X + 2y \leq 5$$

$$2x + 3y \leq 10$$

$$x \geq 0, y \geq 0$$

Example of non-standard linear programming

Minimize

$$R(x, y) = 3x + 11y$$

Subject to the constraints

$$2x + 7y \geq 10$$

$$3x + y \geq 7$$

$$x \geq 0, y \geq 0$$

2.3 COMMON METHODS OF LINEAR PROGRAMMING

The following are common methods of linear solution of linear programming.

2.31 GRAPHICAL METHOD

The idea of linearity shows that linear problems can be solve graphically.

THEOREM: The solution of linear programming problem.

Either

- 1 Does not exist (i.e. we say the problem unbounded)
- 2 The solution exist and occur at a concern point of the feasible region.

A feasible region: is where all the constraints are satisfied.

Feasible solution: is a solution that satisfies all the constraints or inequalities.

A feasible Basic Solution: is the one where all the solution are non-negative.

Optimal solution: is the one that extremizes the objective function.

Steps to take in Graphical Method

- 1 Express the problem in algebra form (if it is not)
- 2 Draw the graph and locate the constraints
- 3 Draw the feasible region (point) accurately.
- 4 Compute co-ordination of all the corner points.
- 5 Evaluate the objective function at each corner point.
- 6 Pick out the optimal value (max or min)

Example 1

Using graphical method, maximize $P(x, y) = 5x + 12y$, Subject to the constraint $x + 2y \leq 10$, $3x + 2y \leq 18$, $x \geq 0$, $y \geq 0$

Solution

Maximize

$$P(x, y) = 5x + 12y$$

Subject to the constraints

$$x + 2y \leq 10$$

$$3x + 2y \leq 18$$

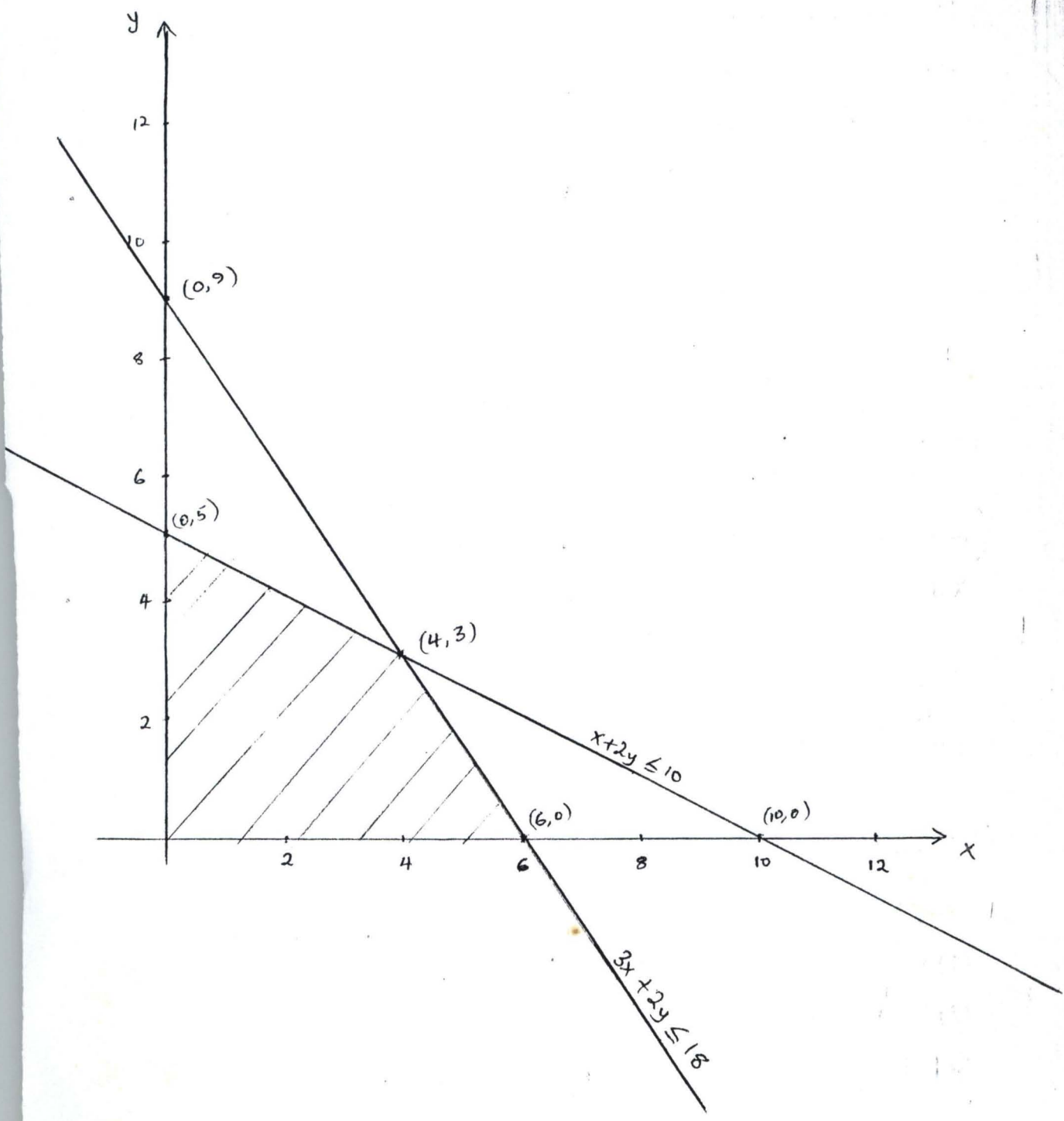
$$x \geq 0, y \geq 0$$

(1) $x + 2y = 10$ gives coordinates (10, 0) (0, 5)

(2) $3x + 2y = 18$ gives coordinates (6, 0) (0, 9)

Solution of equation (1) and (2) is (4, 3) i.e. $x = 4$, $y = 3$

GRAPH



From the objective function

$$P(x, y) = 5x + 12y \quad \text{we have (corner points)}$$

$$P(0, 5) = 0 + 12 \times 5 = 60$$

$$P(6, 0) = 5 \times 6 + 0 = 30$$

$$P(4, 3) = 5 \times 4 + 3 \times 12 = 56$$

Therefore, the maximum value is 60, given by coordinate (0, 5).

2.3.2 SIMPLEX METHOD

Is an algebraic procedure which solves exactly (not approximately) any linear programming problem in a finite no steps or gives an indication that there is an unbounded solution. The calculation starts with a feasible solution, test to see if it is optimal. If not, we find an improved feasible solution until further improvement is not possible. The procedure can be divided into following steps:

1. From the simplex table by turn the inequalities signs to equalities signs in your constraints (using slack surplus variable).
2. Pick the column with the largest negatives no. in the Δ row.
3. Divide every element in the column of constant C by its corresponding element in the column picked in step 2. And pick the row with the smallest positive quotient.
4. Divide every element in the row picked in step 3 by its element in column picked in step 2.

5. Reduce every other element in the picked column to zero by algebraic row operation using the chosen row.
6. If all the element in the new Δ row are positive, then the solution of LLP has been found, otherwise, we go to back to step 2.
7. For the solution, assign the value in the constant column to a variable with an entry 1 under it in the same row, otherwise assign zero value to the variable. The optimal value is the entry under the column of constant in the Δ row.

