



# MACHAKOS UNIVERSITY

University Examinations for 2018/2019 Academic Year

SCHOOL OF BUSINESS AND ECONOMICS

DEPARTMENT OF ECONOMICS

FOURTH YEAR SUPPLEMENTARY EXAMINATION FOR BACHELOR OF  
ECONOMICS AND FINANCE  
EES 402: OPERATIONS RESEARCH II

DATE: 26/7/2019

TIME: 2:00 – 4:00 PM

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## INSTRUCTIONS TO CANDIDATES

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

### QUESTION ONE (30 MARKS)

- a) At a certain bus stop passengers arrive at an average of 16 passengers per hour. They undergo some inspection before they are allowed to board the bus which takes three minutes per passenger on an average. Assuming that the arrivals follow a Poisson distribution and the service time follows an exponential distribution, determine the following;
- (i) The percentage of time that a passenger arrives at the bus stop and is inspected without having to wait. (2 marks)
  - (ii) The average numbers of passengers at the bus stop. (2 marks)
  - (iii) The average number of passengers waiting for their turn to be inspected. (2 marks)
  - (iv) The average time a passenger spends at the bus stop (2 marks)

$$\rho = \frac{\lambda}{\mu} \quad N_q = \frac{\lambda^2}{\mu(\mu - \lambda)} \quad N_s = \frac{\lambda}{\mu - \lambda} \quad T_q = \frac{\lambda}{\mu(\mu - \lambda)} \quad T_s = \frac{1}{\mu - \lambda}$$

- b) A construction project is composed of thirteen activities whose description relationships and durations in days are described as follows.

Activity	Pre-requisite	Expected Time
	Activity	(days)
A	None	20
B	A	12
C	A	8
D	B	12
E	C&D	16
F	C	32
G	C	20
H	B	8
I	B	8
J	E, F&H	12
K	G	20

- a) Draw the network diagram for this project.

(4 marks)

- b) Determine the earliest and latest start times and finish times

(6 marks)

c) Find the critical path and project duration

(2 marks)

c) A textile manufacturing company produces two types of bags, A and B, from its available resources which consist of 400 square metres of fabric and 450 units of labour daily. A unit of product A requires 5 square metres of fabric and 10 units of labour. A unit of product B requires 20 square metres of fabric and 15 units of labour. The company sells the bags at \$450 and \$800 per unit of type A and B respectively.

i) Formulate the problem as linear programming model

(3 marks)

ii) Find the number of units for each type of the bag that the company can make to maximize profit. Use graphical method.

(7 marks)

## QUESTION TWO

a) Explain the following terms as used in inventory control

- i. Inventory carrying costs
- ii. Lead
- iii. Buffer stock
- iv. Economic order quantity (EOQ)

(8 marks)

b) The annual demand per item is 6400 units. The unit cost is £ 12 and the inventory carrying charges are 25% per annum. If the cost of procurement is £ 300 determine the following:

i) Economic order quantity

(3 marks)

ii) Number of orders per year

(3 marks)

iii) Optimum period of supply per optimum order

(3 marks)

iv) Optimum cost

(3 marks)

### QUESTION THREE (20 MARKS)

A linear program is expressed as follows:

Minimize

$$W = 3y_1 + 2y_2$$

Subject to

$$y_1 + 3y_2 \geq 6$$

$$2y_1 + y_2 \geq 3$$

$$y_1 \geq 0, y_2 \geq 0$$

- a) State the corresponding dual maximization problem (5 marks)
- b) Solve the dual maximization problem to determine the solutions for the original minimization problem (15 marks)

### QUESTION FOUR (20 MARKS)

East African Bottlers has three plants, P, Q and R for producing sodas. These plants supply sodas to four towns, A, B, C and D. The capacity of each plant, the demand for each town as well as the per unit transport costs in KShs from one plant to a given town are given as follows.

		Towns				Capacity
		A	B	C	D	
Plants	P	26	22	30	40	12
	Q	34	28	24	26	36
	R	36	36	30	24	42
Demand		18	18	24	30	90

- a) Find the initial feasible solution for the transportation problem using the least cost method and the associated transport cost. (10 marks)
- b) Find the optimum transportation schedule and the minimum total cost of transportation. (10 marks)

**QUESTION FIVE (20 MARKS)**

A steel manufacturing company makes three types of steel products labelled, P, Q and R each of which requires three main inputs that comprise of certain amount of iron in kilogrammes, units of capital and labour-hours. Every day the company has 150 Kgs of iron, 200 units of capital and 320 labour hours available for making these products. A unit of each of these products have the following requirements for the inputs as shown in the table below:

	P	Q	R
Iron	2	1	1
Capital	2	2	8
Labour	2	3	1

The price per unit of P, Q and R is \$ 30, 20 and 10 respectively.

- i) Formulate a linear program using the above information. (5 marks)
- ii) Solve the LP to determine the number of units for each product that the company should make to maximize its revenue. (12 marks)
- iii) Determine and interpret the dual price for capital. (3 marks)