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Comparative Analysis of Initial Feasible Solutions to Balanced Transportation Problems

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Abstract

In this work, we compared three transportation approaches to find the most efficient transportation schedule and the best transportation route for the initial feasible solution in order to maximize profit. Excel solver as a tool was used to compute the optimal solution as a validation for the optimal test.

Keywords: Transportation cost; Transportation problem; Initial basics feasible solution; Excel solver; Optimal solution

Introduction

One of the important applications of linear programming is in transportation problems. Transportation problem is a classical class optimization problem which involves moving goods from one location to another location depending on demand and supply of the goods at the various locations. Hitchcock [1] originally developed transportation problems and Dantzig [2] successfully developed efficient and robust method for the solution of the problems followed by Cooper & Henderson [3] who later improved on the method of solution.

The simplified version of simplex method is transportation method and it can be used to solve linear programming problems. It is known as the transportation problem/model because in solving problems that involves several sources and destinations, transportation method is a major application. A transportation problem is said to be balanced if, total supply equals total demand, if there is a disparity between demand and supply, it is said to be unbalanced transportation problem. In this work, we will focus on balanced transportation problems

Many authors [4-11] had worked on transportation problems with most of them laying emphasis on Vogel approximation method and northwest corner rule method for both the initial basic feasible solution and optimal solution. Though their results were found to be very good but, in this research, we intend to explore row minimal, column minimal and least square methods to obtain both the initial basic feasible solution and the optimal solution for possible comparison.

Problem Formulation

A firm produces goods at locations, i.e. $i = 1, 2, 3, \ldots, m$. The supply product at i^{th} location = si, the demand for the goods is spread out at different demand locations i.e. $j = 1, 2, 3, \ldots, n$. The demand at the j^{th} demand location is D_j. The problem of the firm is to get goods from supply locations to demand locations at minimum cost. Assume that the cost of shipping one unit from supply location to demand location j is c_{ij} and that shipping cost is linear, which means that if you shipped x_{ij} unit from location to demand location, then, the cost would be $c_{ij}x_{ij}$.

Where x_{ij} is the number of units shipped from supply location i to demand location j the problem is to identify the minimum or maximum shipping cost schedule. The constraints being that supply must meet demand at each demand location and cannot exceed supply at each supply location.

By the assumption of linearity, the schedule cost is as below

$$\max \sum_{i-1}^{m} \sum_{j=1}^{n} c_{ij} x_{ij} \quad (3.1)$$

The total amount shipped out of supply location is

$$\sum_{i=1}^{m} x_{ij} \quad (3.2)$$

i.e. x_{ij} is the unit shipped from i to j. Also, from amount of unit can be shipped to any demand location $j = 1, 2, 3, \ldots, n$. The quantity cannot exceed the supply available, hence the constraint

$$\sum_{j=1}^{m} x_{ij} \le S_{i,} \quad i = 1,2,3, \ \ldots, m. \ (3.3)$$

Similarly, the constraints that guarantee that the demand at each demand location is met is given by

$$\sum_{j=1}^{n} x_{ij} \le D_{j,} \quad j = 1,2,3, \ \ldots, n. \ (3.4)$$

Thus, we assume that the total supply is equal to total demand that is if

$$\sum_{j=1}^{n} D_j = \sum_{i=1}^{m} S_i \quad (3.5)$$

The constraints in the problem holds as equations

With the establishment that total supply is equal to total demand, the standard transportation model formulation is given below with the objective to find a transportation plan denoted by x_{ij} that satisfy (3.5) and solves

$$\left.\begin{aligned} &\max \sum_{i=1}^{m}\sum_{j=1}^{n} c_{ij}x_{ij} \\ &\textit{subject to} \sum_{j=1}^{n} x_{ij} \le S_{i,} \quad i = 1,2,3, \ \ldots, m \\ &\sum_{j=1}^{n} x_{ij} \le D_{j,} \quad j = 1,2,3, \ \ldots, n \end{aligned}\right\} \ (3.6)$$

In the problem it is natural to assume that the variable x_{ij} takes on integer value (and non-negative ones). That is one can only ship items in whole number batches.

