



KISII UNIVERSITY
UNIVERSITY EXAMINATIONS

**SECOND YEAR EXAMINATION FOR THE AWARD OF THE
DEGREE OF BACHELOR OF MATHEMATICS AND ACTUARIAL SCIENCE
FIRST SEMESTER 2017/2018
(MAY - AUGUST, 2017)**

MATH 272: OPERATIONS RESEARCH I

STREAM: Y2S1

TIME: 2 HOURS

DAY: TUESDAY, 9:00-11:00 AM

DATE: 12/09/2017

INSTRUCTIONS

1. Do not write anything on this question Paper.
2. Answer question ONE and any other TWO questions.

QUESTION ONE (30 MARKS)

1.

- a. Dorian makes luxury cars and jeeps for high-income men and women. It wishes to advertise with 1 minute spots in comedy shows and football games. Each comedy spot costs \$50K and is seen by 7M high-income women and 2M high-income men. Each football spot costs \$100K and is seen by 2M high-income women and 12M high-income men. How can Dorian reach 28M high-income women and 24M high-income men at the least cost? (6 marks)
- b. Use simplex algorithm to solve

$$\text{Max } z = 50x_1 + 80x_2$$

$$\text{s.t } 2x_1 + 4x_2 \leq 64$$

$$6x_1 + 8x_2 \leq 168$$

$$x_1, x_2 \geq 0$$

(6 marks)

- c. Explain the types of mathematical models used in O.R (6 marks)
- d. Explain the methodologies used in operations research (6 marks)
- e. The table below show the daily demand of product X in a given shop in Kisii

| | | | | | | |
|------------------------|------|------|------|------|------|------|
| Daily demand (number): | 0 | 10 | 20 | 30 | 40 | 50 |
| Probability: | 0.01 | 0.10 | 0.17 | 0.54 | 0.16 | 0.02 |

Use the following sequence of random numbers to simulate the demand for next 7 days.

Random numbers: 22, 11, 65, 76, 05, 45, 90

(6 marks)

QUESTION TWO (20 MARKS)

2.

- a. A farmer owns 100 acre farm and plans to plant at most three crops. The seed for crops A, B and C costs \$40, \$20 and \$20 per acre respectively. A maximum of \$3,200 can be spent on buying seeds. Crops A, B and C requires 1.2 and 3 workdays per acre respectively and there is a maximum of 160 work days available. If the farmer can make a profit of \$100 per acre on crop A, \$300 on crop B and \$200 on crop C, how many acres of each crop should the farmer plant so as to maximize profit. Use simplex method. (10 marks)
- b. The EAC Ltd transports goods from three firms to three warehouses and the cost of transportation is shown in the cells below in pounds per ton.

| TO \ FROM | A | B | C | Supply |
|-----------|------|-----|-----|--------|
| P | 12 | 14 | 12 | 800 |
| Q | 19 | 15 | 9 | 800 |
| R | 21 | 17 | 11 | 400 |
| Demand | 1000 | 400 | 600 | |

Using the table above find the initial solution and estimate the total cost using

- i. North-west corner method (5 marks)
- ii. Vogel Approximation method (5 marks)

QUESTION THREE (20 MARKS)

3.

- a. Company wants to assign each flight officer to a captain pilot according to these evaluations. Showing the steps clearly, determine possible flight crews. (10 marks)

| | FO1 | FO2 | FO3 | FO4 |
|-----|-----|-----|-----|-----|
| CP1 | 2 | 4 | 6 | 10 |
| CP2 | 2 | 12 | 6 | 5 |
| CP3 | 7 | 8 | 3 | 9 |
| CP4 | 14 | 5 | 7 | 7 |

- b. Define the following terms as used in linear programming:
- Simulation (2 marks)
 - Linear programming (2 marks)
 - Feasible solution (2 marks)
 - Slack variable (2 marks)
 - Constrains (2 marks)

QUESTION FOUR (20 MARKS)

- 4.
- a. Find the feasible solution using the graphical method given
- $$\begin{aligned} \text{Max } z &= 3x_1 + 2x_2 \\ \text{s.t. } 2x_1 + x_2 &\leq 100 \text{ (Finishing constraint)} \\ x_1 + x_2 &\leq 80 \text{ (Carpentry constraint)} \\ x_1 &\leq 40 \text{ (Demand constraint)} \\ x_1, x_2 &\geq 0 \text{ (Sign restrictions)} \end{aligned}$$
- (16 marks)
- b. Define:
- Surplus variable, (2 marks)
 - Objective function (2 marks)

QUESTION FIVE (20 MARKS)

- 5.
- Discuss the simplex algorithm (10 marks)
 - The Africa Cup of Nations has four football games on a particular night. Soccer officials want to assign four referees to the four games in a way that will minimize the total distance travelled by the referees. The distances in Kilometres for each referee to each game location is shown below (10 marks)

| Referees | Games Sites | | | |
|----------|-------------|-----|------|------|
| | Rai | Ata | Duri | Clim |
| A | 90 | 180 | 210 | 160 |
| B | 70 | 130 | 100 | 200 |
| C | 105 | 140 | 175 | 170 |
| D | 65 | 105 | 80 | 120 |

Use the assignment model, showing the steps in each case, to find the total distance in a way that will minimize the total distance travelled by the referees.