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Optimizing Movement of Students from Hostels to Lecture Rooms in a Potential World Class University Using Transportation Model

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Abstract

Transportation issue is one of the significant zones of utilization of Linear Programming Model. In this paper, transportation model is utilized to decide an ideal answer for the transportation issue in a run of the mill world class university utilizing Covenant University as a contextual analysis. Covenant University is a potential world class University. The quick development of Covenant University Campus over the most recent fourteen years affects its transportation framework. This paper particularly takes a gander at streamlining the time spent by the students moving from their lodgings to lecture rooms. Google guide was utilized to figure the separation and time between every cause and every goal. North-west corner technique, Least Cost strategy and Vogel's estimation technique were utilized to decide the underlying fundamental plausible arrangement (initial feasible solution) and MODI strategy was utilized to locate the ideal arrangement (optimal solution). The last outcome demonstrates that the development of understudies from hostel to lecture rooms can be streamlined if the total time spent is decreased.

1. Introduction

Transportation issue is an extraordinary class of linear programming issue and it is viewed as imperatively as a vital angle that has been considered in an extensive variety of operations including research areas. All things considered, it has been

utilized as a part of recreation of a few genuine issues. In this way, streamlining transportation issue of factors has amazingly been critical to different controls [1]. Transportation issues are being confronted in urban regions because of increment in human exercises and most world class universities resemble little urban areas in light of their size and structures [2]. Additionally, today's grounds have moved toward becoming as mind boggling as urban zones, in view of their interesting attributes and between related impacts, most principle university's campuses are arranged as little urban communities/groups [2] [3]. Covenant University is a potential world class university and accordingly is considered as a little city. The university has been chosen as one of the best universities in West Africa. The university is located in Ota, Ogun State, Nigeria. As a potential world class university with its refined frameworks, all around prepared labs, all around prepared and qualified teachers, skilled students and an examination driven establishment the university flourishes for more brilliance [4] [5]. Aside the exceptionally normal or understood criteria of turning into a world class university like the one specified over, the transportation organized inside the campus is likewise vital to make campus life favorable and transportation less demanding for their students. In this paper time limiting transportation issue will be considered as against the standard cost limiting transportation issue [5] [6]. The essential contrast between the two is that the cost of transportation changes with varieties in the amount yet the time included stays unaltered and independent of the amounts [6]. Time limiting transportation model will be utilized to decide how the aggregate time spent by students making progress toward move from their hostels to their distinctive lecture rooms can be limited or enhanced to lessen exposure to un-conducive climate conditions and different variables [7] [8] [9]. The outcome that will be gotten from this work can be utilized by the University to deal with the transportation organized inside the campus. Arranging real university campus has been a genuine test as of late [10] [11]. Feasible transportation approaches have turned into a fundamental device to manage road transportation issues in most world class universities [11]. The call for manageable versatility is picking up fame worldwide for little and extensive groups including real university campus [11] [12]. Transportation issue is an extraordinary sort of linear programming issue where the goal is to limit the cost of dispersing an item from various sources or birthplaces to various destinations [13] [14] [15]. Transportation Problem (TP) has broad pragmatic application esteems [16] [17] [18]. In this manner, TP is a subject deserving of further research, in spite of the fact that it has been considered from various points of view by various researchers [19] [20] [21] [22]. The first formulation and discussion of a planar transportation model was introduced by Hitchcock (1941). Likewise, various scientists have done reviews on time transportation issue, for example, Sharma and Swarup (1977). As a general rule, because of changes in free market activity, climate conditions, street conditions and other instability variables, vulnerability transportation issue is especially essential [23] [24] [25].

2. Problem Formulation

Covenant University is used in this paper as a case study. The aim is to reduce the transportation time of students' movement from hostels to their respective lecture rooms. The Hostels represent the origins while the lecture rooms represent the destinations.

2.1. Assumptions

The following assumptions were made in this paper:

1) The time spent to move from one origin to a destination is always the same.

2) All the routes mentioned in this paper are always accessible.

3) Movement of students is always from the named origins to the named destinations.

4) Each student at the origin (hostel) visits each destination (lecture rooms).