Then the standard mathematical model for this problem is:

$$\left.\begin{aligned} &\max Z = \sum_{i}^{m}\sum_{j}^{n} x_{ij}c_{ij} \\ &\textit{subject to} \sum_{j}^{n} x_{ij} \le a_{i,} \quad i = 1,2,3, \ \ldots, m \\ &\sum_{j}^{n} x_{ij} \ge b_{j,} \quad j = 1,2,3, \ \ldots, n \end{aligned}\right\} \ (3.8)$$

where

$m = number \ of \ sources$

$n = number \ of \ destinations$

a_i =capacity of i^{th} source

b_j =capacity of j^{th} destination

c_{ij} = cost coefficient for materials shipped from i^{th} source to j^{th} destination

x_{ij} =amount of materials shipped between i^{th} source to j^{th} destination

Methodology

In this section, we consider column minima, row minima and least square methods for the initial feasible solution of balanced transportation problems while we improve on each of the method for the optimality solution. The basic steps involved in solving a transportation problem are;

(i) find an initial basic feasible solution,

(ii) test the solution for optimality,

(iii) improve the solution when it is not optimal at the initial feasible point.

In a case where the solution is not optimal at the initial feasible solution, steps (ii) and (iii) are repeated until an optimal solution is arrived at. Excel solver was also used for the optimality test.

Data collection and analysis

Data for this research work were collected from Pleasure Travels Limited, Peace Mass Transit, Blue Whales Transport Limited and Young Shall Grow Transport Limited and used for comparison of transportation algorithm(s) with the view of finding the most efficient transportation algorithm and the best transportation route for the benefit of the companies involved in order to maximise profit. Three methods of finding initial feasible solution (Column minima method, Row minima method and Least cost method) where employed. Excel solver was used to compute the optimal solution as a validation tool for the transportation problem.

Construction of pleasure travels transportation table

Table 1: Data Collected from Pleasure Travels Limited.

Route	Passengers Per Bus	No of Vehicle		No of Passengers Carried	Income Per Trip
		TO	FRO		
ABUJA-CALABAR	14	2	2	56	N380,800
	13	1	1	26	N 171,600
ABUJA-OWERRI	36	2	2	144	N 1,022,400
	13	1	1	26	N 182,000
ABUJA-LAGOS	42	1	1	84	N 546,000
	36	1	1	72	N 460, 800
ABUJA-IBADAN	42	1	1	84	N 487,200
	13	1	1	26	N 140,400
Total		10	10	518	N 3,391,200

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Consider a transportation company Pleasure Travels that allocates buses to different route on a daily basis and the total income generated on each per trip (to-fro) as well as the total passengers transported per trip (to-fro) as shown in (Table 1) below is transformed into transportation tableau and the initial feasible solution of the transportation problem is computed as follows (Table 2).

Table 2: Pleasure Travels Transportation Table.

	A	B	C	D	Supply
Abuja- Calabar	6800	6800	6600	6800	82
	28	28	26		
Abuja - Owerri	7100	7100	7000	7100	170
	72	72	26		
Abuja - Lagos	6500	6500	6400	6500	156
	42	42	72		
Abuja - Ibadan	5800	5800	5400	5800	110
	42	42	26		
Demand	184	184	150		518

Now, we compute the total number of passengers that uses bus A to all the routes from Abuja

Demand = 28+72+42+42 = 184

Total number of passengers that uses bus B to all the routes

Demand = 28+72+42+42 =184

Total number of passengers that uses bus C to all the routes from Abuja

Demand = 26+26+72+26 = 150

Total Demand = 518

Number of passengers that moved from Abuja to Calabar using bus A to D = 82

Number of passengers that moved from Abuja to Owerri using bus A to D = 170

Number of passengers that moved from Abuja to Lagos using bus A to D = 156

Number of passengers that moved from Abuja to Ibadan using bus A to D = 110

Total supply = 82+170+156+110 = 518. This gives a balanced transportation problem hence; it satisfies the condition Total Demand = Total Supply

Total income generated is calculated below

6800 * 56 = ₦380,800

6600 * 26 = ₦171,600

7100 * 144 = ₦1,022,400

7000 * 26 = ₦182,000

6500 * 84 = ₦546,000

6400 * 72 = ₦460,800

5800 * 84 = ₦487,200

5400 * 26 = ₦140,400

Total income = ₦3,391,200

Finding initial feasible solution

Column minima method

Table 3: Column Minima Method.

