



MUEO

**MOI UNIVERSITY**

**OFFICE OF THE DEPUTY VICE CHANCELLOR, ACADEMIC AFFAIRS,  
RESEARCH & EXTENSION**

**UNIVERSITY EXAMINATIONS  
2018/2019 ACADEMIC YEAR**

**END OF SEMESTER EXAMINATIONS**

*FOR THE DEGREE*

*IN BACHELOR OF BUSINESS AND ECONOMICS*

**EXAM CODE: BBM 351**

**COURSE TITLE: OPERATION RESEARCH 1**

**DATE: 3<sup>RD</sup> DECEMBER, 2018**

**TIME: 9.00A.M. – 12.00 NOON.**

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*INSTRUCTION TO CANDIDATES*

➤ *SEE INSIDE.*

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## BBM 351: OPERATIONS RESEARCH I

### INSTRUCTIONS:-

- Answer **ALL** Questions in **SECTION A** any other **TWO** in **SECTION B**
- **SECTION A** carries **40 Marks**.
- Some Formulae are provided in the last page.
- Time allowed: **3 hours**

### SECTION A {Question ONE and TWO is Compulsory}

#### QUESTION ONE – Compulsory [20 marks]

- (a) Explain the role of operations research in business management. [5 marks]
- (b) Briefly explain the steps involved in the quantitative analysis approach to decision making. [5 marks]
- (c) Give **three** limitations of operations research techniques. [3 marks]
- (d) “When it becomes difficult to use an optimization technique for solving a problem, one has to resort to simulations.” Discuss this statement. [5 marks]
- (e) Differentiate between pure strategies and mixed strategies in game theory. [2 marks]

#### QUESTION TWO – Compulsory [20 marks]

- (a) Briefly explain why simplex method is superior to graphical method in solving linear programming problems. [2 marks]
- (b) A firm has three shops with a total of 80 televisions. An order is received from the Local Authority for 70 sets to be delivered to 4 schools. The transportation costs from shops to schools are shown below together with the availabilities and requirements.

Available	Shops	Schools					
			A	B	C	D	
	Sets	20	30	15	5	Requirements	
	Shop 1	40	2	4	1	6	Costs
	Shop 2	20	4	3	3	3	
	Shop 3	20	1	2	5	2	

Using least cost method, determine the optimal transportation schedule for the firm and hence the minimum cost of transportation. [5 marks]

- (c) A company manufactures three products A, B and C. These products yield a contribution of Sh. 5, Sh. 6 and Sh. 12 respectively. The products use a machine which has 160 hours capacity for the next period. Each unit of the product uses 2 hours, 4 hours and 6 hours respectively of the machine’s capacity. There

are only 120 kgs available in the period of a special component used in production of the three products. The usage is 3 kgs, 2kgs and 4 kgs respectively for the products A, B and C respectively.

**Required:**

- (i) Formulate this as linear programming problem and use simplex method to determine the production plan which maximizes contribution. [12 marks]
- (ii) What will be the maximum contribution? [1 marks]

**SECTION B {Answer any TWO Questions}**

**QUESTION THREE** – [15 marks]

- (a) Explain **four** main components in a waiting line system. [4 marks]
- (b) A bank has one teller. It is estimated that customers arrive according to Poisson distribution at the rate of 2 every 5 minutes and there is enough space to accommodate a line of 10 customers. Other arriving customers can wait outside this space, if necessary. It takes 1½ minutes on average to serve a customer, but the service time actually varies according to an exponential distribution.