Example 2

Use simplex method to solve the question in example 1

Solution

Maximize

$$P(x, y) = 5x + 12y$$

Subject to the constraints

$$x + 2y \leq 10$$

$$3x + 2y \leq 18$$

$$x \geq 0, y \geq 0$$

The constraints is equality from one

$$x + 2y + u = 10$$

$$3x + 2y + z = 18$$

where u and z are added SLACK variables.

	X	y	u	z	p	c
P3	1	2	1	0	0	10
P4	3	2	0	1	0	18
Δ	-5	-12	0	0	1	0

NOTE

Equation of objective function as been transformed as:

$$P(x, y) - 5x - 12y = 0$$

No. of equation determine no. of slack or surplus variable

	X	Y	U	Z	P	C
P2	$\frac{1}{2}$	1	$\frac{1}{2}$	0	0	5
$P_4 = P_4 - 2P_2$	2	0	-1	1	0	8
$\Delta = \Delta + 12P_2$	1	0	6	0	1	60

At this stage (i.e. Table 2) it is observe that all the elements in the Δ row are positive. Therefore, the solution has been found i.e. $x = 0$, $y = 5$ and maximum value $P = 60$.

Problems

- Using graphical method, minimize $C(x, y) = x + 2y$, subject to the constraints $2x + y \geq 100$, $x + 2y \geq 60$, $2x + 2y \geq 50$, $x \geq 0$, $y \geq 0$.
- Maximize $P(X_2, y) = 13x + 17y$ by simplex method, using the constraints $4x + y \leq 24$, $x + 2y \leq 20$, $x + y \leq 12$ and $x \geq 0$, $y \geq 0$.

2.33 DUAL PROBLEM

Any given problem is called primal problem, and the associated problem to the primal problem is called Dual Problem.

- If the solution for the primal problem exist, then the solution for the dual problem exist.
- The optimal solution for the dual problem is the same as that of the primal problem.

After the primal problem has been changed to dual problem, it then solve (usually) by simplex method.

The solution to the, primal problem is given by the values under the slack variables in the least row of the final simplex table.

How to write Dual Problem

1. Prepare primal table from given primal problem.
2. Formulate dual table from prepared primal table by interchanging rows with columns.
3. Transform dual table to dual problem by taking the last rows as objective function (to maximize) and first 2 rows as constraints.

Example 3

Write the dual problem associated with the following problem.

Minimize

$$C(x, y) = 7x + 11y$$

Subject to the constraints

$$2x + 5y \geq 20$$

$$3x + 2y \geq 30$$

$$x \geq 0, y \geq 0$$

Solution

Primal Table

x	y	C
2	5	20
3	2	30
7	11	

Dual Table

u	V	C
2	3	7
5	2	11
20	30	

Dual Problem will be Maximize

$$P(u, v) = 20u + 30v$$

Subject to the constraints

$$2u + 3v \leq 7$$

$$5u + 2v \leq 11$$

$$u \geq 0, v \geq 0$$

To solve associated dual problem by simplex method.

Objective function becomes $P(u, v) - 20u - 30v = 0$ and

Constraints in equality form $2u + 3v + w = 7$

$$5u + 2v + x = 11$$

where w and x are 2 added slack variables.

	U	V	W	X	P	Constant
P_3	2	3	1	0	0	7
P_4	5	2	0	1	0	11
Δ	-20	-30	0	0	1	0

	U	v	w	X	p	Constant
P_2	$\frac{2}{3}$	1	1	$\frac{1}{3}$	0	$\frac{7}{3}$
$P_4 = P_4 - 2P_2$	$\frac{11}{3}$	0	0	$-\frac{2}{3}$	0	$\frac{19}{3}$
$\Delta = \Delta + 30P_2$	0	0	10	0	1	70

Since every elements in the last row is either zero or positive the optimum value is found and it is 70 where $w = 10$ and $x = 0$ (10, 0)

i.e. for primal

$$c(x, y) = 7x + 11y$$

$$7(10) + 11(0) = 70 + 0 = 70$$

2.4 TRANSPORTATION PROBLEM

A transportation problem is all about finding or looking for the cheapest means of transport freights or passengers from a origin centre to their destination.

The origin centre, may be a supply center (e.g. warehouse) or terminal(e.g. motor park, stadium) where freights or passengers were taking of. While the destination can by demand center (e.g. market) of another terminal (e.g. hotel, airport).

2.5 TRANSPORTATION MODEL

A transportation model is mathematical representation of a typical transportation problem.

Suppose there are M centres and N destinations. Let a_i be the amount of a commodity available at centre i ($i = 1, 2, 3, \dots, M$) and b_j be the amount required at destination j ($j = 1, 2, 3, \dots, N$).

Let C_{ij} be ther cost per unit of transporting the commodity from centre i to destination j .

The objective is to determine the amount of commodity (X_{ij}) transported from centre i to destination j such that the total transportation cost is minimized.

Mathematical interpretation of the problem is

Minimize

$$F = \sum x_{ij} \quad 1$$

Subject to the Constraints

$$\sum x_{ij} = a_i \quad i = 1, 2, 3 \dots m \dots 2$$

$$\sum x_{ij} = a_i \quad j = 1, 2, 3 \dots n \dots 3$$

And $X_{ij} \geq 0$ where $i = 1, 2, \dots, n$ and $j = 1, 2, \dots, m$

It can be seen that this is LLP in MN variables and $M + N$ equality constraints.

The first constraint (i.e. eqn. 2) show that the total commodity transported from the centre i to various destination must equal to the amount available to the centre i . And the second constraint (i.e. eqn. 3) State that the total amount of the commodity received by destination j from all origin centres must equal to the amount needed at the destination j .

The non-negativity condition is added since negative value for any X_{ij} have no meaning.

For example, let $S_1, S_2,$ and S_3 be three manufacturing houses producing goods and let D_1, D_2, D_3 and D_4 be four destinations demanding their goods. This can be illustrates by the following diagrams.

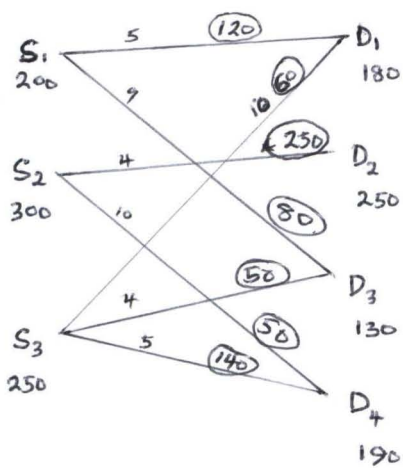


Diagram A

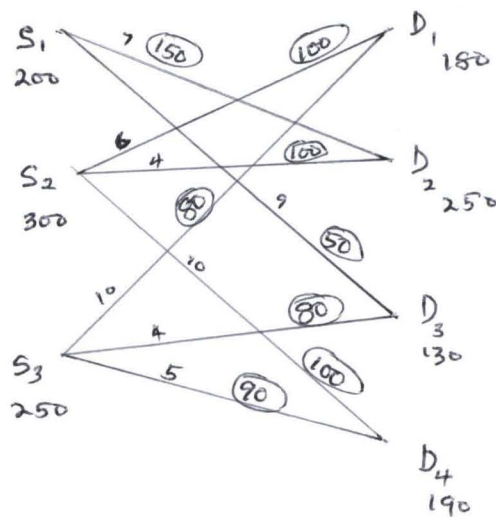


Diagram B

Diagram A

In diagram A and B

1. The numerical labels at the manufacturing houses are their daily production capacities.

2. The numerical labels at the demand centres (i.e. destinations) are the daily demands.
3. The line segments represent shipment routes from manufacturing houses to the destinations.
4. The numerical labels on the line segments represent the cost of transportation of a unit of goods along the route.
5. The circled numerical labels on the line segments represent the total supplied goods along that route.