5) Students attend lectures in each lecture room at least once a week (that is, from origin (hostel) to destination (lecture rooms)).

2.2. Transportation Tableau

In this paper ten origins representing the hostels and eight destinations representing the lecture rooms were considered.

Table 1 shows the different origins and destinations while Table 2 shows the transportation problem tableau. The distance between the origins and destinations are shown in the cells. The total time and distance covered in each route was determined using goggle map. The mathematical modeling of this transportation problem is a special linear programming problem in which the objective function is to minimize the time of transportation subject to the demand and supply constraints. The values in each cell represents the time per unit distance between one origin and one destination. They are measured in (meter $\times 100$). Along the outer rim in the tableau is the actual distance and expected distance

Table 1. Origins and destinations considered.

Origin		Destination	
Esther Hall	O_1	College of Science and Technology	D_1
Mary Hall	O_2	College of Developmental Studies	D_2
Deborah Hall	O_3	Lecture Theatre One	D_3
Lydia Hall	O_4	Lecture theatre two	D_4
Dorcas Hall	O_5	Chemical and Petroleum Engineering Block	D_5
Peter Hall	O_6	Mechanical Engineering Block	D_6
Paul Hall	O_7	Civil Engineering Block	D_7
John Hall	O_8	Electrical and Electronics Engineering Block	D_8
Joseph Hall	O_9		
Daniel Hall	O_{10}		

Table 2. Transportation tableau.

	D_1	D_2	D_3	D_4	D_5	D_6	D_7	D_8	Actual Distance (m × 100)
O_1	10	8	11	11	11	16	17	20	9
O_2	14	11	15	14	15	19	20	23	11
O_3	12	10	13	13	13	18	19	22	10
O_4	13	11	14	14	14	19	20	23	11
O_5	13	11	14	14	14	19	20	23	10
O_6	12	11	14	14	14	22	24	23	11
O_7	15	14	16	16	17	21	23	25	12
O_8	16	14	17	17	17	22	23	26	13
O_9	15	13	16	16	16	21	22	25	11
O_{10}	14	13	16	16	16	20	22	24	12
Expected Distance (m × 100)	11	10	12	12	13	16	17	19	

constraint quantity values which are referred to as rim requirements. In a time transportation problem, the time of transportation from m origins to n destinations is minimized, satisfying certain condition in respect of availability at sources and requirements at the destinations. From **Table 2**, we have a balanced transportation problem in which the total demand (expected distance) equals the total supply (actual distance). The distance is measured in meter ×100 while the time or duration is measured in minutes.

3. Problem Solution

Solving transportation problems involves a lot of methods, some of them heuristic in nature [26]-[31]. In this paper, the transportation problem is solved based on the data collected, which is relatively reliable. The first stage of the solution process was to find the initial basic feasible solution [32]. The following three methods of obtaining the initial solution were used. These methods are North-west corner method, least cost method and Vogel's approximation method. Based on the Least cost method that gave the minimum time spent an optimality test was carried out, after checking for degeneracy, to determine an optimal solution using the MODI (Modified Distribution) method.

3.1. North-West Corner Method

Using the North West corner method to obtain an initial basic solution the values derived are shown below (**Table 3**).

3.2. Least Cost Method

Using the least cost method we obtain the following values as shown below (**Table 4**).

Table 3. North-west corner method matrix.

Total time spent

$$= 9 \times 10 + 2 \times 14 + 9 \times 11 + 1 \times 10 + 9 \times 13 + 3 \times 14 + 8 \times 14 + 4 \times 14 + 6 \times 14$$
$$+ 7 \times 14 + 4 \times 22 + 12 \times 21 + 13 \times 23 + 4 \times 22 + 7 \times 25 + 12 \times 24$$
$$= 1926$$

