



# MACHAKOS UNIVERSITY

University Examinations for 2017/2018 Academic Year

**SCHOOL OF BUSINESS AND ECONOMICS**

**DEPARTMENT OF ECONOMICS**

**FOURTH YEAR SECOND SEMESTER EXAMINATIONS FOR**

**BACHELOR OF ECONOMICS AND FINANCE**

**BACHELOR OF ECONOMICS**

**EES 402: OPERATIONS RESEARCH II**

**DATE: 11/12/2017**

**TIME: 2:00 – 4:00 PM**

## INSTRUCTIONS TO CANDIDATES

**Answer Question ONE and any other TWO questions**

### QUESTION ONE (COMPULSORY) (30 MARKS)

- a) Discuss four basic assumptions in linear programming (4 marks)
- b) Discuss explicitly the advantages and disadvantages of using simulation in decision making (6 marks)
- c) Consider the following activities, their normal time, crash time, normal cost and crash cost for a particular project in a textile industry and use the data to answer the questions that follow:

| Activity | Proceeding Activity | Time (days) |       | Cost (\$) |       |
|----------|---------------------|-------------|-------|-----------|-------|
|          |                     | Normal      | Crash | Normal    | Crash |
| A        | -                   | 5           | 3     | 250       | 370   |
| B        | A                   | 4           | 4     | 160       | 160   |
| C        | A                   | 6           | 3     | 360       | 750   |
| D        | C                   | 7           | 6     | 490       | 950   |
| E        | B                   | 8           | 4     | 640       | 1300  |
| F        | E,D                 | 6           | 3     | 390       | 760   |
| G        | F                   | 5           | 3     | 230       | 450   |

It is further given that the site cost associated with the project is estimated to be \$600 per day. Required;

- i) Draw the network and state the critical path (5 marks)
- ii) Calculate the total completion of the project in the normal time (5 marks)
- iii) Find the cost of completion in the crash time (5 marks)
- iv) Calculate the cost slope for each activity (5 marks)

### **QUESTION TWO (20 MARKS)**

- a) Write short notes on the following terms;
  - i) Jockeying
  - ii) Reneging
  - iii) Balking
  - iv) Queues in tandem
  - v) Poisson distribution (10 marks)
- b) The arrival rate of customers at a single window booking counter of a two wheeler agency follows Poisson distribution and the service time also follows poisson distribution. The arrival rate and service rate are 25 customers per hour and 35 customers per hour respectively. Find the following
  - i) Utilization of the booking clerk
  - ii) The average number of waiting customers in the queue
  - iii) The average number of waiting customers in the system
  - iv) Average waiting time per customer in the queue
  - v) Average waiting time per customer in the system (10 marks)

### **QUESTION THREE (20 MARKS)**

- a) Differentiate between the following terms:
  - i) Carrying cost and sock-out cost (4 marks)
  - ii) Safety stock and re-order level (4 marks)
- b) The annual demand for a component is 7200 units. The carrying cost is £500 per unit per year, the ordering cost is £ 1500 per order and shortage cost is £ 2000 per unit per year. Find the optimal values of the following:
  - i) Economic order quantity
  - ii) Maximum inventory
  - iii) Maximum shortage quantity
  - iv) Cycle time
  - v) Inventory period
  - vi) Shortage period (12 marks)

#### QUESTION FOUR (20 MARKS)

- a) What do you understand by the term simulation and give reasons why study simulation? (4 marks)
- b) Mr. Musyoka, a regional manager of United Bank is planning to open a drive-in facility in a commercial area in Machakos. A market research study has projected the inter-arrival times at the branch are as follows:

| Time between two consecutive arrivals | Probability |
|---------------------------------------|-------------|
| 3                                     | 0.17        |
| 4                                     | 0.25        |
| 5                                     | 0.25        |
| 6                                     | 0.20        |
| 7                                     | 0.13        |

The Bank management plans for one teller's window at this branch. The teller car service customer at these rates;

| Service time (minutes) | Probability |
|------------------------|-------------|
| 3                      | 0.10        |
| 4                      | 0.30        |
| 5                      | 0.40        |
| 6                      | 0.15        |
| 7                      | 0.05        |

Use the following random numbers:

Arrival time: 67,49,42,03,82,48,32,53,00,32,56,70,98,49,59,54,32,11,46,10

Service time: 71,64,23,89,34,76,66,23,72,59,52,63,09,77,12,99,99,08,99,66

Before signing the contract for construction Mr. Musyoka would like to know how much pace to allow for waiting cars. He is also concerned about the mean waiting time for arriving customers.

- Simulate the operation of the facility for arriving sample of 20 cars and assist Mr. Musyoka in determining the number of cars he should plan for assuming that the banking business starts at 9.00am (10 marks)
- What is the longest time that a customer can wait before being served? (1 mark)
- What is the mean waiting time in your sample (3 marks)
- Advice Mr. Musyoka accordingly (2 marks)

### QUESTION FIVE (20 MARKS)

a) What is meant by the following terms as used in linear programming

- i. Duality
- ii. Degeneracy
- iii. Optimal solution
- iv. Feasible and infeasible solution

(8 marks)

b) Consider the following problem;

$$\text{Maximize } Z=5X_1+3X_2$$

$$\text{Subject to: } 6X_1+2X_2\leq 36$$

$$2X_1+2X_2\leq 28$$

$$5X_1+5X_2\leq 40$$

$$\text{And } X_1, X_2\geq 0$$

i) Construct the primal problem

(2 marks)

ii) Apply simplex method to this model to yield optimal solution

(10 marks)