$$\begin{aligned} \text{Total Cost in A} &= 5 \times 120 + 9 \times 80 + 250 \times 4 + 10 \times 50 + 10 \times 60 + 4 \times 50 + 5 \\ &\quad \times 140 \\ &= 600 + 720 + 1000 + 500 + 600 + 200 + 700 = \text{N}4320 \end{aligned}$$

Total Cost in B

$$\begin{aligned} &= 7 \times 150 + 9 \times 80 + 6 \times 100 + 4 \times 100 + 10 \times 100 + 10 \times 80 + 4 \times 80 + 5 \times 90 \\ &= 1050 + 450 + 600 + 400 + 1000 + 800 + 320 + 450 \\ &= \text{N}5070 \end{aligned}$$

Comment: The cost of transportation in A is cheaper than that of B, but not necessarily the cheapest cost.

The illustration in diagrams A and B can also be represented in tabular form as follows:

Destination →	D ₁	D ₂	D ₃	D ₄
↓ Manufacture Houses	180	250	130	190
S ₁ 200	⁵ 120	⁰	⁹ 80	
S ₂ 300		⁴ 250		¹⁰ 50
S ₃ 250	¹⁰ 60		⁴ 50	⁵ 140

Table A

Destination →	D ₁	D ₂	D ₃	D ₄
Manufacturing houses ↓	180	250	130	190
S ₁ 200		⁷ 150	⁹ 50	
S ₂ 300	⁶ 100	⁴ 100		¹⁰ 100
S ₃ 250	¹⁰ 80		⁴ 80	⁵ 90

Table B

CHAPTER THREE

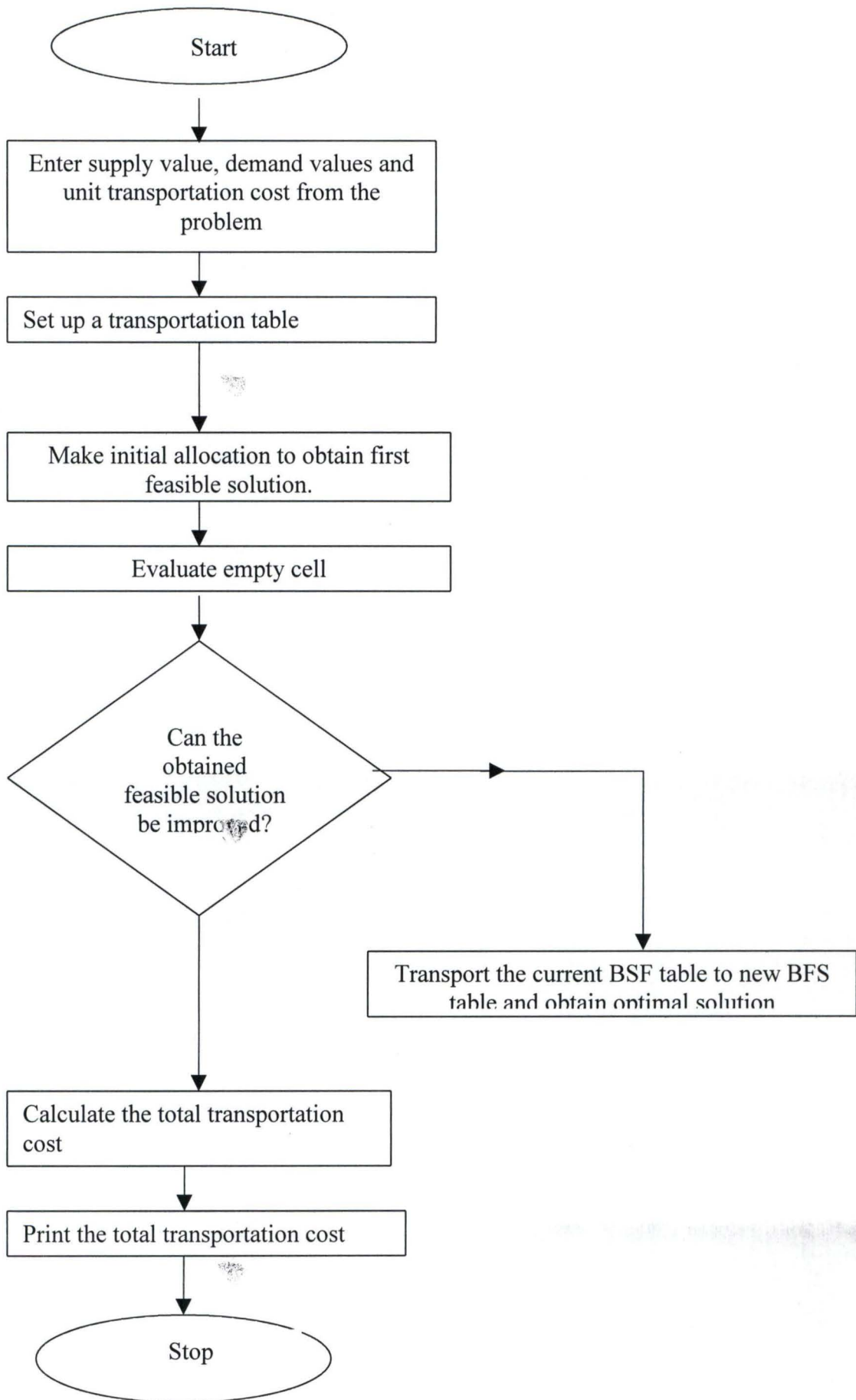
Techniques and procedures for solving transportation problems

3.1 ALGORITHM

This is a systematic step procedure that starts from preparing an initial transportation table. After the table (or matrix) is formed, the following steps were follow:

1. Make initial allocation in order to obtain an initial feasible solution
2. Determine whether the feasible solution can be improved, if there is no further improvement then the solution is optimal. But if there is need for improvement.
3. Transform the table again to obtain the optimal solution.

The above algorithm can be illustrated in a flow chart below.



3.2 BASIC FEASIBLE SOLUTION (BSF)

A solution is called basic feasible solution if it has the following characteristics.

- (1) The number of cycle cells must be equal to $m+n-1$ where n is the number of rows and m is the number of columns in the table.
- (2) There must be no circuit within the table.

Circuit - A circuit within the transportation table is a sequence of cells that satisfy these two conditions.

