

DEPARTMENT OF STATISTICS AND DEMOGRAPHY

MAIN EXAMINATION, 2011/12

COURSE TITLE: OPERATIONS RESEARCH I

COURSE CODE: ST 307

TIME ALLOWED: TWO (2) HOURS

INSTRUCTION: ANSWER QUESTION ONE AND ANY TWO QUESTIONS
ALL QUESTIONS CARRY EQUAL MARKS AS GIVEN IN
PARENTHESIS

SPECIAL REQUIREMENTS: SCIENTIFIC CALCULATORS AND GRAPH PAPER

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

Question 1

Consider the following linear programming problem

$$\text{Maximise } Z = 2x_1 + 3x_2$$

Subject to

$$x_1 + 2x_2 \leq 10$$

$$3x_1 + x_2 \leq 15$$

$$x_2 \leq 4$$

$$x_1, x_2 \geq 0$$

- (a) Solve this problem using the graphical method
 (b) Find the range of values for the objective function coefficients for which the current optimal solution will remain optimal.
 (c) Which resource is to be given top priority when the allocation of resources is made and why?
 (20 marks)

Question 2

- (a) Briefly define the following terms as used in linear programming

- (i) Infeasible solution
 (ii) Degeneracy
 (iii) Alternative optimal solution

- (b) (i) Solve the following linear program using the simplex method.

$$\text{Maximize } Z = 3x_1 + 2x_2 + 5x_3$$

Subject to

$$x_1 + 2x_2 + x_3 \leq 430$$

$$3x_1 + 2x_3 \leq 460$$

$$x_1 + 4x_2 \leq 420$$

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

- (ii) Identify shadow prices for the resources and explain their significance.

(20 marks)

Question 3

Given the following primal problem

$$\text{Minimize } Z = 10x_1 + 5x_2 + 4x_3$$

Subject to

$$3x_1 + 2x_2 - 3x_3 \geq 3$$

$$4x_1 + 2x_3 \geq 10$$

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

- Obtain the dual for this problem.
- Solve the dual problem using the simplex method.
- Use the dual solution to identify the optimal solution to the original primal problem.

(20 marks)

Question 4

A product is produced at three plants and shipped to three warehouses. The transportation costs per unit are shown in the following table:

Plant	Warehouse			Plant Capacity/Supply
	W1	W2	W3	
P1	20	16	24	300
P2	10	10	8	500
P3	12	18	10	100
Warehouse demand	200	400	300	

- Use the Northwest corner rule method to find the initial basic feasible solution
- Find the optimal solution to this problem.
- Express the transportation problem as a linear programming problem.

(20 marks)

Question 5

Swazi Auto Spares wants to advertise his products on national radio or television (TV). The advertisement budget is limited to E10,000 a month. Each minute of radio advertisement costs E15 and each minute of TV commercials cost E300. The shop likes to use radio advertisement at least twice as much as TV. In the meantime it is not practical to use more than 400 minutes of radio advertisement per month. Past experience shows that TV advertisement is estimated to be 25 times more effective than that of radio. Determine the optimal allocation of the budget to radio and TV advertisements.

(20 marks)

END OF EXAM!!