	A	B	C	D	Supply
A	6800	6800	6600	6800	82
	82				
B	7100	7100	7000	7100	170
		20	150		
C	6500	6500	6400	6500	156
	102	42			
D	5800	5800	5400	5800	110
		110			
Demand	184	184	150		518

The initial basic feasible solution is obtained using column minima method following the algorithm presented starting from the least cell in the first column until all demand and supply are met as shown in (Table 3).

Total income generated by the column minima method

6800 * 82 = ₦557,600

7100 * 20 = ₦142,000

7000 * 150 = ₦ 1,050,000

6500 * 102 = ₦663,000

6500 * 54 = ₦351,000

5800*110= ₦638,000

Total income = ₦3,401,600

Row minima method

Table 4: Row Minima Method.

	A	B	C	D	Supply
A	6800	6800	6600	6800	82
	82		82		
B	7100	7100	7000	7100	170
		102	68		
C	6500	6500	6400	6500	156
	156				
D	5800	5800	5400	5800	110
	28	82			
Demand	184	184	150		518

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The Row Minima Method is applied starting allocation to the cell with the minimum cost in the first row following the algorithm mentioned earlier as shown in (Table 4).

Total income generated using the Row Minima Method

6600 * 82 = ₦541,200

7000 * 68 = ₦476,000

7100 * 102 = ₦724,200

6500 * 156 = ₦1,014,000

5800 * 28 = ₦162,400

5800 * 82 = ₦475,600

TOTAL INCOME = ₦3,393,400

Least cost method

The initial basic feasible solution is obtained using the least cost method following the algorithm presented earlier starting from the least cell until all demand and supply are met as shown in (Table 5).

Total income generated using the least cost method is calculated below

6800 * 82 = ₦557,600

7100 * 20 = ₦142,000

7000 * 150 = ₦1,050,000

6500 * 82 = ₦533,000

6500 * 74 = ₦481,000

5800 * 110 = ₦638,000

Total income =3,401,600

Table 5: Least Cost Method.

	A	B	C	D	Supply
A	6800 82	6800	6600	6800	82
B	7100 20	7100	7000 *150	7100	170
C	6500 82	6500 74	6400	6500	156
D	5800 28	5800 110	5400	5800	110
Demand	184	184	150		518

Construction of Peace Mass Transit Transportation Problem

Table 6: Data Collected from Peace Mass Transit.

Route	Passenger Per Bus	No of Vehicle		Total Passenger	Income
		TO	FRO		
ABUJA-CALABAR	14	2	2	56	375,200
	13	2	2	52	343,200
ABUJA-PORTHHARCOURT	13	3	3	78	468,000
	14	1	1	28	170,800
ABUJA – OWERRI	36	1	1	72	489,600
	13	1	1	26	182,000
ABUJA-IBADAN	42	1	1	84	478,800
	13	2	2	52	291,200
TOTAL		13	13	448	2,798,800

(Table 6) is transformed into a transportation tableau and the initial feasible solution of the transportation problem is computed as follows (Table 7).

Table 7: Peace Mass Transit Transportation Table.

	A	B	C	D	Supply
A	6700 28	6700 28	6600 26	6600 26	108
B	6000 26	6000 26	6600 26	6100 28	106
C	6800 72	7000 26	6800	6800	98
D	5700 84	5600 26	5600 26	5600	136
Demand	210	106	78	54	448

Column minima method

Table 8: Column Minima Method.

	A	B	C	D	Supply
A	6700 104	6700	6600 4	6600	108
B	6000 106	6000	6600	6100	106
C	6800	7000 98	6800	6800	98
D	5700	5600 8	5600 74	5600 54	136
Demand	210	106	78	54	448

Total income generated by the column minima method (Table 8)

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6700 * 104 = ₦698,800

6600 * 4 = ₦26,400

6000 * 106 = ₦ 636,000

7000 * 98 = ₦686,000

5600 * 8 = ₦44,800

5600 * 74 = ₦414,400

5600*54 = ₦302,400

Total income = ₦2,806,800

The row minima method

Total income generated using the row minima method (Table 9).

Table 9: Row Minima Method.