	D_1	D_2	D_3	D_4	D_5	D_6	D_7	D_8	Actual Distance (Km)
O_1	$\mathbf{9}^{10}$	8	11	11	11	16	17	20	9
O_2	$\mathbf{2}^{14}$	$\mathbf{9}^{11}$	15	14	15	19	20	23	11
O_3	12	$\mathbf{1}^{10}$	$\mathbf{9}^{13}$	13	13	18	19	22	10
O_4	13	11	$\mathbf{3}^{14}$	$\mathbf{8}^{14}$	14	19	20	23	11
O_5	13	11	14	$\mathbf{4}^{14}$	$\mathbf{6}^{14}$	19	20	23	10
O_6	12	11	14	14	$\mathbf{7}^{14}$	$\mathbf{4}^{22}$	24	23	11
O_7	15	14	16	16	17	$\mathbf{12}^{21}$	23	25	12
O_8	16	14	17	17	17	22	$\mathbf{13}^{23}$	26	13
O_9	15	13	16	16	16	21	$\mathbf{4}^{22}$	$\mathbf{7}^{25}$	11
O_{10}	14	13	16	16	16	20	22	$\mathbf{12}^{24}$	12
Expected Distance (Km)	11	10	12	12	13	16	17	19	

Table 4. Least cost method matrix.

Total time spent

$$= 9 \times 8 + 11 \times 14 + 9 \times 12 + 1 \times 10 + 11 \times 14 + 1 \times 14 + 1 \times 14 + 8 \times 14 + 2 \times 12$$
$$+ 5 \times 14 + 4 \times 23 + 4 \times 21 + 6 \times 23 + 2 \times 25 + 13 \times 26 + 11 \times 22 + 12 \times 20$$
$$= 1916$$

	D_1	D_2	D_3	D_4	D_5	D_6	D_7	D_8	Actual Distance (Km)
O_1	10	$\mathbf{9}^{8}$	11	11	11	16	17	20	9
O_2	14	11	15	$\mathbf{11}^{14}$	15	19	20	23	11
O_3	$\mathbf{9}^{12}$	$\mathbf{1}^{10}$	13	13	13	18	19	22	10
O_4	13	11	$\mathbf{11}^{14}$	14	14	19	20	23	11
O_5	13	11	$\mathbf{1}^{14}$	$\mathbf{1}^{14}$	$\mathbf{8}^{14}$	19	20	23	10
O_6	$\mathbf{2}^{12}$	11	14	14	$\mathbf{5}^{14}$	22	24	$\mathbf{4}^{23}$	11
O_7	15	14	16	16	17	$\mathbf{4}^{21}$	$\mathbf{6}^{23}$	$\mathbf{2}^{25}$	12
O_8	16	14	17	17	17	22	23	$\mathbf{13}^{26}$	13
O_9	15	13	16	16	16	21	$\mathbf{11}^{22}$	25	11
O_{10}	14	13	16	16	16	$\mathbf{12}^{20}$	22	24	12
Expected Distance (Km)	11	10	12	12	13	16	17	19	

3.3. Test for Degeneracy

The only optimality test condition is transportation degeneracy. Out of the three methods used to find the initial basic feasible solution to the transportation problem under consideration, the least cost method gave the minimum value of 1916. Therefore the least cost matrix is used to check for degeneracy:

$$m+n-1=10+8-1=17$$

The basic cells are also 17. This implies there is no problem of degeneracy thus optimality test is carried out (Table 5).

3.4. Test for Optimality

From the results obtained using the three methods of finding the initial basic feasible solution, least cost method gave the least amount of total time spent. Thus, its solution will be used to test for optimality in order to obtain the optimal solution (Table 6).

3.5. Modified Distribution Method (Modi Method)

This method involves two formulas in arriving at an optimal solution.

$U_i + V_j = C_{ij}$, which is used in determining the values of U_i and V_j using the values in the occupied cells.

$U_i - V_j - C_{ij} = K_{ij}$, which is used in determining the best empty route that can

Table 5. Vogel method.

Total time spent
$$= 2\times11+7\times11+11\times4+10\times11+10\times12+3\times19+8\times23+6\times14+4\times20$$
$$+11\times14+1\times16+11\times25+13\times22+10\times16+12\times22$$
$$=1926$$