- (1) The first cell is the same as the last cell.
- (2) The cell in the circuit are connected by either horizontal or vertical lines.

Rim conditions A transportation solution table is said to be 'rim condition' if it has the following qualities.

- (1) In each row the sum of the circled values equals the supply for that row.
- (2) In each column, the sum of the circled values equals the total demand for that column.

3.3 HOW TO GET BASIC FEASIBLE SOLUTION (BFS)

The cheapest cost in a transportation problem is always achieved by some basic feasible solutions.

As it is said in the above algorithm, the first step is to find an initial BFS. Some of the methods used in finding basic feasible solution (BFS) are

- (1) North West corner Rule (NWCR)
- (2) The Least Cost Method (LCM)
- (3) The Vogel's Approximation method.
- (4) Stepping stone improvement method.

3.31 THE NORTH WEST CORNER RULE (NWCR)

STEPS:

- (1) Choose the entry in the North west (i.e. upper left) corner of the table this represent the shipment route from S_1 (supply center 1) to D_1 (Demand center 1).
- (2) Use this route to satisfy as much of the demand at D_1 as possible from supply at S_1 . Record the shipment with a circled value in the upper left cell.
- (3) If the supply at S_1 is not used up, use the remaining supply to fill remaining demand at $D_2 D_3 \dots\dots\dots$ in that order until the supply at S_1 is used up, record the shipment with circled number.
- (4) When one supply is used up, go to the next supply and start filling demands in order with the $D_i \{i = 1,2,3,\dots\dots\dots\}$ where there is still some demands not yet fulfilled.

The circular entries in Northwest corner rule make a stair case pattern, stretching from the Northwest to the Southeast corner. An example solved by this method is given in unit 3.33.

ADVANTAGE OF NORTHWEST CORNER RULE.

- (1) It is systematic rather than trial and error.
- (2) It involves logical procedure. This makes it to be important when using a computer.

One major demerit of Northwest corner rule is that it needs more iteration to obtain the optimal solution, as it does not take cost in to consideration in obtaining the initial feasible solution.

3.32 THE LEAST COST METHOD.

Like the Northwest corner rule, the initial basic feasible solution to be taken must have $m+n-1$ used route (i.e. circled cells). The procedures are as follows.

- (1) Identify the least cost cell or route and locate as many as are required or available to it.
- (2) Allocate as many as required or available to the next cheapest route, and continue this way until the whole allocation has been made.

ADVANTAGES

- (1) Least corner method requires less iteration than Northwest corner rule in getting the optimal solution.
- (2) It takes both supply and cost of transportation into consideration. This makes it better than Northwest corner rule.

3.33 SAMPLE PROBLEM 1

A manufacturing company has warehouses in Lagos, Owerri, Kaduna, Jos, and wishes to supply customers in Minna, Benin, Ibadan and Markurdi. The unit cost and volume informations are given in the tables below.

Volume information table

Supply Depots	Volume produced	Destination	Requirement
Lagos	233	Minna	172
Owerri	195	Benin	280
Kaduna	330	Ibadan	350
Jos	272	Makurdi	228

Transportation unit cost in (₦)

From	To Minna	To Benin	To Ibadan	To Markurdi
Lagos	6	5	4	9
Owerri	9	4	8	7

Kaduna	5	10	9	6
Jos	8	10	10	5

Compute the optimal transportation cost using

- (1) The Northwest corner rule.
- (2) The least cost method; and compare the results.

Solution

(1) by Northwest corner rule

Destination Supply depot →	Minna	Benin	Ibadan	Makurdi
Lagos 233	6 (172)	5 (61)	4	9
Owerri 195	9	4 (195)	8	7
Kaduna 330	5	10 (24)	9 (306)	6
Jos 272	8	10	10 (44)	5 (228)

The value in the right upper corner of each cell represent transportation cost on that route and the circled values represents the quantity of supply in that route.

$$\begin{aligned}
 \text{Total transportation cost} &= (6 \times 172) + (5 \times 61) + (4 \times 195) + (10 \times 24) + (9 \times 306) \\
 &+ (10 \times 44) + (5 \times 228) \\
 &= 1032 + 305 + 780 + 240 + 2754 + 440 + 1140 \\
 &= \text{N}6,691.
 \end{aligned}$$

2. By least cost method.

Destination Supply depot →	Minna	Benin	Ibadan	Makurdi
Lagos 233	6	5 (85)	4 (148)	9
Owerri 195	9	4 (195)	8	7
Kaduna 330	5 (128)	10	9 (202)	6
Jos 272	8 (44)	10	10	5 (228)

The circled values represent quantity supply on that route and the value in the right upper corner of each cell represent transportation cost on that route Naira.

$$\begin{aligned}\text{Total transportation cost.} &= (5 \times 128) + (8 \times 44) + (5 \times 85) + (4 \times 195) + (4 \times 148) \\ &+ (9 \times 202) + (5 \times 228) \\ &= 1032 + 305 + 780 + 240 + 2754 + 440 + 1140 \\ &= \text{N}5,747.\end{aligned}$$

Both methods gives basic feasible solution (BFS) because the number of their circles cells in each table equal to $m+n-1$ i.e. $4+4-1=7$ and they satisfy the rim condition.

But least cost method gives the cheapest transportation (i.e. optimal solution).

3.4 STEPPING STONE IMPROVEMENT METHOD.

The stepping stone technique is most efficient method for finding the optimal solution to a transportation problem when an initial feasible solution is given by Northwest corner rule or any other method. It uses a basic feasible solution to know when the optimal solution has been obtained or when more iterations are needed.

Its procedure is given in the following steps.

1. Begin with an empty cell where there is no entry in the current BFS table, place a positive sign (+) in it.
2. Trace a circuit, using only horizontal and vertical lines and turning where there are entries and ending up at the starting point, alternating plus (+) and minus (-) sign in the cells.
3. Calculate the improvement index.
4. If the improvement index is non-negative, look for a new empty cell and start from step two again.

5. If the improvement index is a negative value, look for a negative cell with the least entry and move it to the cell with entry and balance up the rest.

3.5 SAMPLE PROBLEM 2.

Motoring delivery service (MDS), a department in the Universal Parcel Service (UPS), has stations at Lagos, kano and Calabar wishes to deliver goods for her customers at Illorin, Suleja, Jalingo and Zamfara. She obtained a reasonable basic feasible solution of ₦36, 400. When Northwest corner rule method applied to their problem.

The current BSF table of NWCR is given below, apply stepping stone method on this table to get a cheaper transportation cost for MDS.

Note that the value in the right upper corner of each cell represent transportation cost in (₦10).

