



MUEO

# MOI UNIVERSITY

OFFICE OF THE DEPUTY VICE CHANCELLOR  
(ACADEMICS, RESEARCH, EXTENSION & STUDENT AFFAIRS)

## UNIVERSITY EXAMINATIONS

### 2022/2023 ACADEMIC YEAR

#### THIRD YEAR EXAMINATION

#### FOR THE DEGREE OF

#### BACHELOR

#### OF

#### BUSINESS MANAGEMENT

**COURSE CODE:** BBM 351

**COURSE TITLE:** OPERATIONS RESEARCH

**DATE:** WEDNESDAY-9<sup>TH</sup> AUGUST, 2023      **TIME:** 9.00 A.M. – 12.00 NOON.

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### INSTRUCTION TO CANDIDATES

- SEE INSIDE.

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**BBM 351: OPERATIONS RESEARCH / ECF 311: QUANTITATIVE METHODS I.****INSTRUCTION.**

**Answer QUESTION ONE and any other THREE QUESTIONS.**

**QUESTION ONE (25 MARKS).**

- a) Elucidate on the scope of operations research in management of an organization. (3marks).
- b) Outline three assumptions of a single server model in queueing theory. (3marks).
- c) Discuss the various causes of poor inventory control in an organization. (3marks)
- d) Describe the main difference between the project evaluation and review technique (PERT) and critical path movement (CPM) tools of decision making in operations research. (4marks).
- e) A manufacturer produces two products, Klunk and Klick. Klunk has a contribution of \$3 per unit and klick \$4 per unit. The manufacturer wishes to establish the weekly production plan, which maximizes contributions. Production data are as follows;

	Machining(Hours)	Labor (Hours)	Material (lbs)
Klunk	4	4	1
Klick	2	6	1
Total available per week	100	180	40

Because of a trade agreement, sales of klunk are limited to a weekly maximum of 20 units and to honour an agreement with an old established customer at least 10 units of klick must be sold per week.

- i) Formulate a linear programming model in a standard manner. (3marks)
- ii) Using graphical solution techniques solve the linear programming model. (5marks)
- iii) Find the dual prices or shadow prices by dual formulation method and interpret it. (5marks)

**QUESTION TWO( 15 MARKS).**

- a) A department store wishes to purchase the following quantities of ladies' dresses.

Dress type	A	B	C	D
Quantity	150	100	75	250

The tenders are submitted by three different manufacturers who undertake to supply not more than the quantities below, (all types of dresses combined).

Manufacturer	W	X	Y
Total quantity	350	250	150

The store estimates that its profit per dress will vary with the manufacturer as shown in the matrix below.

Manufacturer		Dress			
		A	B	C	D
	W	2.75	3.50	4.25	2.25
	X	3.00	3.25	4.50	1.75
	Y	2.50	3.50	4.75	2.00

Determine the initial basic feasible solution using the Vogel Approximation method(VAM) and the maximum profit. (9marks).

- b) Outline the main distinctions between the following concepts as used in operation research.

- i) Pure strategy and mixed strategy (2marks)  
 ii) Feasible region and feasible solution. (2marks)  
 iii) Basic variable and non – basic variable. (2marks)

**QUESTION THREE (15 MARKS).**

Three machine shops A, B and C produces three types of products X, Y, and Z respectively. Each product involves operation of each of the machine shops. The time required for each operation on various products is given as follows;

Products	Machine shops		
	A	B	C
X	10	7	2
Y	2	3	4
Z	1	2	1

The available hours at the machine shops A, B and C are 100, 77 and 80 respectively. The profit per unit of products X, Y and Z is \$12, \$3 and \$1 respectively.



- a) Formulate a linear programming model in a standard manner. (4marks)
- b) Using any appropriate technique, determine an optimal solution and the maximum profit. (8marks)
- c) Evaluate the shadow prices and give its interpretations. (3marks)

**QUESTION FOUR (15 MARKS).**

- a) The arrival rate of customers at the single window-booking counter of a two-wheeler agency follows a Poisson distribution and the service time follows exponential distribution and hence, the service rate also follows a Poisson distribution. The arrival rate and the service rate are 25 customers per hour and 35 customers per hour, respectively. Determine the followings;
- i) Average number of waiting customers in the queue. (2marks)
- ii) Average number of waiting customers in the system. (2marks)
- iii) Average waiting time per customer in the queue. (2marks)
- iv) Average waiting time per customer in the system. (2marks).

- b) i) In an inventory model, the total cost is the sum of the fixed cost and variable cost. The fixed cost is independent of order size while the variable cost is dependent on the order size. Therefore, the total cost is given as;

$TC = CD + C_o \frac{D}{Q} + C_h \frac{Q}{2}$ ; where TC is the total cost, Q is the order size, CD is the fixed cost,  $C_o$  is ordering cost,  $C_h$  is the holding cost or carrying cost per unit of item per one year time period. It is expressed either in terms of cost per unit per period or in terms of percentage charge of the purchase price. D is deterministic demand in units per year, and  $Q/2$  is the average inventory per cycle, since the safety stock (buffer stock) is not need, hence it is zero. Show that the order size or economic order quantity is given as; (3marks)

$$EOQ = Q^* = \sqrt{\frac{2C_o D}{C_h}}$$

- ii) A manufacturer uses \$20,000 worth of an item during the year. The manufacturer estimated the ordering cost as \$50 per order and holding costs as 12.5% of average inventory value. Find the optimal order size and number of orders per year. (4marks)

**QUESTION FIVE (15 MARKS).**

- a) You are given below the preceding activities and activity duration in days.

Activity	Preceding activity	Duration(days)
A	-	9
B	-	3
C	A	8

D	A	2
E	A	3
F	C	2
G	C	6
H	C	1
J	B, D	4
K	F, J	1
L	E, H, G, K	2
M	E, H	3
N	L, M	4

Draw network diagram to represent this activity and determine the critical path and duration of the project. (7marks).

- b) A company has one surplus truck in each of the cities A, B, C, D and E and one deficit truck in each of the cities 1, 2, 3, 4, 5 and 6. The distance between the cities in kilometers is shown in the matrix table below. Find the assignment of trucks from cities in surplus to cities in deficit so that the total distance covered by vehicles is minimum. (8marks).

Cities	1	2	3	4	5	6
A	12	10	15	22	18	8
B	10	18	25	15	16	12
C	11	10	3	8	5	9
D	6	14	10	13	13	12
E	8	12	11	7	13	10

### QUESTION SIX (15 MARKS).

- a) Players A and B play a game in which each player has three coins, thus 20P, 25P and 50P. Each of them selects a coin without the knowledge of the other person. If the sum of the values of the coins is an even number, A wins B's coin. If that sum is an odd number, B wins A's coin. Determine a payoff matrix with respect to player A and the optimal strategies for the players. (7marks)
- b) Dr. Thomas has been thinking about starting his own independent nursing home. The problem is to decide how large the nursing home should be. The annual returns will depend on both the size of nursing home and a number of marketing factors. After a careful analysis, Dr. Thomas developed the following table;

Size of nursing home	Good market (£)	Fair Market (£)	Poor market (£)
Small	50,000	20,000	-10,000
Medium	70,000	35,000	-25,000

Large	90,000	35,000	-45,000
Very large	200,000	25,000	-120,000

Determine,

- i) The maximin decision. (2marks)
- ii) The equally likely decision. (2marks)
- iii) The criterion of realism decision where  $\alpha = 0.8$  (2marks)
- iv) The minimax decision. (2marks)

\*\*\*\*\*E\_N\_D\*\*\*\*\*