	D_1	D_2	D_3	D_4	D_5	D_6	D_7	D_8	Actual Distance (Km)
O_1	10	8	11	$\mathbf{2}^{11}$	$\mathbf{7}^{11}$	16	17	20	9
O_2	$\mathbf{11}^4$	$\mathbf{10}^{11}$	15	14	15	19	20	23	11
O_3	$\mathbf{10}^{12}$	10	13	13	13	18	19	22	10
O_4	13	11	14	14	14	$\mathbf{3}^{19}$	20	$\mathbf{8}^{23}$	11
O_5	13	11	14	14	$\mathbf{6}^{14}$	19	$\mathbf{4}^{20}$	23	10
O_6	12	11	$\mathbf{11}^{14}$	14	14	22	24	23	11
O_7	15	14	16	16	17	21	$\mathbf{1}^{23}$	$\mathbf{11}^{25}$	12
O_8	16	14	17	17	17	$\mathbf{13}^{22}$	23	26	13
O_9	15	13	$\mathbf{1}^{16}$	$\mathbf{10}^{16}$	16	21	22	25	11
O_{10}	14	13	16	16	16	20	$\mathbf{12}^{22}$	24	12
Expected Distance (Km)	11	10	12	12	13	16	17	19	

Table 6. Modified least cost method matrix.

		D$_1$ V$_1$=	D$_2$ V$_2$=	D$_3$ V$_3$=	D$_4$ V$_4$=	D$_5$ V$_5$=	D$_6$ V$_6$=	D$_7$ V$_7$=	D$_8$ V$_8$=	Actual Distance (Km)
U$_1$=	O$_1$	10	**9**^{8}	11	11	11	16	17	20	9
U$_2$=	O$_2$	14	11	15	**11**^{14}	15	19	20	23	11
U$_3$=	O$_3$	**9**^{12}	**1**^{10}	13	13	13	18	19	22	10
U$_4$=	O$_4$	13	11	**11**^{14}	14	14	19	20	23	11
U$_5$=	O$_5$	13	11	**1**^{14}	**1**^{14}	**8**^{14}	19	20	23	10
U$_6$=	O$_6$	**2**^{12}	11	14	14	**5**^{14}	22	24	**4**^{23}	11
U$_7$=	O$_7$	15	14	16	16	17	**4**^{21}	**6**^{23}	**2**^{25}	12
U$_8$=	O$_8$	16	14	17	17	17	22	23	**13**^{26}	13
U$_9$=	O$_9$	15	13	16	16	16	21	**11**^{22}	25	11
U$_{10}$=	O$_{10}$	14	13	16	16	16	**12**^{20}	22	24	12
	Expected Distance (Km)	11	10	12	12	13	16	17	19	

be followed to reduce the total time spent and it is only the route with the most negative K_{ij} that will be considered.

U_i and V_j are the row and column values which will be determined while C_{ij} and K_{ij} are the unit time and time increase or decrease respectively.

Calculating for occupied cells gives:

$$U_i + V_j = C_{ij}$$

$$O_1D_2 : U_1 + V_2 = 8 \tag{1}$$

$$O_2D_4 : U_2 + V_4 = 14 \tag{2}$$

$$O_3D_1 : U_3 + V_1 = 12 \tag{3}$$

$$O_3D_2 : U_3 + V_2 = 10 \tag{4}$$

$$O_4D_3 : U_4 + V_3 = 14 \tag{5}$$

$$O_5D_3 : U_5 + V_3 = 14 \tag{6}$$

$$O_5D_4 : U_5 + V_4 = 14 \tag{7}$$

$$O_5D_5 : U_5 + V_5 = 14 \tag{8}$$

$$O_6D_1 : U_6 + V_1 = 12 \tag{9}$$

$$O_6D_5 : U_6 + V_5 = 14 \tag{10}$$

$$O_6D_8 : U_6 + V_8 = 23 \tag{11}$$

$$O_7D_6 : U_7 + V_6 = 21 \tag{12}$$

$$O_7D_7 : U_7 + V_7 = 23 \tag{13}$$

$$O_7D_8 : U_7 + V_8 = 25 \tag{14}$$

$$O_8D_8 : U_8 + V_8 = 26 \tag{15}$$

$$O_9 D_7 : U_9 + V_7 = 22 \qquad (16)$$

$$O_{10} D_6 : U_{10} + V_6 = 20 \qquad (17)$$

From the equations above there are eighteen (18) unknowns but seventeen (17) equations. To solve this, 0 is assigned to one of the unknowns.