Destination MDS station →	Illorin	Suleja	Jalingo	Zamfara
Lagos 200	5 (180)	7 - (20)	4 +	8
Kano 300	6	4+ (230)	7 (70) -	10
Calabar 250	10	7	4 (60)	5 (190)

Current BSF table by Northwest corner rule (NWCR)

Solution

$$\text{Improvement index on (NWCR)} = +9 - 7 + 4 - 7 = -1 < 0$$

Destination MDS station →	Illorin	Suleja	Jalingo	Zamfara
Lagos 200	5 (180)	7	9 (20)	8
Kano 300	6	4 (250)	7 (50) -	10
Calabar 250	10	7	4 (60)	5 (190)

New basic feasible solution (BFS) table.

$$\begin{aligned}
 \text{The total cost of the transportation} &= (5 \times 180) + (4 \times 250) + (9 \times 20) + (7 \times 50) \\
 &+ (4 \times 60) + (5 \times 190) \\
 &= 900 + 1000 + 180 + 350 + 240 + 950 \\
 &= \text{N}36,200.
 \end{aligned}$$

Stepping stone improvement method gives a cheaper transportation cost (i.e. ~~N~~36,200) than Northwest corner rule (i.e. ~~N~~36,400). It always gives the cheapest transportation cost.

CHAPTER FOUR

SYSTEM ANALYSIS AND DESIGN

4.1 BRIEF HISTORY OF KWARA EXPRESS

After the advent of Structural Adjustment program (SAP) there was acute shortage of vehicle in our society. It is impossible for people to maintain their vehicles due to increase in the price of motor vehicles part. The situation was so bad for urban situation transportation to the extend that State and Federal Government had no choice than to come and assist the masses.

Based on this, Kwara State Transportation Company popularly known as KWARA EXPRESS was established in March 1988 to reduce the transportation hardship being faced by residents of Kwara State. The private vehicle owners were then pushing the fare beyond the reach of the common people.

4.2 ANALYSIS OF ROUTE AND OPERATION

Kwara Express started with 50 Fiat (Burren) buses. Before the partition of Kwara State, Kwara Express has three main stations. They are Okene, New Bussa and Ilorin as head quarter. T here mode of operation can be divided into three i.e. Inter State, Inter city and city service.

Routes under interstate service from Ilorin station were Ilorin/Oyo, Ilorin/Oshogbo, Ilorin/Kaduna, Ilorin/Lagos and Ilorin/Minna.

Routes under Inter city service are:

Ilorin/Offa

Ilorin/Laffiagi

Ilorin/Lokoja

Ilorin/Kaba

Ilorin/Afon

Ilorin/Okene

City service within Ilorin were running post office, Uni-Ilorin, Oja, Kwara Poly, etc.

Okene and New Bussa stations were also operated in a similar way as Ilorin station.

After six months of service, Federal Government assisted the company with ten luxurious buses and five J5 Peugeot buses to increase their service to the masses. In addition to this the company bought five Mercedes 6080 Faccas buses in 1990.

The partition of then Kwara Express in 1991 brought a remark to Kwara Express Transport company in which all the vehicles were shared among Kogi State, part of Niger state and Kwara state.

4.21 NEW KWARA EXPRESS.

Presently at the time of writing this project, Kwara Express has the following number of vehicles. Three 1414 buses, two Civilian Nissan buses, two Hurvan Nissan buses, two Peugeot Boxer buses, three luxurious buses and fifteen 6080 (Faccas) buses.

There are no serious charges in the former routes and the present one. The following are routes that Kwara Express is without the country.

Ilorin /Onisha

Ilorin /kano

Ilorin /Abuja

Ilorin /Kaduna

Ilorin /Minna

Ilorin /Lagos

Ilorin /Lokoja

Their service as extended to other places like;

Oke- Ode

Oro-Ago

Offa

Malete

Laffiagi

Afon

Kwara express also shuttles;

Uni-Ilorin

Post office

Oja

Kwara Poly etc within Ilorin city.

Kwara express drivers don't just board or pick passenger anywhere, they have mini stations in each town I mention above, and they have bus – stops for their city service vehicles.

Ticket is issue for their passengers at the point of booking, and their transportation fare is moderate. For example, Ilorin/minna is ₦250 while any other commercial vehicle will charge you ₦400 or more for the same trip. Ilorin / Lagos is ₦250, Ilorin /Onisha is ₦600, Ilorin /Kaduna is ₦400 etc.

Kwara express also operate on hiring or chartered to any part of the country.

4.2.2 ACHIVEMENT

Kwara Express is definitely a shining example of a successful government transport company. Its wonderful performance has not gone unnoticed because she has been able to win laurels for the state. The company won the Federal Road Safety Commission (FRSC) award for 1992 as the safest mass transit organisation in Nigeria.

The organisation also provides employment for the people, it brought comfort to the masses in terms of reduced transportation fare and of course it generates revenue for its state government.

4.3 TYPICAL TRANSPORTATION MODEL FOR KWARA EXPRESS

MODEL 1

After the football match of Nigeria/Ghana '99' Kwara Express was among three transportation companies to transport Nigerian Football Association (NFA) staffs to their state capitals from the National Stadium situated at Lagos, Kano and Calabar.

Kwara Express has a total of 210 NFA staffs (to transport) as follows: 50 staffs at Lagos, 100 staffs at Kano, and 60 staffs at Calabar. 38 of this 210 staffs are from Kwara state, 100 of them are indigene of Oyo state, 27 are from Kaduna State and 45 are from Edo state, i.e. they should be transported to Ilorin, Ibadan, Kaduna and Benin city respectively. Find the minimum cost of transporting this people to their respective state capital. The table below shows the transportation unit cost in hundred Naira.

To \ From	Illorin	Benin city	Kaduna	Ibadan
Lagos	3	5	9	2
Kano	8	10	2	10
Calabar	11	7	6	12

Solution

State capital stadium →	Illorin	Benin city	Kaduna	Ibadan
Lagos 50	38	45	27	100
Kano 100	3	5	9	2 (50)
Calabar 60	8 (23)	10	2 (27)	10 (50)
	11 (15)	7 (45)	6	12

The circled values represent the number of staff traveled on that route. And the values on the right upper corner of each cell represent transportation cost on that route in hundred naira.

$$\begin{aligned} \text{Total transportation cost.} &= (8 \times 23) + (11 \times 15) + (7 \times 45) + (2 \times 27) + (2 \times 50) \\ &+ (10 \times 50) \\ &= 184 + 165 + 315 + 54 + 100 + 500 \\ &= \text{₦}131,800. \end{aligned}$$

However, the problem in model¹ can also be solved by linear programming software, what to do is enter the objective function and constraints into computer. Indicate whether to minimize or maximize and run the program. The result will be generated immediately. i.e.

Minimize the objective function.

$$Z = 3x_{11} + 5x_{12} + 9x_{13} + 2x_{14} + 8x_{21} + 10x_{22} + 2x_{23} + 10x_{24} + 11x_{31} + 7x_{32} + 6x_{33} + 12x_{34}$$

Subject to the constraints below

Meeting requirement:

$$\text{At Ilorin } x_{11} + x_{21} + x_{31} = 38$$

$$\text{At B/city } x_{21} + x_{22} + x_{23} = 45$$

$$\text{At Kaduna } x_{31} + x_{32} + x_{33} = 27$$

$$\text{At Ibadan } x_{41} + x_{42} + x_{43} = 100$$

Not exceeded supplies available

$$\text{At Lagos } x_{11} + x_{12} + x_{13} + x_{14} \leq 50$$

$$\text{At Kano } x_{21} + x_{22} + x_{23} + x_{24} \leq 100$$

$$\text{At Calabar } x_{31} + x_{32} + x_{33} + x_{34} \leq 60$$

Total constraint is 7 and we have 12 variables.