<table>
<tr><th></th><th>A</th><th>B</th><th>C</th><th>D</th><th>Supply</th></tr>
<tr><td rowspan="2">A</td><td rowspan="2">6700</td><td rowspan="2">6700</td><td>6600</td><td>6600</td><td rowspan="2">108</td></tr>
<tr><td>78</td><td>30</td></tr>
<tr><td rowspan="2">B</td><td>6000</td><td rowspan="2">6000</td><td rowspan="2">6600</td><td rowspan="2">6100</td><td rowspan="2">106</td></tr>
<tr><td>106</td></tr>
<tr><td rowspan="2">C</td><td rowspan="2">6800</td><td>7000</td><td rowspan="2">6800</td><td rowspan="2">6800</td><td rowspan="2">98</td></tr>
<tr><td>98</td></tr>
<tr><td rowspan="2">D</td><td>5700</td><td>5600</td><td rowspan="2">5600</td><td>5600</td><td rowspan="2">136</td></tr>
<tr><td>104</td><td>8</td><td>24</td></tr>
<tr><td>Demand</td><td>210</td><td>106</td><td>78</td><td>54</td><td>448</td></tr>
</table>

6600 * 78 = ₦514,800

6600 * 30 = ₦198,000

6000 * 106 = ₦636,000

7000 * 98 = ₦686,000

5700 * 104 = ₦592,800

5600 * 8 = ₦44,800

Total income = ₦2,806,800

The least cost method

Table 10: Least Cost Method.

<table>
<tr><th></th><th>A</th><th>B</th><th>C</th><th>D</th><th>Supply</th></tr>
<tr><td rowspan="2">A</td><td>6700</td><td>6700</td><td rowspan="2">6600</td><td rowspan="2">6600</td><td rowspan="2">108</td></tr>
<tr><td>104</td><td>4</td></tr>
<tr><td rowspan="2">B</td><td>6000</td><td rowspan="2">6000</td><td rowspan="2">6600</td><td rowspan="2">6100</td><td rowspan="2">106</td></tr>
<tr><td>*106</td></tr>
<tr><td rowspan="2">C</td><td rowspan="2">6800</td><td>7000</td><td rowspan="2">6800</td><td rowspan="2">6800</td><td rowspan="2">98</td></tr>
<tr><td>98</td></tr>
<tr><td rowspan="2">D</td><td>5700</td><td>5600</td><td>5600</td><td>5600</td><td rowspan="2">136</td></tr>
<tr><td>104</td><td>4</td><td>78</td><td>54</td></tr>
<tr><td>Demand</td><td>210</td><td>106</td><td>78</td><td>54</td><td>448</td></tr>
</table>

Total income generated using the least cost method (Table 10).

6700 * 104 = ₦696,800

6700 * 4 = ₦26,800

6000 * 106 = ₦636,000

7000 * 98 = ₦686,000

5600 * 4 = ₦22,400

5600 * 78 = ₦436,800

5600 * 54 = ₦302,400

Total income = ₦2,807,200

Construction of blue whale's transport company limited transportation problem

Table 11: Row Minima Method.

<table>
<tr><th rowspan="2">Route</th><th rowspan="2">Vehicle Make</th><th colspan="2">No of Vehicle</th><th rowspan="2">No of Passengers</th><th rowspan="2">Income</th></tr>
<tr><th>TO</th><th>FRO</th></tr>
<tr><td rowspan="2">Abuja – Lagos</td><td>22</td><td>2</td><td>2</td><td>88</td><td>506,000</td></tr>
<tr><td>22</td><td>1</td><td>1</td><td>44</td><td>253,000</td></tr>
<tr><td rowspan="2">Abuja – Delta</td><td>22</td><td>1</td><td>1</td><td>44</td><td>233,200</td></tr>
<tr><td>36</td><td>1</td><td>1</td><td>76</td><td>395,200</td></tr>
<tr><td rowspan="2">Abuja Yenagoa</td><td>42</td><td>1</td><td>1</td><td>84</td><td>638,400</td></tr>
<tr><td>22</td><td>1</td><td>1</td><td>44</td><td>334,400</td></tr>
<tr><td rowspan="2">Abuja – Edo</td><td>22</td><td>3</td><td>3</td><td>132</td><td>871,200</td></tr>
<tr><td>36</td><td>1</td><td>1</td><td>72</td><td>475,200</td></tr>
<tr><td>Total</td><td></td><td>11</td><td>11</td><td>584</td><td>₦3,706,600</td></tr>
</table>

Table 12: Blue Whales Travels Transportation Table.