Let $U_1 = 0$

From Equation (1),

$$O_1 D_2 : U_1 + V_2 = 8 \qquad (18)$$

$$0 + V_2 = 8$$

Therefore, $V_2 = 8$

Substituting Equation (18) into Equation (4) gives

$$U_3 = 2 \qquad (19)$$

Substituting Equation (19) into Equation (3) gives

$$V_1 = 10 \qquad (20)$$

Substituting Equation (19) into Equation (9) gives

$$U_6 = 2 \qquad (21)$$

Substituting Equation (21) into Equation (10) gives

$$V_5 = 12 \qquad (22)$$

Substituting Equation (21) into Equation (11) gives

$$V_8 = 21 \qquad (23)$$

Substituting Equation (23) into Equation (14) gives

$$U_7 = 4 \qquad (24)$$

Substituting Equation (23) into Equation (15) gives

$$U_8 = 5 \qquad (25)$$

Substituting Equation (22) into Equation (8) gives

$$U_5 = 2 \qquad (26)$$

Substituting Equation (26) into Equation (7) gives

$$V_4 = 12 \qquad (27)$$

Substituting Equation (21) into Equation (2) gives

$$U_2 = 2 \qquad (28)$$

Substituting Equation (26) into Equation (6) gives

$$V_3 = 12 \qquad (29)$$

Substituting Equation (30) into Equation (5) gives

$$U_4 = 2 \qquad (30)$$

Substituting Equation (24) into Equation (12) gives

$$V_6 = 17 \qquad (31)$$

Substituting Equation (24) into Equation (13) gives

$$V_7 = 19 \tag{32}$$

Substituting Equation (33) into Equation (16) gives

$$U_9 = 3 \tag{33}$$

Substituting Equation (32) into Equation (17) gives

$$U_{10} = 3 \tag{34}$$

Calculating for the unoccupied cells gives:

$$C_{ij} - U_i - V_j = K_{ij}$$

$$O_1D_1 : 10 - U_1 - V_1 = 10 - 0 - 10 = 0$$

$$O_1D_3 : 11 - U_1 - V_3 = 11 - 0 - 12 = -1$$

$$O_1D_4 : 11 - U_1 - V_4 = 11 - 0 - 12 = -1$$

$$O_1D_5 : 11 - U_1 - V_5 = 11 - 0 - 12 = -1$$

$$O_1D_6 : 16 - U_1 - V_6 = 16 - 0 - 17 = -1$$

$$O_1D_7 : 17 - U_1 - V_7 = 17 - 0 - 19 = -2$$

$$O_1D_8 : 20 - U_1 - V_8 = 20 - 0 - 21 = -1$$

$$O_2D_1 : 14 - U_2 - V_1 = 14 - 2 - 10 = 4$$

$$O_2D_2 : 11 - U_2 - V_2 = 11 - 2 - 8 = 1$$

$$O_2D_3 : 15 - U_2 - V_3 = 15 - 2 - 12 = -1$$

$$O_2D_5 : 15 - U_2 - V_5 = 15 - 2 - 12 = -1$$

$$O_2D_6 : 19 - U_2 - V_6 = 19 - 2 - 17 = 0$$

$$O_2D_7 : 20 - U_2 - V_7 = 20 - 2 - 19 = -1$$

$$O_2D_8 : 23 - U_2 - V_8 = 23 - 2 - 21 = 0$$

$$O_3D_3 : 13 - U_3 - V_3 = 13 - 2 - 12 = -1$$

$$O_3D_4 : 13 - U_3 - V_4 = 13 - 2 - 12 = -1$$

$$O_3D_5 : 13 - U_3 - V_5 = 13 - 2 - 12 = -1$$

$$O_3D_6 : 18 - U_3 - V_6 = 18 - 2 - 17 = -1$$

$$O_3D_7 : 19 - U_3 - V_7 = 19 - 2 - 19 = -2$$

$$O_3D_8 : 22 - U_3 - V_8 = 22 - 2 - 21 = -1$$

$$O_4D_1 : 13 - U_4 - V_1 = 13 - 12 - 10 = -9$$

$$O_4D_2 : 11 - U_4 - V_2 = 11 - 12 - 8 = -9$$

$$O_4D_4 : 14 - U_4 - V_4 = 14 - 12 - 12 = -10$$

$$O_4D_5 : 14 - U_4 - V_5 = 14 - 12 - 12 = -10$$

$$O_4D_6 : 19 - U_4 - V_6 = 19 - 12 - 17 = -10$$

$$O_4D_7 : 20 - U_4 - V_7 = 20 - 12 - 19 = -11$$

$$O_4D_8 : 23 - U_4 - V_8 = 23 - 21 - 10 = -10$$

$$O_5D_1 : 13 - U_5 - V_1 = 13 - 2 - 10 = 1$$

$$O_5 D_2 : 11 - U_5 - V_2 = 11 - 2 - 8 = 1$$

$$O_5 D_6 : 19 - U_5 - V_6 = 19 - 2 - 17 = 0$$

$$O_5 D_7 : 20 - U_5 - V_7 = 20 - 2 - 19 = -1$$

$$O_5 D_8 : 23 - U_5 - V_8 = 23 - 2 - 21 = 0$$

$$O_6 D_2 : 11 - U_6 - V_2 = 11 - 2 - 8 = 1$$

$$O_6 D_3 : 14 - U_6 - V_3 = 14 - 2 - 12 = 0$$

$$O_6 D_4 : 14 - U_6 - V_4 = 14 - 2 - 12 = 0$$

$$O_6 D_6 : 22 - U_6 - V_6 = 22 - 2 - 17 = 3$$

$$O_6 D_7 : 24 - U_6 - V_7 = 24 - 2 - 19 = 3$$

$$O_7 D_1 : 15 - U_7 - V_1 = 15 - 4 - 10 = 1$$

$$O_7 D_2 : 14 - U_7 - V_2 = 14 - 4 - 8 = 2$$

$$O_7 D_3 : 16 - U_7 - V_3 = 16 - 4 - 12 = 0$$

$$O_7 D_4 : 16 - U_7 - V_4 = 16 - 4 - 12 = 0$$

$$O_7 D_5 : 17 - U_7 - V_5 = 17 - 4 - 12 = 1$$

$$O_8 D_1 : 16 - U_8 - V_1 = 16 - 5 - 10 = 1$$

$$O_8 D_2 : 14 - U_8 - V_2 = 14 - 5 - 8 = 1$$

$$O_8 D_3 : 17 - U_8 - V_3 = 17 - 5 - 12 = 0$$

$$O_8 D_4 : 17 - U_8 - V_4 = 17 - 5 - 12 = 0$$

$$O_8 D_5 : 17 - U_8 - V_5 = 17 - 5 - 12 = 0$$

$$O_8 D_6 : 22 - U_8 - V_6 = 22 - 5 - 17 = 0$$

$$O_8 D_7 : 23 - U_8 - V_7 = 23 - 5 - 19 = -1$$

$$O_9 D_1 : 15 - U_9 - V_1 = 15 - 3 - 10 = 2$$

$$O_9 D_2 : 13 - U_9 - V_2 = 13 - 3 - 8 = 2$$

$$O_9 D_3 : 16 - U_9 - V_3 = 16 - 3 - 12 = 1$$

$$O_9 D_4 : 16 - U_9 - V_4 = 16 - 3 - 12 = 1$$

$$O_9 D_5 : 16 - U_9 - V_5 = 16 - 3 - 12 = 1$$

$$O_9 D_6 : 21 - U_9 - V_6 = 21 - 3 - 17 = 1$$

$$O_9 D_8 : 25 - U_9 - V_8 = 25 - 3 - 21 = 2$$

$$O_{10} D_1 : 14 - U_{10} - V_1 = 14 - 3 - 10 = 1$$

$$O_{10} D_2 : 13 - U_{10} - V_2 = 13 - 3 - 8 = 2$$

$$O_{10} D_3 : 16 - U_{10} - V_3 = 16 - 3 - 12 = 1$$

$$O_{10} D_4 : 16 - U_{10} - V_4 = 16 - 3 - 12 = 1$$

$$O_{10} D_5 : 16 - U_{10} - V_5 = 16 - 3 - 12 = 1$$

$$O_{10} D_7 : 16 - U_{10} - V_7 = 16 - 3 - 19 = -6$$

$$O_{10} D_8 : 24 - U_{10} - V_8 = 24 - 3 - 21 = 0$$

Table 7. MODI method iteration showing the new allocation.