MODEL 2.

It is assumed that there is 10% increase in the price of fuel. Find the minimum transportation cost of the problem faced by Kwara Express in Model 1, using the table below.

Transportation Unit cost in ₦100

To \ From	Ibadan	Kaduna	Benin city	Illorin
Kano	12	3	11	10
Calabar	12.5	6.5	7.5	12
Lagos	2.5	10	7	4

Solution to model 2.

To \ From	Ibadan	Kaduna	Benin city	Illorin
Kano 100	12 (50)	3 (27)	11	10 (23)
Calabar 60	12.5	6.5	7.5 (45)	12 (15)
Lagos 50	2.5 (50)	10	7	4

The values in the right upper corner of each cell represent transportation cost on that route in hundred naira. And the circled values represent the number of people traveled on that route.

$$\begin{aligned}
 \text{Total transportation cost.} &= (12 \times 50) + (2.5 \times 50) + (3 \times 27) + (7.5 \times 45) + \\
 &+ (10 \times 23) + (12 \times 15) \\
 &= 600 + 125 + 81 + 337.5 + 230 + 180 \\
 &= 1,553.5 \times \text{₦}100 \\
 &= \text{₦}155,350.
 \end{aligned}$$

Minimize the objective function

$$\begin{aligned}
 Z &= 12x_{11} + 3x_{12} + 11x_{13} + 10x_{14} + 12.5x_{21} + 6.5x_{22} + 7.5x_{23} + 12x_{24} + 2.5x_{31} + \\
 &+ 10x_{32} + 7x_{33} + 4x_{34}.
 \end{aligned}$$

Subject to the set of constrain

- Meeting requirement:
- At Ibadan $x_{11} + x_{21} + x_{31} = 100$
 - At Kaduna $x_{21} + x_{22} + x_{23} = 27$
 - At B/city $x_{31} + x_{32} + x_{33} = 45$
 - At Ilorin $x_{41} + x_{42} + x_{43} = 38$
- Not exceed what available
- At Kano $x_{11} + x_{12} + x_{13} + x_{14} = \leq 100$
 - At Calabar $x_{21} + x_{22} + x_{23} + x_{24} = \leq 60$
 - At Lagos $x_{31} + x_{32} + x_{33} + x_{34} = \leq 50$

There are 7 constraint and 12 variables

4.4 COST BENEFIT ANALYSIS

A cost benefit analysis is necessary to determine economic feasibility in which its primary objective is to find out whether it is economically worthwhile to invest in a certain project.

As part of this project, Kwara Express office was visited at ilorin and it was found that there system of operating is still manually in all aspects. Even keeping records like movement of vehicles in which data will be entering under NAME OF DRIVER, REGISTRATION NUMBER, NUMBER OF VEHICLE, DATE, NUMBER OF RECIEPT NAME OF CONDUCTOR ETC. is done manually. Not only this other records were done manually e.g. a record that describes..... EXPECTED DAILY REVENUE FOR EACH VEHICLE,

The cost and benefit below is made to see whether it will be economically worthwhile for Kwara Express to go into computerization.

4.4.1 COST

DEVELOPMENT COST.

System analysis and design (for 2 or 3 weeks.....	₦60,000.00
Software development.....	₦30,000.00

Three personnel computers.....	₦240,000.00
A printer.....	₦80,000.00
	<hr/>
	₦ 410,000.00

PERSONNEL COST

Staff training.....	₦30,000.00
Staff Allowance.....	₦25,000.00
	<hr/>
	₦55,000.00

OPERATING COST

Operating materials (Diskettes, Ink, stationary etc.).....	₦70,000.00
UPS (Uninterrupted Power Supply).....	₦30,000.00
Labour (Two operators)	₦30,000.00
Program and Equipment maintenance	₦100,000.00
Two Air conditioner.....	₦100,000.00
Miscellaneous.....	₦30,000.00
	<hr/>
	₦360,000.00

GRAND TOTAL ₦825,000.00.

4.4.2 BENEFITS

1. Reduction of cost and time spent on data preparation
2. Faster provision of desire information (hard copy) with high level of accuracy.
3. Reduction in the use of paper work
4. Automatic up dating of records and maintenance
5. Eliminating of loss and data stored in life
6. Less fraudness
7. Reduction in journey time and cost
8. Improved comfort and convenience for staff and travelers.

4.5 PROGRAM DESIGN

It was mentioned in chapter one of this project that, there are many ready-made transportation software that are purposely designed for transporters. These programs cover many aspects of transportation planning such as highway, trip generation, trip distribution, shortest route, modeling etc. The MSIS linear programming software is also available to minimize or maximize transportation cost or profit therefore at this early stage of ones computer literacy, one cannot write a program that will be better than all those packages. Meanwhile another program that is still in line with this project is written.

The program is divided in three, i.e. the Introduction, the Topic and the Menu. The menu is divided into six different programs they are: AEROPLANE, BICYCLE, SHIP, TRAIN AND EXIT. When the program is running, it first introduce the inter, after the introduction, the topic "MILESTONE IN TRANSPORTATION" will open on the screen and will ask to press any key to continue. When any key is pressed, menu will appear on the screen, then you can select menu to view each of the programs.

4.5.1 PROGRAMMING LANGUAGES (INTRODUCTION)

Software is described as a set of programs used to direct the affairs of a computer. This implies that for a computer to be controlled, it requires writing a program and this process is refereed to as programming.

Therefore a program can be defined as set or sequence of instructions, which informs a computer of the steps required for achieving a defined task.

However, the act of giving instruction to a computer is made possible through the computer programming languages. Thus the

programming language is simply the mode of communicating to computers. It is in a form of artificial defined set of characters, symbols and rules and the mode of combining these characters, symbols and words plus the rules into meaningful communication, so designed to be conveniently used by human beings in developing programs.

There are three main methods of computer language namely:

1. Machine language
2. Assembly language
3. High level language

All programs written in languages other than the machine language needs to be translated to machine language processor before their instructions can be understood by control unit. These languages processor are:

1. Assembler
2. Compiler
3. Interpreter

4.5.2 CHOICE OF PROGRAMMING LANGUAGE

The program 'Milestone in transportation' was developed using QBASIC language. QBASIC is not only a complete and efficient programming language but also incorporates of the fourth generation programming language because of some powerful function it posses and its flexibility in managing logic and graphic design.

BASIC, an acronym for: beginners, all purpose symbolic instruction code, is a product created in 1964 at Dartmouth college in Hangover, New Hampshire by John Kenemy and Thomas Kurtz as a language for teaching programming. Over the year, BASIC has grown to be a popular and powerful program tool. This is because its method of coding and syntax is the easiest available language to learn by any user.

4.5.3 FEATURES OF QBASIC.

- 1- QBASIC is the latest version of BASIC language
- 2- It belongs to class of high level language that has a variety of commands and auxiliary functions that allow user to load, save, edit and modify program.
- 3- QBASIC is available in all disk operating system (DOS). This made it to work with QBASIC the moment you have DOS.
- 4- Unlike lower version (BASICA, GWBASIC) of BASIC language line numbering is optional in QBASIC.
- 5- QBASIC support instant syntax checking as instructions are entered and give instant help on errors.
- 6- QBASIC has a facility that supports a structure programming i.e. blocked operation e.g. If.....Then. Else if; Do.....While....Until.
- 7- It also allows built-in in function.
- 8- QBASIC program runs much faster than other BASIC programs because it uses compile processor.

