UNIVERSITY OF JOHANNESBURG

PROGRAM	:	**B TECH** **CIVIL ENGINEERING TECHNOLOGY**
SUBJECT	:	**TRANSPORTATION PLANNING 4**
CODE	:	**TPP411**
DATE	:	SUMMER EXAMINATION 2015 13 NOVEMBER 2015
DURATION	:	(SESSION 1) 08:30 - 11:30
WEIGHT	:	**60:40**
TOTAL MARKS	:	100

EXAMINER	:	DR HA QUAINOO
MODERATOR	:	MR I. ARIYO
NUMBER OF PAGES	:	PAGES 5

INSTRUCTIONS	:	PLEASE ANSWER ALL THE QUESTIONS.
REQUIREMENTS	:	NONE

UNIVERSITY OF JOHANNESBURG
DEPARTMENT OF CIVIL ENGINEERING TECHNOLOGY
TPP411: TRANSPORTATION PLANNING 4

OCTOBER EXAM 2015
ANSWER ALL QUESTIONS – TIME ALLOWANCE: 3 HOURS

Question 1

(a)

(i) Managing transportation demand is an integral component of Transportation Planning. Briefly explain what you understand by "Elasticity of Demand for Public Transport".

[3 marks]

(ii) A demand analysis for Trip, T, is given by the function of fare, P, as follows:

$$T = 1000 * P^{-2.0}$$

Suppose the fare changed from R100 to R150, what is the approximate arc elasticity of demand? Comment on the significance of your answer.

NB: $e_{arc} = \dfrac{\Delta X / X}{\Delta v / v}$, whereby v = price or income

X = quantity demanded

This may be approximated as $e_{arc} = \dfrac{(X_1 - X_0) / (X_1 + X_0)}{(v_1 - v_0) / (v_1 + v_0)}$

[5 marks]

(b) Briefly discuss the importance of integrating urban land-use planning with transportation planning. **[5 marks]**

(c) The railway between towns A and B spans 800 km through mountainous terrain. The total one-way travel time, t_r, is 20 hrs and currently the fare, c_r, is R6000/ton. As the service is used at low capacity t_r is a constant, independent of the traffic volume V_r.

There is a truck service competing with the railway in an approximately parallel route; its average speed is 60 km/hr and it charges a fare of R9500/ton. A new project is underway to build a highway in order to replace the present road; it is expected that most of its traffic will continue to be heavy trucks. The level-of-service function of the new highway has been estimated as:

$$t_t = 7 + 0.08V_t \text{ (hours)}, \quad \text{where } V_t \text{ is the total flow of trucks per hour.}$$

On the other hand the railway has estimated its demand function as follows:

$$(V_r / V_t) = 0.83\,(t_r / t_t)^{-0.8}\,(c_r / c_t)^{-1.6}$$

and it is expected that the total volume transported between the two towns, $V_r + V_t$, will remain constant and equal to 200 truckloads/hr in the medium term.

(i) Estimate the current modal split (i.e. volumes transported by rail and truck).
(ii) What would be the modal split if the highway is built?

[12 marks]

Question 2

A transportation survey during the last twelve months produced the data in Table 2, relating Trips generated in an urban centre divided into 8 zones to Employment and Car Ownership.

Table 2: Trip Generated, Employment levels and *zonal* Car ownership

Zone	Employment ('00) X_1	Car Ownership ('00) X_2	Trips generated ('00) Y
1	39	8	7
2	52	6	6
3	49	7	8
4	46	12	10
5	61	9	9
6	35	6	5
7	25	7	3
8	55	4	4

(a) Develop a multiple regression (Trip Generation) model for the above data.

(b) If the level of employment and car ownership were to be constant at 4,800 and 900 respectively, what would be the expected number of trips generated in a zone?

(c) Calculate the Standard Error of the regression trip generation model in (a) and interpret its significance in relation to the answer in (b) above.

[Hint: important formulae to apply are as follows:

$\Sigma Y = na + b_1\Sigma X_1 + b_2\Sigma X_2$

$\Sigma X_1 Y = a\Sigma X_1 + b_1\Sigma X_1^2 + b_2\Sigma X_1 X_2$

$\Sigma X_2 Y = a\Sigma X_2 + b_1\Sigma X_1 X_2 + b_2\Sigma X_2^2$

Se = Square root of $\{\Sigma (Y - \hat{Y})^2 / (n-k-1)\}$

where Se = Standard error

Y = Sample values of the dependent variable

$\hat{Y}$ = Corresponding estimated values from the regression equation

n = number of zones

k = number of independent variables

[25 marks]

Question 3

A transport study is being undertaken incorporating three zones 1, 2 and 3. The estimated future work trip production and attractions are presented in Table 3.1 The travel costs between these zones in generalised time units as well as the disincentive to travel (in the form of friction factors) are given in Tables 3.2 and 3.3 respectively. Table 3.4 provides the socio-economic adjustment factors. Compute the expected zonal trips (first iteration only). State the adjustment values for the 2nd iteration.