**Required:**

- (i) The proportion time the facility remains idle. [2 marks]
- (ii) The expected number of customers waiting but currently not being served at a particular point of time. [2 marks]
- (iii) The expected time a customer spends in the system. [2 marks]
- (iv) The probability that the waiting line will exceed the capacity of the space leading to the counter. [2 marks]
- (v) The average time spent in the queue. [2 marks]
- (vi) The utilization ratio with the cashier functioning as the service mechanism. [1 marks]

**QUESTION FOUR** – [15 marks]

(a) Define the following terms as used in linear programming:

- (i) Feasible solution. [1 marks]
- (ii) Transportation problem. [1 marks]
- (iii) Assignment problem. [1 marks]

b) The *Eldocome Ltd.* is considering an expansion into five new cities. The company has been able to hire four new experienced sales representatives. Upon analysing the new sales representative’s past experience in combination with a personality test which was given to them, the company assigned a rating to each of the sales representatives for each of the cities. These rating are as follows:

Sales-representatives	City				
	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	C <sub>4</sub>	C <sub>5</sub>
S <sub>1</sub>	82	80	84	81	73
S <sub>2</sub>	74	78	86	72	71
S <sub>3</sub>	80	80	83	76	83

S <sub>4</sub>	68	84	79	74	78
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The company knows that with four sales representatives, only four of the five potential cities can be covered.

**Required:**

- (i) The four cities that the sales representatives should be assigned to in order to maximize the total of the ratings. [10 marks]
- (ii) Maximum total rating. [2 marks]

**QUESTION FIVE – [15 marks]**

- (a) Define the following terms used in game theory:
- (i) Two-person zero sum game. [1 marks]
- (ii) Dominance principle. [1 marks]
- (b) Give two limitations of game theory. [2 marks]
- (c) The management of *Migorogoro Ltd* is in the process of deciding whether to agree to negotiate with the striking union employees now or delay. The decision is difficult because the management does not know the union leadership's position. The union leaders may be adamant and insist on their original demands, they may be ready to compromise or may be ready to yield and accept management offer. The matrix of payoffs to management as management sees it, is as shown below. (Figures is in millions shillings).

Management	Union			
	Negotiate	Adamant	Compromise	Yield
		-20	10	20
	Delay	50	-20	-30

**Required:**

- (i) Solve the management's problem. [3 marks]
- (ii) What should be union's strategy? [3 marks]
- (iii) What is the value of the game? [2 marks]
- (iv) Discuss the implications of the conclusion to adopt a random strategy. [2 marks]

**QUESTION SIX – [15 marks]**

- (a) Give two applications of simulation in business. [2 marks]

Sales (Units)	Probability
27	0.10
28	0.15
29	0.20

(b) Horizon	30	0.35	food kiosk
	31	0.15	
	32	0.05	

manufactures 30 cakes per day. The sale of these cakes depend upon demand which has the following distribution:

The production cost and the selling price of each cake are Sh. 40 and Sh. 50 respectively. Any unsold cake is disposed off at a loss of Sh. 15 per unit. There is a penalty of Sh. 5 per unit if the demand is not met.

**Required:**

- (i) Using the following random numbers, compute the total profit/loss for the kiosk for the next 10 days. The random numbers are: 23, 99, 65, 99, 95, 01, 79, 11, 16 and 10. [11 marks]
- (ii) If 29 cakes are produced per day, will it be advantageous or disadvantageous to the kiosk? [2 marks]

————— **END** —————

**Formulae for use (Single Server Queues)**

$$P(n \geq k) = \left(\frac{\lambda}{\mu}\right)^k$$

$$U = \text{Utilization ratio} = \frac{\lambda}{\mu}$$

$$P_0 = \text{Prob} \left[ \begin{array}{l} \text{system is} \\ \text{empty (idle)} \end{array} \right] = 1 - \frac{\lambda}{\mu}$$

$$L_q = \begin{array}{l} \text{average number} \\ \text{in the queue} \end{array} = \frac{\lambda^2}{\mu(\mu - \lambda)}$$

$$L = \begin{array}{l} \text{average number} \\ \text{in the system} \end{array} = \frac{\lambda}{\mu - \lambda}$$

$$W_q = \begin{array}{l} \text{average time} \\ \text{in the queue} \end{array} = \frac{\lambda}{\mu(\mu - \lambda)}$$

$$W = \begin{array}{l} \text{average time} \\ \text{in the system} \end{array} = \frac{1}{\mu - \lambda}$$

Note:

$\lambda$  is the arrival rate.

$\mu$  is the service rate.