4.5.4 PROGRAM CODING

Coding is the writing of the program text as a set of program instruction, either in black and white or by direct input from a keyboard. The code is written in one of many programming languages. Thus, QBASIC is used for program developed and the program code is given in appendix C below.

4.6.0 OPERATIONAL MANUAL

Operational manual is nothing but documenting the program after the program is coded. The next step is debugging errors (syntax or logic).

When the program is free of errors, testing is carried out before implementation of the program. For successful implementation for other users, the program should be documented.

Documenting a program is very important because it aids the users in understanding the program better and it also aids maintenance of such programs.

4.6.1 MENU

The program “milestone in transportation” is made to run on the system by first of all loading the QBASIC at the “DOS PROMPT”, A:>, as soon as this is achieved, the user select the option OPEN from the file menu and then types the name of the file (Akeem Bas). The entire content of the program coded is displayed on the screen and the function f5 is pressed for the program to run.

When this program is running, the user is supplied with the introduction of the writer and the title of the program, then the user will be asked to press any key to continue, when a key is pressed, the user is supplied with the message (below) on the screen which is the main menu

MAIN MENU

AIR.....	[1]
BIC.....	[2]
CAR.....	[3]
SHIP.....	[4]
TRAIN.....	[5]
EXIT.....	[6]

The first five options from the menu are five major means of transportation, which was explained one after the other as milestone in transportation inside the program. The program will request the user to

make choice from the menu by typing any of the number 1,2,3,4,5,6 to indicate the means of transportation that the user desire.

4.6.2 EXIT

The sixth option (exit) under menu will call a sub-program BYE when the user ^{chose} choice 6 and this will allow the user to quit the program.

This 'exit' put under menu so that the user can go from one menu to another and exit without going through all the menu.

CHAPTER FIVE

RECOMMENDATION AND CONCLUSION

5.1 RECOMMENDATION

People should not believe that computerization of transportation system is possible only in developed countries. Transporters must believe that applying scientific models contribute immensely to the analysis of their managerial decision. And adoption of computerized system will only influence their feedback positively as we have seen the benefit in chapter four.

In order to master and understand this field of transportation, however, it is not sufficient to learn the technique and method of minimizing transportation cost alone. It is therefore suggest for transporter and any other invested person to take the pain of attend short or long-term program on any aspect of transportation at Nigeria Institute of Transport Technology (NITT) Zaria.

Also it is advisable for any student who may use this project as a ^{reference} influence in future to extend his/her model to other aspect like trip generation or short route.

5.2 CONCLUSION

It is widely acclaimed that the history of civilization is the history of transportation. This is testifying at home and abroad. In Nigeria today, road transportation has become an important and the most vibrant sector of the national economy which account for daily movement of 920,000 persons out of the estimated 957,000 travelers that transverse the length and breadth of the country in one day.

Morlock, a transporter, says; Advances in the transport have made possible changes in the way we live and the way in which societies and organized and thereby have influenced the development of civilization.

Holmes also agrees that the rapid growth in the economy of the USA in the early decades of last century was probably a direct result of the expansion of the transport system.

Generally, one thing is certain i.e. the future will be different from the past, and all branches and aspect of transportation will be influenced in one way or the other. I hope the idea presented in this project will be useful now and in the future trend of travel and demand for transportation.

APPENDIX 'A'

IMPORTANT DATES IN AUTOMOBILE HISTORY

1770 – Nocholas Joseph of France successfully operated a three-wheeled steam powered vehicle.

1860 – Jean Joseph Etieme Lenair of France developed an internal combustion engine fueled by illuminating gas.

1885 – Gottlieb Daimler and Karl Benz of Germany developed a successful gasoline engines of the type used in today's cars.

1890 – William Morrison of Des Moines, Iowa USA built a car powered by electricity.

1908 – Ford introduced the model T.

William C. Durant organized the General Motor Company

Henry M. Leyland introduced interchangeable part of cars.

1912 – General Motors introduced the electric starter.

1914 – Cadillac produced the first practical V-3 Engine

1922 – Balloon tyres were introduced.

1939 – Fully automatic transmission and Air conditioning were introduced.

1948 – Tubeless tyres were introduced

1996 – Chryster introduced computer controlled engine source.

Culled from the world book of encyclopedia.

APPENDIX 'B'

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**APPENDIX C
PROGRAMME CODE**

```
DECLARE SUB BOX ()
DECLARE SUB TOPIC ()
DECLARE SUB air ()
DECLARE SUB bic ()
DECLARE SUB car ()
DECLARE SUB ship ()
DECLARE SUB train ()
DECLARE SUB BYE ()
DECLARE SUB menu ()
DECLARE SUB INTRO ()
SCREEN 9
CALL INTRO
```

```
SUB air
CLS
COLOR , 8
CALL BOX
LOCATE 2, 30: COLOR 5: PRINT "AEROPLANE"
LOCATE 4, 22: COLOR 10: PRINT "For hundred of years, people tried to think of ways"
LOCATE 6, 22: COLOR 10: PRINT "to fly. In 1793 the MONTGOLFIER BROTHERS of France built"
LOCATE 8, 22: COLOR 10: PRINT "the first balloons that could carry passengers. These"
LOCATE 10, 22: COLOR 10: PRINT "balloons were made of paper and silk and were filled with"
LOCATE 12, 22: COLOR 10: PRINT "heated air. However, the first successful engine - powered"
LOCATE 14, 22: COLOR 10: PRINT "flight was made by ORVILLE and WILBUR WRIGHT of"
Dayton,"
LOCATE 16, 22: COLOR 10: PRINT "Ohio on December 17th 1903."
```

```
LOCATE 21, 27: COLOR 10: INPUT "[Goto Menu(?)]"; m$
IF (m$ = "Y") OR (m$ = "y") THEN
    CALL menu
ELSE
    LOCATE 22, 27: COLOR 10: INPUT "[Make Another Choice(?)]"; c
END IF
END SUB
```

```
SUB bic
CLS
COLOR , 8
CALL BOX
LOCATE 2, 30: COLOR 5: PRINT "BICYCLE"
LOCATE 4, 22: COLOR 10: PRINT "The great 15th century Italian aretist and inventor"
LOCATE 6, 22: COLOR 10: PRINT "LEONARDO da VINCI made the first sketches and drawing"
LOCATE 8, 22: COLOR 10: PRINT "of a bicycle. But the person credited with desining a"
LOCATE 10, 22: COLOR 10: PRINT "workable bicycle was BARON KARN von D of Germany in"
1818"
```

```
LOCATE 21, 20: COLOR 10: INPUT "[Goto Menu(?)]"; m$
IF (m$ = "Y") OR (m$ = "y") THEN
    CALL menu
ELSE
    LOCATE 22, 20: COLOR 10: INPUT "[Make Another Choice(?)]"; c
END IF
END SUB
```

```
SUB BOX
LINE (1, 1)-(630, 330), 10, B
LINE (1, 1)-(150, 330), , B
END SUB
```

```

SUB BYE
CLS
COLOR 7
FOR I = 1 TO 630 STEP 10
    LINE (1, 1)-(I, 330), , B
NEXT I
COLOR 7
LINE (1, 1)-(630, 330), , B
LOCATE 12, 32: COLOR 4, 8: PRINT "GOOD BYE"
END
END SUB

