

DEPARTMENT OF STATISTICS AND DEMOGRAPHY

SUPPLEMENTARY EXAMINATION, 2014/15

COURSE TITLE: OPERATIONS RESEARCH I

COURSE CODE: ST 307

TIME ALLOWED: TWO (2) HOURS

- INSTRUCTION:
1. ANSWER QUESTION ONE AND CHOOSE TWO QUESTIONS FROM THE REMAINING QUESTIONS.
 2. QUESTION ONE CARRIES 40 MARKS AND THE REMAINING QUESTIONS CARRY 30 MARKS EACH.

SPECIAL REQUIREMENTS: SCIENTIFIC CALCULATORS AND GRAPH PAPER

DO NOT OPEN THIS PAGE UNTIL PERMISSION HAS BEEN GRANTED BY THE CHIEF INVIGILATOR

Question 1

(a) A firm produces three products 1, 2 and 3. Each product requires production time in three departments as shown below:

Product	Department 1	Department 2	Department 3
1	3 hrs/unit	2 hrs/unit	1 hr/unit
2	4 hrs/unit	1 hr/unit	3 hr/unit
3	2 hrs/unit	2 hrs/unit	3 hrs/unit

There are 600, 400 and 300 hours of production time available in the three departments respectively. If each unit of products 1, 2, and 3 contributes E2, E4 and E2.5 to profit respectively, find the optimal product mix. **(25 marks)**

(b) In a maximization problem, explain what the $C_j - Z_j$ values mean and how we determine the variables to become basic at an iteration of the simplex method? **(10 marks)**

(c) What does a positive slack or surplus mean at optimality? **(5 marks)**

Question 2

Consider the following problem:

$$\text{Minimize } Z = 2x_1 + 15x_2 + 5x_3 + 6x_4$$

$$\text{Subject to } \begin{aligned} x_1 + 6x_2 + 3x_3 + x_4 &\geq 2 \\ -2x_1 + 5x_2 - x_3 + 3x_4 &\leq -3 \end{aligned}$$

$$x_1, x_2, x_3, x_4 \geq 0.$$

(i) Give the dual linear problem. **(5 marks)**

(ii) Solve the dual problem by simplex method. **(15 marks)**

(iii) Utilise the information of the dual linear problem and the duality theorem to solve the primal problem. **(10 marks)**

Question 3

(a) How do you determine the following when solving linear programming problem using the simplex method:

- (i) Multiple optimal solutions (3 marks)
 (ii) Infeasible solution (3 marks)
 (iii) Shadow prices (4 marks)

(b) Consider the following problem:

$$\text{Maximise } Z = 2x_1 + x_2$$

$$\begin{array}{rcll} \text{Subject to} & & x_2 & \leq & 10 \\ & 2x_1 & + 5x_2 & \leq & 60 \\ & x_1 & + x_2 & \leq & 18 \\ & 3x_1 & + x_2 & \leq & 44 \end{array}$$

$$x_1, x_2, \geq 0.$$

(i) Construct the initial simplex tableau, introducing slack variables and so forth as needed for applying the simplex method. (10 marks)

(ii) Solve the problem by simplex method. (10 marks)

Question 4

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? **(25 marks)**
- (b) What is the total cost of the subcontracts? **(5 marks)**

Question 5

DJ Leather works creates products from exotic skins obtained by the owner on hunting trips. The skins are cut to strips of equal size, to make purse straps, belts, plant hangers and hat bands. These items are sold to a skin boutiques at an agreed price and yield the following profits:

Skin type	Purse strap	Belt	Plant hangers	Hat band
Rattle snake	5	12	5	10
Crocodile	10	15	5	10
Armadillo	8	10	10	5
Gila monster	10	20	20	15

On the latest hunting trip, the following number of strips were obtained: 30 rattle snake, 100 crocodiles, 50 armadillos and 20 Gila monsters. The skin boutique will buy up to 50 purse straps, 100 belts, 50 plant hangers and 100 hat bands, regardless of the material used to make them.

Solve the above problem using the transportation method to determine how DJ Leather works can maximize its profits. **(30 marks)**

END OF EXAM!!