<table>
<tr><th></th><th>A</th><th>B</th><th>C</th><th>D</th><th>Supply</th></tr>
<tr><td rowspan="2">A</td><td>5750</td><td>5750</td><td>5750</td><td rowspan="2">5750</td><td rowspan="2">132</td></tr>
<tr><td>44</td><td>44</td><td>44</td></tr>
<tr><td rowspan="2">B</td><td>5300</td><td>5200</td><td rowspan="2">5300</td><td rowspan="2">5300</td><td rowspan="2">120</td></tr>
<tr><td>44</td><td>76</td></tr>
<tr><td rowspan="2">C</td><td>7600</td><td>7600</td><td rowspan="2">7600</td><td rowspan="2">7600</td><td rowspan="2">128</td></tr>
<tr><td>84</td><td>44</td></tr>
<tr><td rowspan="2">D</td><td>6600</td><td>6600</td><td>6600</td><td>6600</td><td rowspan="2">204</td></tr>
<tr><td>44</td><td>44</td><td>44</td><td>72</td></tr>
<tr><td>Demand</td><td>216</td><td>208</td><td>88</td><td>72</td><td>584</td></tr>
</table>

(Table 11) above can be transformed into transportation tableau as shown in the next table (Table 12).

Column minima method

Total income generated using the column minima method (Table 13).

5750 * 132 = ₦759,000

5300 * 84 = ₦445,200

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7600 * 128 = ₦972,800

6600 * 80 = ₦528,000

6600 * 88 = ₦580,800

6600 * 36 = ₦237,600

5300 * 36 = ₦190,800

Total income = ₦3,714,200

Table 13: Column Minima Method.

	A	B	C	D	Supply
A	5750	5750	5750	5750	132
	132				
B	5300	5200	5300	5300	120
	84	36			
C	7600	7600	7600	7600	128
		128			
D	6600	6600	6600	6600	204
		44	88	72	
Demand	216	208	88	72	584

Row minima method

Table 14: Row Minima Method.

	A	B	C	D	Supply
A	5750	5750	5750	5750	132
	132				
B	5300	5200	5300	5300	120
	84	36			
C	7600	7600	7600	7600	128
		128	44		
D	6600	6600	6600	6600	204
	132	44	88	72	
Demand	216	208	88	72	584

Total income generated using the row minima method (Table 14).

5750 * 132 = ₦759,000

5300 * 84 = ₦445,200

5200 * 36 = ₦187,200

7600 * 128 = ₦972,800

6600 * 44 = ₦290,400

6600 * 88 = ₦580,800

6600 * 72 = ₦475,200

Total income = ₦3,701,600

The least cost method

Total income generated using the least cost method (Table 15).

5750 * 88 = ₦506,000

5750 * 44 = ₦253,000

5300 * 120 = ₦636,000

7600 * 96 = ₦72,960

7600 * 32 = ₦243,200

6600 * 176 = ₦1,161,600

6600 * 28 = ₦184,800

Total income = ₦3,714,200

Table 15: Least Cost Method.

	A	B	C	D	Supply
A	5750	5750	5750	5750	132
			88	44	
B	5300	5200	5300	5300	120
	*120				
C	7600	7600	7600	7600	128
	96	32			
D	6600	6600	6600	6600	204
		176		28	
Demand	216	208	88	72	584

Construction of young shall grow transportation table

Table 16: Data Collected from Young Shall Grow Transport.

Route	Passenger Per Bus	No of Vehicle		Total Passenger	Income
		TO	FRO		
ABUJA-ENUGU	22	3	3	132	607,200
	50	1	1	100	450,000
ABUJA-ONITSHA	22	2	2	88	369,600
	50	2	2	200	820,000
ABUJA – ABA	22	1	1	44	233,200
	50	1	1	100	530,000
ABUJA-UMUAHIA	22	2	2	88	440,000
	50	1	1	100	500,000
TOTAL		13	13	852	3,950,000

Table 17: Young Shall Grow Transportation Table.

