

DEPARTMENT OF STATISTICS AND DEMOGRAPHY

MAIN EXAMINATION, 2014/15

COURSE TITLE: OPERATIONS RESEARCH I

COURSE CODE: ST 307

TIME ALLOWED: THREE (3) HOURS

INSTRUCTIONS: ANSWER A TOTAL OF FOUR QUESTIONS
SECTION A: ANSWER BOTH QUESTIONS
SECTION B: ANSWER ANY TWO QUESTIONS
ALL QUESTIONS CARRY EQUAL MARKS (25 MARKS)

SPECIAL REQUIREMENTS: SCIENTIFIC CALCULATORS AND GRAPH PAPER

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SECTION A

Question 1

(a) For which decision environment is linear programming most suited? (2 marks)

(b) Briefly explain these terms:

- (i) Range of feasibility
- (ii) Range of optimality
- (iii) Range of insignificance
- (iv) Shadow price

(8 marks)

(c) Solve the following Linear Programming problem by simplex technique:

Maximise $G = 10x + 6y + 4z$

Subject to $x + y + z \leq 100$
 $10x + 4y + 5z \leq 600$
 $2x + 2y + 6z \leq 300$
 $x, y, z \geq 0.$

(15 marks)

Question 2

Solve the following problem using the dual simplex method. (25 marks)

Minimize $Z = x_1 + 2x_2$

Subject to

x_1			≤ 10
	x_2		≤ 10
	$x_1 +$	x_2	≥ 15
	$x_1,$	x_2	≥ 0

SECTION B**Question 3**

A company has three plants producing a certain product that is to be shipped to four distribution centres. Plant 1, 2 and 3 produce 12, 17 and 11 shipments per month, respectively. Each distribution centre need to receive 10 shipments per month. The distance from each plant to the respective distribution centres is given below in kilometres:

Plant	Distribution Centre			
	1	2	3	4
1	800	1,300	400	700
2	1,100	1,400	600	1,000
3	600	1,200	800	900

The freight cost for each shipment is E100 plus E50 cents per kilometre.

The company wishes to determine how much should be shipped from each plant to each of the distribution centres to minimise total shipping costs.

- Use the Vogel's Approximation method to obtain an initial feasible solution (15 marks).
- Use the MODI method to test the optimality of the solution (10 marks)

Question 4

Williams Auto Top Carriers currently maintains plants in Atlanta and Tulsa to supply auto top carriers to distribution centres in Los Angeles and New York. Because of expanding demand, Williams has decided to open a third plant and has narrowed the choice to one of two cities – New Orleans and Houston. The below provides pertinent production and distribution costs in dollars (\$) as well as plant capacities and distribution demands. Which of the new locations, in combination with the existing plants and distribution centres, yield lower cost for the firm? Use the Northwest-Corner Rule and the stepping-stone method to answer this question.

From Plants	To Distribution Centres		Normal Production	Unit Production Cost
	Los Angeles	New York		
Existing plants				
Atlanta	\$8	\$5	600	\$6
Tulsa	\$4	\$7	900	\$5
Proposed locations				
New Orleans	\$5	\$6	500	\$4(anticipated)
Houston	\$4	\$6	500	\$3(anticipated)
Forecast demand	800	1,200	2,000	

(25 marks)

Question 5

Five companies (A, B, C, D and E) submitted the following bids to do contract work in five areas (V, W, X, Y, and Z).

Company	Bids in (E'000)				
	V	W	X	Y	Z
A	45	60	75	100	30
B	50	55	40	100	45
C	60	70	80	110	40
D	30	20	60	55	25
E	60	25	65	185	35

- (a) Which bids should be accepted in order to fulfill the contract terms at the least cost? (20 marks)
- (b) What is the total cost of the subcontracts? (5 marks)

Question 6

- (a) What is duality? What important conclusions do you draw from the optimal tableaux of primal and dual solutions of a linear programming problem? (5 marks)
- (b) Construct the dual of the following Linear programming problem and solve one problem to get solutions for both the primal and the dual:

$$\begin{aligned}
 &\text{Minimise} && Z = 4x_1 + 2x_2 + 3x_3 \\
 &\text{Subject to} && 2x_1 + 4x_3 \geq 5 \\
 &&& 2x_1 + 3x_2 + x_3 \geq 4 \\
 &&& x_1, x_2, x_3 \geq 0.
 \end{aligned}$$

(20 marks)

END OF EXAM!!