

**CHUKA**



**UNIVERSITY**

**UNIVERSITY EXAMINATIONS**

**EXAMINATION FOR THE AWARD OF DEGREE OF BACHELOR OF SCIENCE IN  
ACTUARIAL SCIENCE**

**ACMT 212: PRINCIPLES OF OPERATIONS RESEARCH**

**STREAMS: B.SC**

**TIME: 2 HOURS**

**DAY/DATE: FRIDAY 13/12/2019**

**8.30 A.M. – 10.30 A.M.**

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**INSTRUCTIONS:**

- **Attempt question ONE (compulsory) and any other TWO questions.**

**QUESTION ONE (30 MARKS)**

- (a) Outline 4 properties of linear programming model. (4 marks)
- (b) Distinguish between the following terms.
- (i) Game theory and decision theory. (2 marks)
- (ii) Linear programming and dynamic programming. (2 marks)
- (c) A firm manufactures two products P and Q using three machines namely A, B and C. Machine A has 4 hours of capacity available during the coming week. Similarly, the available capacity of machine B and C during the coming week is 24 hours and 35 hours respectively. One unit of product P requires one hour of machine A, 3 hours of machine B and 10 hours of machine C. Similarly, 1 unit of product Q requires 1 hour, 8 hours and 7 hours of machine A, B and C respectively. When one unit of P is sold in the market, it yields a profit of 5 USD per product and Q is 7 USD per unit. Solve the problem by using graphical method to find the optimal product mix. (10 marks)
- (d) Solve the game with the following payoff matrix. (5 marks)

		Player B strategies				
		I	II	III	IV	V
Player	1	-2	5	-3	6	7
A	2	4	6	8	-1	6
Strategies	3	8	2	3	5	4
	4	15	14	18	12	20

- (e) Customer arrive at a milk booth for the required service assume the inter-interval and service time are constant and given by 1.5 and 4 minutes respectively. Simulate the system by hand computations for 14 minutes. (7 marks)

**QUESTION TWO (20 MARKS)**

- (a) What are the basic steps involved in an operation research problem? (5 marks)
- (b) Use the simplex method to solve the L. P.

$$\text{Min}Z = -2x_1 - 3x_2$$

$$Z/t$$

$$x_1 + x_2 \leq 2$$

$$4x_1 + 6x_2 \leq 9$$

$$x_1, x_2 \geq 0$$

(15 marks)

**QUESTION THREE (20 MARKS)**

Hill side grand hotel must decide on the level of suppliers it must stock to meet the needs of customers in December 2019. The exact number of customer is not from known but it is expected to lie in one of the four categories, 200, 250, 300 or 350 customers. Four level of suppliers are thus suggested with i being ideal if the number of customer fall in category i.

		Customer category			
Supplies	A1	$C_1$	$C_2$	$C_3$	$C_4$
Level	A2	5	10	18	25
	A3	8	7	8	23
	A4	21	18	12	21
		30	22	19	15

Determine the best level of inventory using

- (i) The laplace criterion (5 marks)
- (ii) The minimax criterion (5 marks)
- (iii) The squared criterion (5 marks)
- (v) The hurwiez criterion with  $\alpha = 0.5$  (5 marks)

**QUESTION FOUR (20 MARKS)**

(a) Outline 5 advantages of simulation in operation research. (5 marks)

(b) Given that

The distribution inter-arrival in  
A single server model is

T	1	2	3
$f(T)$	$\frac{1}{4}$	$\frac{1}{2}$	$\frac{1}{4}$

The distribution of serve time is

5	1	2	3
$f(s)$	$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{4}$

Complete the following table using the two digit random number as 12, 40, 48, 93, 61, 17, 55, 21, 85, 68 to generate arrival and 54, 90, 18, 38, 16, 87, 91, 41, 54, 11 to generate the corresponding service times.

Arrival number	Random number	Arrival Time	Time Service beginning	Random number	Time Service ends	Liquidity time in queue
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(15 marks)

**QUESTION FIVE (20 MARKS)**

(a) In a departmental store one cashier is there to serve the customers. The customers pick up their needs by themselves. The arrival rate is 9 customers for every 5 minutes and the cashier can serve 10 customers in 5 minutes. Assuming poison arrival rate and exponential distribution for service rate.

Find (i) Average number of customers in the system. (4 marks)

(ii) Average number of customers in the queue or average queue length. (3 marks)

(iii) Average time a customer spent in the system. (3 marks)

(iv) Average time a customer waits before being served. (3 marks)

(b) Obtain the dual of the following L. P

$$\text{Min } Z = 40x_1 + 120x_2$$

$$x_1 - 2x_2 \leq 8$$

$$3x_1 + 5x_2 = 90$$

$$15x_1 + 44x_2 \geq 66$$

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

(7 marks)