	A	B	C	D	Supply
A	4600	4600	4600	4500	123
	44	44	44	100	
B	4200	4200	5300	4100	288
	44	44	100	100	
C	5300	5300	5300	7600	144
	44	100			
D	5000	5000	5000	6600	188
	44	44	100		
Demand	176	232	244	200	852

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(Table 16) above can be transformed into transportation tableau as shown in the next table (Table 17).

Column minima method

Total income generated using the column minima method (Table 18).

Table 18: Column Minima Method.

	A	B	C	D	Supply
A	4600	4600	4600	4500	232
	176	56			
B	4200	4200	4100	4100	288
		176	112		
C	5300	5300	5300	5300	144
D	5000	5000	5000	5000	188
			132	56	
Demand	176	232	244	200	852

4600 * 176 = ₦809,600

4600 * 56 = ₦257,600

4200 * 176= ₦739,200

4100 * 112 = ₦459,200

5300 * 144 = ₦763,200

5000 * 132 = ₦660,000

5000 * 56 = ₦280,000

Total income = ₦3,968,800

The row minima method

Table 19: Row Minima Method.

	A	B	C	D	Supply
A	4600	4600	4600	4500	232
	176	56			
B	4200	4200	4100	4100	288
		176	112		
C	5300	5300	5300	5300	144
			132	12	
D	5000	5000	5000	5000	188
				188	
Demand	176	232	244	200	852

Total income generated using row minima method (Table 19).

4600 * 176 = ₦809,600

4600 * 56 = ₦257,600

4200 * 176= ₦739,200

4100 * 112 = ₦459,200

5300 * 132 = ₦699,600

5300 * 12 = ₦63,600

5000 * 188 = ₦940,000

Total income = ₦3,968,800

The least cost method

Table 20: Least Cost Method.

	A	B	C	D	Supply
A	4600	4600	4600	4500	232
		120	112		
B	4200	4200	4100	4100	288
	*176	112			
C	5300	5300	5300	5300	144
			132	12	
D	5000	5000	5000	5000	188
				188	
Demand	176	232	244	200	852

Total income generated using least cost method (Table 20).

4600 * 120= ₦552,000

4600 * 112 = ₦515,200

4200 * 176= ₦739,200

4200 * 112 = ₦470,400

5300 * 132 = ₦699,600

5300 * 12 = ₦63,600

5000 * 188 = ₦940,000

Total income = ₦3,980,000

Result

Using the excel solver application, the optimal solution for the four companies were obtained as follows: Pleasure Travels Limited = ₦ 3,401,600, Peace Mass Transit = ₦2,823,600, Blue Whales Transport Company Limited = ₦ 3,714,200, Young Shall Grow Motors Limited = ₦ 3,980,000. The table below shows the companies name, initial income generated by the companies, the initial basic feasible solution using the three (3) different methods of solving transportation problems, the optimal solution obtained using the excel solver, the difference between the optimal solution and the initial basic feasible solution methods and the percentage (%) difference (Table 21).

Difference = Optimal Solution – Initial Basic Feasible Solution

$$\% \, difference = \frac{optimal\ solution - initial\ basic\ feasible\ solution}{optimal\ solution} \times 100$$

From the table above it is clear that the column minima method generated the same income as that of the optimal solution for two companies (Pleasure Travels and Blue whales Travels),

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and generated income less than that of the optimal solution for two companies (Peace Mass Transit and Young Shall Grow Motors Limited). However, the column minima method generates a higher income than the initial income for all the companies. The row minima method generated an income the same as the optimal solution for none of the companies. However, the row minima method also generates a higher income than the initial income for all the companies.

Table 21: Analysis of Results.

