

DEPARTMENT OF STATISTICS AND DEMOGRAPHY

MAIN EXAMINATION, 2016/17

COURSE TITLE: OPERATIONS RESEARCH I

COURSE CODE: ST 307

TIME ALLOWED: THREE (3) HOURS

- INSTRUCTION:**
1. ANSWER QUESTION ONE AND ANY THREE QUESTIONS
 2. EACH QUESTION IS WORTH 25 MARKS

SPECIAL REQUIREMENTS: SCIENTIFIC CALCULATORS AND GRAPH PAPER

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Question 1

- (a) Why does VAM provide a good initial feasible solution? Could the northwest corner rule ever provide an initial solution with as low a cost? **(4 marks)**
- (b) What is a balanced transportation problem? Describe the approach you would use to solve an unbalanced problem. **(4 marks)**
- (c) Explain what happens when the solution to a transportation problem does not have $m + n - 1$ occupied cells (where m = number of rows in the table and n = number of columns in the table). **(4 marks)**
- (d) Solve the following LP formulation graphically, using either the Isocost line approach or the Corner Point Method: **(13 marks)**

$$\text{Minimise } Z = 24x_1 + 28x_2$$

$$\text{s.t. } 5x_1 + 4x_2 \leq 2,000$$

$$x_1 \geq 80$$

$$x_1 + x_2 \geq 300$$

$$x_2 \geq 100$$

$$x_1, x_2 \geq 0$$

Question 2

The Hardrock Concrete Company has plants in three locations and is currently working on three major construction projects, each located a different site. The shipping cost per truckload of concrete, daily plant capacities, and daily project requirements are provided in the table below:

- (a) Formulate an initial feasible solution to this transportation problem using the northwest corner rule method. Evaluate each unused shipping route by computing all improvement indices. Is this solution optimal? why?

	Project A	Project B	Project C	Plant capacities
Plant 1	\$10	\$4	\$11	70
Plant 2	12	5	8	50
Plant 3	9	7	6	30
Project Requirements	40	50	60	150

(b) Is there more than one optimal solution to this problem? Why? (15 marks)

(c) Use VAM to find an initial feasible solution to this transportation problem. Then apply the MODI technique to find the least-cost distribution assignment. (10 marks)

Question 3

A Johannesburg based publishing company wants to assign three recently hired college graduates, Jabulani, Siphon and Wilson to regional sales offices in Durban, Polokwane and Nelspruit. But the firm also has an opening in Pretoria and would send one of the three there if it were more economical than a move to Durban, Polokwane or Nelspruit. It would cost R1, 000 to relocate Jabulani to Pretoria, R800 to relocate Siphon there and R1, 500 to move Wilson. What is the optimal assignment of personnel to offices? (25 marks)

Personnel	Durban	Polokwane	Nelspruit
Jabulani	R800	R1, 100	R1, 200
Siphon	R500	R1, 600	R1, 300
Wilson	R500	R1, 000	R2, 300

Question 4

Solve the following Linear Programming problem by simplex technique:

$$\text{Maximise } G = 10x + 6y + 4z$$

$$\text{Subject to } x + y + z \leq 100$$

$$10x + 4y + 5z \leq 600$$

$$2x + 2y + 6z \leq 300$$

$$x, y, z \geq 0.$$

(25 marks)

Question 5

(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 either the primal or the dual and specify the solutions for the two problems:

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

(20 marks)

END OF EXAM!!