Total time

$$= 9 \times 8 + 11 \times 14 + 9 \times 12 + 1 \times 10 + 5 \times 14 + 6 \times 20 + 1 \times 14 + 1 \times 14 + 8 \times 14 + 2 \times 12$$
$$+ 5 \times 14 + 4 \times 23 + 6 \times 16 + 4 \times 21 + 2 \times 25 + 13 \times 26 + 11 \times 22 + 12 \times 20$$
$$= 1896$$

		D_1 $V_1=$	D_2 $V_2=$	D_3 $V_3=$	D_4 $V_4=$	D_5 $V_5=$	D_6 $V_6=$	D_7 $V_7=$	D_8 $V_8=$	Actual Distance (Km)
$U_1=$	O_1	10	9^8	11	11	11	16	17	20	9
$U_2=$	O_2	14	11	15	11^{14}	15	19	20	23	11
$U_3=$	O_3	9^{12}	1^{10}	13	13	13	18	19	22	10
$U_4=$	O_4	13	11	$5(-)^{14}$	14	14	19	$6(+)^{20}$	23	11
$U_5=$	O_5	13	11	1^{14}	1^{14}	8^{14}	19	20	23	10
$U_6=$	O_6	2^{12}	11	14	14	5^{14}	22	24	4^{23}	11
$U_7=$	O_7	15	14	$6(+)^{16}$	16	17	4^{21}	$(-)^{23}$	2^{25}	12
$U_8=$	O_8	16	14	17	17	17	22	23	13^{26}	13
$U_9=$	O_9	15	13	16	16	16	21	11^{22}	25	11
$U_{10}=$	O_{10}	14	13	16	16	16	12^{20}	22	24	12
	Expected Distance (Km)	11	10	12	12	13	16	17	19	

From the calculations above, O_4D_7 is the only cell with the most negative K_{ij} with −11. With this result it means that the total time will be reduced by −11 if we allocate to that cell. The Table 7 illustrates this.

4. Result Discussion

From the analysis carried out with the data collected, it can be seen that least cost method gave the best initial basic feasible solution. Optimality test carried out, using MODI method, gave an optimal value of 1896. This was an improvement on the result, 1916, given by the least cost method. Also, it can be seen that by allocating maximally to route O_4D_7, the total time will be reduced by −11. From Table 7 above, it can be seen that the total time can be minimized if 900 m is covered using route O_1D_2, 11 km covered using O_2D_4, 9 km covered using O_3D_1, 1 km covered using O_3D_2, 5 km covered using O_4D_3, 6 km covered using O_4D7, 1 km covered using O_5D_3, 1 km covered using O_5D_4, 8 km covered using O_5D_5, 2 km covered using O_6D_1, 5 km covered using O_6D_5, 4 km covered using O_6D_8, 6 km covered using O_7D_3, 400 m covered using O_7D_6, 13 km covered using O_8D_8, 11 km covered using O_9D_7, 1200 m covered using $O_{10}D_6$. Also, from the table it can be seen that some requires less time to cover than the others. For instance, route O_1D_2 requires just 8 minutes to cover 900 m while some other routes, like route O_5D_3 and route O_5D_4, require a lot of time. This could be as a result of different factors relating to the transportation system generally which

the university authority should look into. Also, this analysis and the result would help the university to plan in order to optimize its transportation system within the campus, especially as regards the movement of students to and fro their lecture rooms.

5. Conclusion

In this paper time minimizing transportation model was used to determine how the movement of students by road from their hostels to their different lecture rooms can be optimized. Three methods were used to arrive at an initial basic feasible solution and Least Cost method was found to give the least total time as compared to the other two methods. MODI method was used to obtain an optimal solution. From the result derived, it shows that the total time spent on the movement of students to their lecture rooms, from their different hostels, can be minimized thereby improving campus life and reducing lateness to lectures. Covenant University can use this to plan and manage the transportation system of the university, as it thrives on becoming one of the best universities in the world.

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