Company Name	Initial Solution	Methods			Optimal Solution	Difference			% Difference		
COMPANY	INITIAL	CMM	RMM	LCM	OPTIMAL	OPT-CMM	OPT-RMM	OPT-LCM	CMM	RMM	LCM
PT	3,391,200	3,401,600	3,393,400	3,401,600	3,401,600	0	8,200	0	0	0.24%	0
PMT	2,798,800	2,806,800	2,806,800	2,807,200	2,823,600	16,800	16,800	16,400	0.59%	0.59%	0.58%
BTL	3,706,600	3,714,200	3,710,600	3,714,200	3,714,200	0	3,600	0	0	0.09%	0
YSGML	3,950,000	3,968,800	3,968,800	3,980,000	3,980,000	11,200	11,200	0	0.28%	0.28%	0

The least cost method yields the best initial basic feasible solution for all the companies as its income generated were found to be the same as that of optimal solution for three companies (Pleasure Travels, Blue whales Transport Company and Young Shall Grow Motors Limited) and generates an income less than that of the optimal solution for one company (Peace Mass Transit). This could be achieved because it takes into consideration the least cost associated with each route alternatives. Although it takes a longer time to compute, this is something the Column Minima Method and Row Minima Method could not have achieved.

The above data is shown graphically in (Figures 1-3).

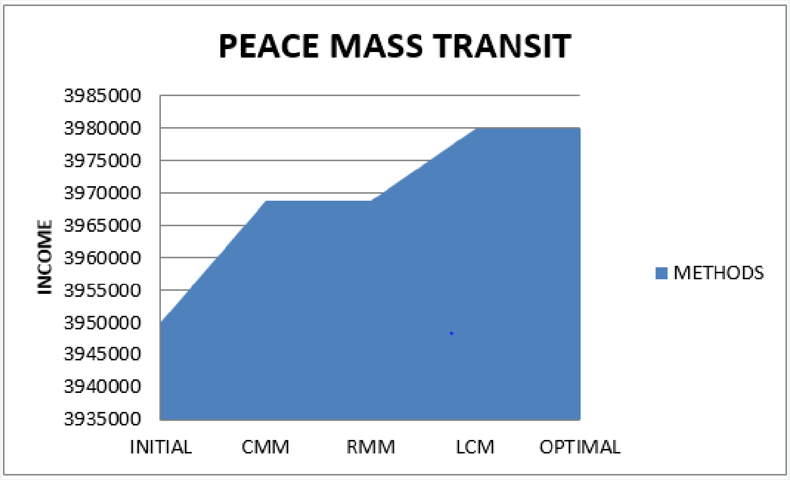

Figure 1: Peace mass transit.

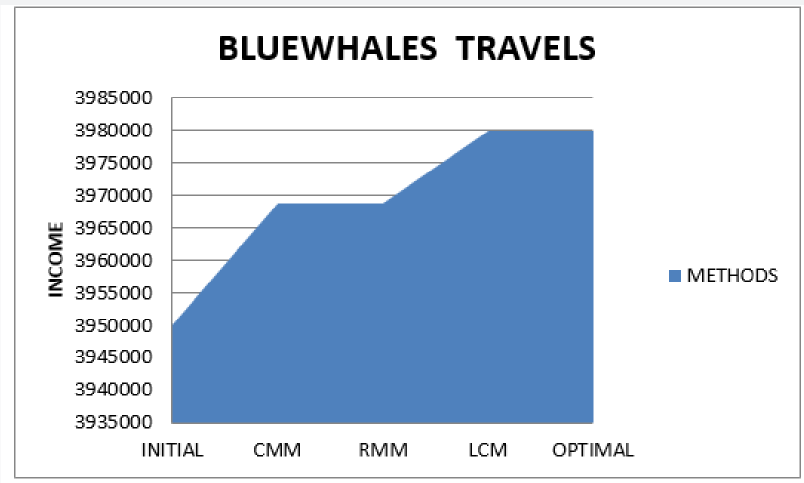

Figure 2: Blue whales travels.

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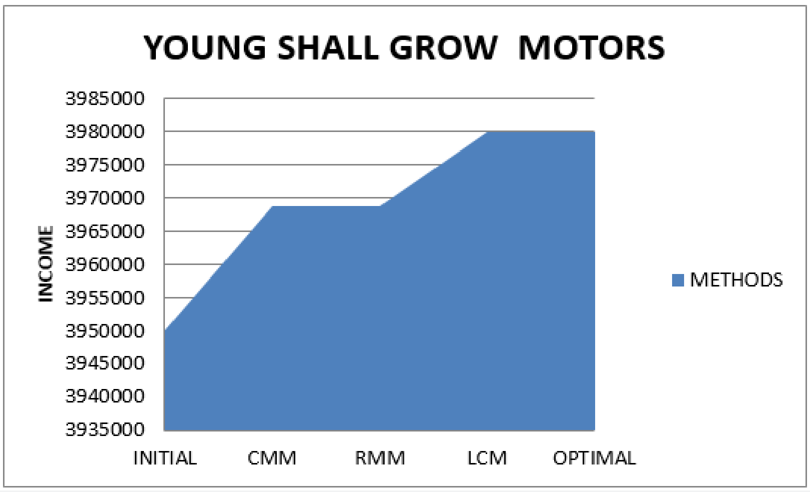

