



UNIVERSITY OF KELANIYA – SRI LANKA

Centre for Distance and Continuing Education

FACULTY OF COMMERCE & MANAGEMENT STUDIES

Bachelor of Commerce (Special) Degree Third Year Examination (External) – 2024

May - 2026

BCOM E3055 – Operations Research

No. of questions: Five (05)

Time: 03 hours

Answer all the questions

Question No. 01

a) Briefly discuss the importance of the operations research applications in business field.

(04 Marks)

b) *Sunrise Woodworks Ltd.* manufactures two types of chairs: Office Chairs (X_1) and Recliner Chairs (X_2). Each Office Chair yields a profit of Rs. 50, and each Recliner Chair yields a profit of Rs. 70. Determine the optimal production plan to maximize profit using the graphical method.

The production process is subject to the following constraints:

Maximize:

$$Z = 50x_1 + 70x_2$$

Subject to:

$$4x_1 + 5x_2 \leq 2800$$

$$6x_1 + 3x_2 \leq 2700$$

$$x_1 \geq 150$$

$$x_2 \geq 120$$

$$3x_1 + 4x_2 \geq 1600$$

Where:

x_1 = number of office chairs produced

x_2 = number of recliner Chairs produced

Also, $x_1, x_2 \geq 0$

(08 Marks)

c) Nimal Enterprises sells fast-moving spare part. The following information is available.

Annual demand, $D = 18,000$ units

Ordering cost per order, $S = \text{Rs. } 120$

Unit purchase cost, $C = \text{Rs. } 30$

Annual holding cost rate = **25% of unit cost**

Lead time, $L = 10$ days

Number of working days per year = **320 days**

Standard deviation of daily demand, $\sigma_d = 12$ units/day

Desired cycle service level = **95%** (use $z = 1.65$)

You are required to

- i. Calculate the Economic Order Quantity (EOQ).
- ii. Find the safety stock required to achieve the desired service level.
- iii. Compute the reorder point (ROP).

(08 Marks)

(Total 20 Marks)

Question No. 02

a) Explain how Operations Research techniques help to improve decision-making and cost efficiency in a manufacturing organization.

(05 Marks)

b) Following are the details regarding manufacturing of three products using three types of resources. Calculate number of units to be produced to maximize the profit using simplex method.

$$\text{Maximize } Z = 80x_1 + 60x_2 + 90x_3$$

Subject to;

$$20x_1 + 10x_2 + 30x_3 \leq 1000$$

$$10x_1 + 20x_2 + 10x_3 \geq 800$$

$$30x_1 + 20x_2 + 20x_3 \geq 1500$$

$$x_1, x_2, x_3 \geq 0$$

(15 Marks)

(Total 20 Marks)

Question No. 03

- a) Briefly describe the Critical Path Method (CPM) in network analysis. (05 Marks)
- b) A highway road project consists of the following activities with their **optimistic (to)**, **most likely (tm)**, and **pessimistic (tp)** time estimates (in weeks).

Activity	Immediate Predecessors	Optimistic time (to)	Most likely time (tm)	Pessimistic Time (tp)
A	-	1	2	3
B	-	2	3	4
C	A	2	4	6
D	A	3	5	6
E	B	1	2	3
F	C	3	4	5
G	C, D	2	3	8
H	E	2	4	6
I	F	1	2	3
J	G, H	3	5	7
K	I	2	3	4
L	J, K	1	2	3

You are required to

- Compute the expected time (te) and variance for each activity using PERT estimates.
- Draw the project network diagram.
- Identify the critical path(s) and calculate the expected project completion time.

(15 Marks)

(Total 20 marks)

Question No. 04

- a) An organization is required to make two critical operational decisions: first one is allocation of workers to specific jobs within the organization, and second one is the transportation of goods from multiple factories to various markets. Explain the most appropriate Operations Research model applicable to each of the above decision-making situations. Further, justify your choice by comparing the Assignment Problem and the Transportation Problem with respect to their characteristics. (06 Marks)
- b) Lanka Sri Manufacturing Company has three factories (S₁, S₂, S₃) supplying products to four regional warehouses (D₁, D₂, D₃, D₄) in Sri Lanka.

Supply/Demand	D ₁	D ₂	D ₃	D ₄	Supply
S ₁	8	6	10	9	4000
S ₂	9	7	4	2	3000
S ₃	3	4	2	5	5000
Demand	2000	3000	3000	4000	

- i. Find an initial basic feasible solution using the
 - a. North-West Corner Method.
 - b. Least cost method.
 - c. Vogel's approximation method.
- ii. Calculate the minimum total transportation cost.

(14 Marks)

(Total 20 Marks)

Question No. 05

- a) A technology company has designed a smart wearable health tracker and must choose one of the following strategies:

- A. Produce and market the device itself
- B. License the technology to another firm for a royalty payment
- C. Sell the patent outright for a fixed amount.

The expected profit in Rs. '000 under different market conditions and their probability are:

Market Condition	Probability	Produce Itself	Royalty	Sell Patent
High demand	0.25	120	45	30
Moderate demand	0.35	40	30	30
Low demand	0.40	-20	10	30

- i. Draw a decision tree representing the company's problem.
- ii. Extend the tree to include the following additional information:
 - If the company produces the device itself and the demand is high or moderate, it can choose to introduce an advanced AI-enabled version.
 - The company estimates a 70% probability of successful AI integration.
 - The development cost for the AI upgrade is Rs. 25,000, and the net additional returns (after cost) are:
 - High demand: Rs. 50,000 additional profit
 - Moderate demand: Rs. 20,000 additional profit

(08 Marks)

- a) Frosty Cup produces premium ice-cream cups using an automated filling machine. Production is done in lots of 10 cups. Each perfect cup sells for Rs. 180, while the production cost per cup is Rs. 90. Before each lot is produced, the supervisor must choose between two actions:

Option A — Clean and recalibrate the machine

Cost of cleaning + recalibration: Rs. 300 per lot

Guarantee: No defective cups will be produced.

Option B — Run the machine without recalibration

If recalibration is skipped, defects may occur because of filling inaccuracies. Based on past observations, the number of defective cups in a lot of 10 follows the following probability distribution.

Number of Defectives	Probability
0	0.25
1-2	0.30
3-5	0.20
More than 5	0.25

Defective cups cannot be sold as premium items, but Frosty Cup has two recovery options:

Sell as “economy cups” at Rs. 60 each, or Reprocess the entire defective set at a cost of Rs. 40 per defective cup, after which they can be sold as normal premium cups.

As the section supervisor, you are required to construct a decision tree comparing the two alternatives—recalibrating the machine before production or proceeding without recalibration. Using the expected monetary value (EMV) for each option, provide your recommendation to management on which action should be taken.

(12 Marks)

(Total 20 Marks)