```

```

SUB car
CLS
COLOR , 8
CALL BOX
LOCATE 2, 30: COLOR 5: PRINT "CAR"
LOCATE 4, 22: COLOR 10: PRINT "The first recorded use of self - powered vehicle was"
LOCATE 6, 22: COLOR 10: PRINT "in 1769. A French artillery officer, NICHOLAS CUGNOT,"
LOCATE 8, 22: COLOR 10: PRINT "designed and built a three - wheeled steamed-powered"
LOCATE 10, 22: COLOR 10: PRINT "vehicle. By 1885, KARL BENZ and GOTTLIEB D., were "
LOCATE 12, 22: COLOR 10: PRINT "making cars with gasoline - drive engine."
LOCATE 21, 20: COLOR 10: INPUT "[Goto Menu(?)]"; m$
    IF (m$ = "Y") OR (m$ = "y") THEN
        CALL menu
    ELSE
        LOCATE 22, 20: COLOR 10: INPUT "[Make Another Choice(?)]"; c
    END IF
END SUB

```

```

SUB INTRO
CLS
COLOR , 8
LINE (1, 1)-(630, 330), 4, B
LOCATE 12, 24: COLOR 10: PRINT "WELCOME TO THIS PROGRAM"
SLEEP 3
CLS
LINE (1, 1)-(630, 330), 4, B
LOCATE 10, 24: COLOR 10: PRINT "THIS PROGRAM IS WRITTEN"
SLEEP 1
LOCATE 14, 34: COLOR 10: PRINT "BY"
SLEEP 3
CLS
LINE (1, 1)-(630, 330), 4, B
LOCATE 6, 26: COLOR 10: PRINT "AMUZAT AKEEM ADETUNJI"
SLEEP 1
LOCATE 8, 25: COLOR 10: PRINT "AD/NO PGD/MCS/98-99/762"
SLEEP 1
LOCATE 10, 21: COLOR 10: PRINT "MATHEMATICS/COMPUTER SCIENCE DEPT."
SLEEP 1
LOCATE 12, 22: COLOR 10: PRINT "FEDERAL UNIVERSITY OF TECHNOLOGY"
SLEEP 1
LOCATE 14, 29: COLOR 10: PRINT "MINNA NIGER STATE"
SLEEP 3
CALL TOPIC
CALL menu
END SUB

```

```

SUB menu
10 CLS

```

```

COLOR , 8
LINE (1, 1)-(630, 330), 10, B
LOCATE 4, 30: PRINT "MAIN MENU"
LOCATE 6, 24: PRINT "AIR-CRAFT===== [1]"
LOCATE 8, 24: PRINT "BICYCLE===== [2]"
LOCATE 10, 24: PRINT "CAR===== [3]"
LOCATE 12, 24: PRINT "SHIP===== [4]"
LOCATE 14, 24: PRINT "TRAIN===== [5]"
LOCATE 16, 24: PRINT "EXIT===== [6]"

LOCATE 6, 42: COLOR 12: PRINT "[1]"
LOCATE 8, 42: COLOR 12: PRINT "[2]"
LOCATE 10, 42: COLOR 12: PRINT "[3]"
LOCATE 12, 42: COLOR 12: PRINT "[4]"
LOCATE 14, 42: COLOR 12: PRINT "[5]"
LOCATE 16, 42: COLOR 12: PRINT "[6]"
'LOGIC OF THE SELECTION
FOR c = 1 TO 6
    LOCATE 22, 20: COLOR 10: INPUT "[MAKE YOUR CHOICE(?)]"; c
    IF c = 1 THEN
        GOSUB air
    ELSEIF c = 2 THEN
        GOSUB bic
    ELSEIF c = 3 THEN
        GOSUB car
    ELSEIF c = 4 THEN
        GOSUB ship
    ELSEIF c = 5 THEN
        GOSUB train
    ELSEIF c = 6 THEN
        GOSUB BYE
    ELSE CALL menu
    END IF
NEXT c
    x = RND * 6
    y = RND * 6
    GOTO 10

air:
    CALL air

bic:
    CALL bic

car:
    CALL car

ship:
    CALL ship

train:
    CALL train

BYE:
    CALL BYE
END SUB

SUB ship
CLS
COLOR , 8
CALL BOX

```



```

LOCATE 2, 30: COLOR 5: PRINT "SHIP"
LOCATE 4, 22: COLOR 10: PRINT "Prophet NOAH(p.b.o.h)made the first recorded ship called"
LOCATE 6, 22: COLOR 10: PRINT "ARK OF NOAH. However, the first practical steamboat was"
LOCATE 8, 22: COLOR 10: PRINT "built by an American inventor, JOHN FITCH,in 1787.And the"
LOCATE 10, 22: COLOR 10: PRINT "first steam powered vessel crossed the Atlantic in 1819,"
LOCATE 12, 22: COLOR 10: PRINT "it was named Savannah's Voyage."

```

```

LOCATE 21, 20: COLOR 10: INPUT "[Goto Menu(?)]"; m$
IF (m$ = "Y") OR (m$ = "y") THEN
    CALL menu
ELSE
    LOCATE 22, 20: COLOR 10: INPUT "[Make Another Choice(?)]"; c
END IF

```

```

END SUB

```

```

SUB TOPIC

```

```

CLS
COLOR , 8
LINE (1, 1)-(630, 330), 10, B
LOCATE 12, 24: COLOR 10: PRINT "MILESTONES IN TRANSPORTATION"
scale$ = "CDEFGAB"
PLAY "L16"
FOR I% = 0 TO 6
    PLAY "O" + STR$(I%)
    PLAY "X" + VARPTR$(scale$)
NEXT I%
LOCATE 20, 22: COLOR 2: PRINT "[PRESS ANY KEY TO CONTINUE...]"
A$ = INPUT$(1)
END SUB

```

```

SUB train

```

```

CLS
COLOR , 8
CALL BOX
LOCATE 2, 30: COLOR 5: PRINT "TRAIN"
LOCATE 4, 22: COLOR 10: PRINT "The railroad industry began in England near the begining"
LOCATE 6, 22: COLOR 10: PRINT "of the industrial revolution. In 1804 RICHARD TREVITHINK"
LOCATE 8, 22: COLOR 10: PRINT "built the first steam locomotive to run on tracks. It is"
LOCATE 10, 22: COLOR 10: PRINT "said to have pulled 10 tonnes and 70 people."
LOCATE 21, 20: COLOR 10: INPUT "[Goto Menu(?)]"; m$
IF (m$ = "Y") OR (m$ = "y") THEN
    CALL menu
ELSE
    LOCATE 22, 20: COLOR 10: INPUT "[Make Another Choice(?)]"; c
END IF
END SUB

```