Figure 3: Young shall grow motors.

Conclusion

An advantage of the transportation problem algorithm is that, the solution process involves only main variables, artificial variables are not required as in the case of simplex method. Large transportation problem could relatively be solved using the transportation algorithm. It was shown that solving balanced transportation problem was easier using the column minima method and row minima method using the transportation problem formulated for Pleasure Travels, Bluewhales Transport Co. Ltd, Peace Mass Transit and Young Shall Grow Motors Ltd. The least cost method was found to be a bit difficult to calculate, yet it always yields a better result near optimal if not optimal. It can therefore be concluded that the least cost method although not quite as easy as the other methods, facilitates a better initial basic feasible solution than the column minima method and the row minima method. The optimal solution obtained using the excel solver application for the four (4) companies were found to be ₦3,401,600.00, ₦3,714,000.00, ₦2,823,600.00 and ₦3,980,000.00 respectively. It should be noted that although the Least cost method facilitates an optimal or near optimal result, it is not too reliable since it did not yield an optimal result for all the companies.

Recommendation

The use of a scientific approach gives a systematic and transparent solution as compared with a haphazard method. Using the more scientific assignment problem model for a given transportation problem gives a better result and management may benefit from the proposed approach to guarantee optimal profits from them. We therefore recommend that the assignment problem model should be adopted by managements of transportation companies for maximum profits. In general, the passenger population (demand) is always greater than the vehicle availability (supply). But this can only be verified (for an unbalanced transportation problem), if the actual data management and records are always available for researches to be carried out on them. Further research needs to be carried out in the area of bus services and maintenance looking at the number of times the buses could breakdown.

References

1. Hitchcock FL (1941) The Distribution of a Product from Several Sources to Numerous Localities. Journal of Mathematics and Physics 20: 224-230.
2. Dantzig GB (1951) Application of the Simplex Method to a Transportation Problem, Activity Analysis of Production and Allocation. In: Koopmans TC (Ed.), John Wiley and Sons, New York, pp. 359-373.
3. Charnes A, Cooper WW, Henderson A (1953) An Introduction to Linear Programming. John Wiley & Sons, New York.
4. Taghrid I, Gaber E, Mohamed G, Iman S (2009) Solving transportation problems using object-oriented model. International Journal of Computer Science and Network Security 9(2): 353-361.
5. Abdul Q, Shakeel J, Khalid MM (2012) A new Method for Finding an Optimal Solution for transportation problems. International Journal of Computer Science and Engineering 4(7): 1271-1274.
6. Abdul SS, Gurudeo AT, Ghulam MB (2014) A Comparative Study of Initial Feasible Solution methods for transportation problems. Mathematical Theory and Modelling 4(1): 134-136.
7. Veena A, Krysztof K (2009) Alternate Solutions Analysis for Transportation Problem. Journal of Business and Economic Research 7(6): 6-9.
8. Anthony C, Zhong Z, Piya C, Seungkyu R, Chao Y, Wong SC (2011) Transport Network Design Problem under Uncertainty: A review and new developments. Transport Reviews: A Transnational Transdisciplinary Journal 31(6): 743-768.
9. Odior AO, Charles Owaba OE, Oyawale FA (2010) Determining Feasible Solutions of a multi-criteria assignment problem. Journal of Applied Science and Environmental Management 14(1): 35-38.
10. Ashayeri J, Gelders LF (1985) Warehouse design Optimization. Journal of Operation Research 21(1985): 285-294.
11. Mollah MAA, Aminur RK, Md Sharif U, Faruque A (2016) A new Approach to Solve Transportation Problems. Open Journal of Optimization 5(2016): 22-30.

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