Table 3.1: Trip Generation data

Zone	1	2	3
Trip Production	550	600	380
Trip Attraction	400	620	510

Table 3.2: Travel times (mins)

i \ j	1	2	3
1	1	6	11
2	7	3	12
3	15	13	

Table 3.3: Friction Factors

i \ j	1	2	3
1	0.876	1.554	0.77
2	1.554	0.876	0.77
3	0.77	0.77	0.876

Table 3.4 Socio-economic activities adjustment factors

i \ j	1	2	3
1	1.04	1.15	0.66
2	1.06	0.79	1.14
3	0.76	0.94	1.16

[Hint: use this variant of the Gravity model equation:

$$T^{m}_{i\text{-}j} = \left[\frac{P_i * (A_j F_{ij}^{m} * K_{ij})}{\sum_{j=1}^{n} (A_j F_{ij}^{m} * K_{ij})} \right]_p$$

Adjustment factor: $A_{jk} = \frac{A_j * A_{j(k-1)}}{C_{j(k-1)}}$

where each symbol has its usual meaning.

[25 marks]

Question 4

Company X manufactures mobile phones in three different production centres, 1, 2 and 3, and markets them through three retail stores, 5, 6 and 7 as shown in Figure 4.1. The symbols "S" and "D" denote the supply and demand respectively. The number on each link represents the unit cost (in Rand) for transporting the mobile phones from each source to specific destinations. The company wishes to establish the quantity to be transported from each source to respective destinations in order to minimise overall total cost and simultaneously satisfy all the supply and demand constraints.

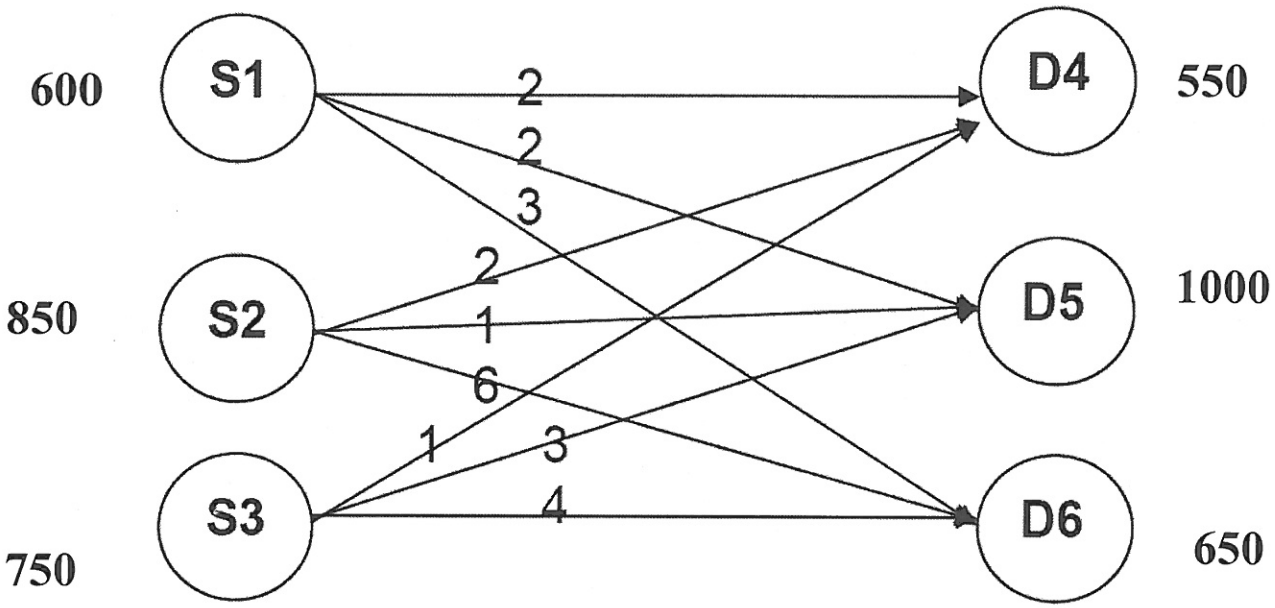

Figure 4.1

(a) Formulate the problem as a Linear Programming model
(b) Determine the initial feasible solution using both the North West Corner Method and the Least Cost Method. Comment on the answers obtained.
(c) Hence deriving from the initial feasible solution obtained through the North West Method, use the Stepping Stone Method to determine the optimum solution to the transportation problem.

[25 marks]

TOTAL MARKS = 100