# Eastern University, Sri Lanka
## Faculty of Commerce and Management
### Second Year-Second Semester Examination in BBA/BCom Hons - 2018/2019 (January 2022) [Proper/Repeat]
### MGT 2053 Management Science

**Answer All Five Questions**                               **Time: 03 Hours**

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**Q1.**

The XYZ Sawmill Company's CEO asks to see next month's log transportation schedule to his three sawmills. He wants to make sure he keeps a steady, adequate flow of logs to his sawmills to capitalize on the good timber market. Secondary, but still important to him, is to minimize the cost of transportation. The harvesting group plans to move to three new logging sites. The distance from each site to each sawmill is in Table 1. The average transport cost is Rs. 2 per mile for both loaded and empty trucks. The logging supervisor estimated the number of truckloads of logs coming off each harvest site daily. The number of truckloads varies because landscape and cutting patterns are unique for each site. Finally, the sawmill managers have estimated the truckloads of logs their mills need each day. All these estimates are in Table 1.

**Table 1: Supply and Demand of Sawlogs for the XYZ Sawmill Company**

| Logging Site | Distance to Mill (Miles) | | | Maximum truckloads/day per logging site |
|---|---|---|---|---|
| | Mill A | Mill B | Mill C | |
| 1 | 8 | 15 | 50 | 20 |
| 2 | 10 | 17 | 20 | 30 |
| 3 | 30 | 26 | 15 | 45 |
| Mill demand (truckloads/day) | 30 | 35 | 30 | |

**You are required to:**

**(a)** Determine costs to transport from each site to each mill.                               **(05 Marks)**

**(b)** Determine initial feasible solution by using least cost method.                               **(05 Marks)**

**(c)** Determine the optional solution by using MODI Method.                               **(05 Marks)**

**(d)** Does an alternative optimal solution exist? Explain. If so, find the alternative optimal solution.                               **(05 Marks)**

**(Total 20 Marks)**

## Q2

An electronic firm has signed a contract to install an instrument landing device at the lo[...] airport. The complete installation can be broken down into activities as shown below. T[...] contract specifies that the installation will be completed within **18 days**. There is a pena[...] (extra cost) of **Rs.1000 per day** beyond the **specified time (18 days)**.

| Activity | Preceding Activity | Normal | | Crash | |
|---|---|---|---|---|---|
| | | Days | Cost (Rs.) | Days | Cost (Rs.) |
| A | - | 3 | 3200 | 2 | 3600 |
| B | - | 5 | 5500 | 4 | 6000 |
| C | - | 6 | 5750 | 4 | 7000 |
| D | A | 7 | 7500 | 5 | 8500 |
| E | A | 4 | 4200 | 3 | 4700 |
| F | B, D | 2 | 1800 | 2 | 1800 |
| G | C | 4 | 4250 | 3 | 4850 |
| H | A | 8 | 8500 | 5 | 9600 |
| I | C | 5 | 4750 | 4 | 5350 |
| J | C | 7 | 6750 | 5 | 7350 |
| K | E, F,G | 4 | 4000 | 3 | 4400 |
| L | H, I | 6 | 6500 | 4 | 7500 |
| M | L | 3 | 2800 | 2 | 3350 |
| N | J, K | 5 | 5250 | 4 | 5750 |

(a)   What is the normal time to complete the installation?

(b)   What is the shortest possible time for completing the installation?

(c)   What is the most economical period of time in which to schedule the installation?

(d)   What is the minimum total cost (installation plus penalty)?

(Total 20 Ma[...]

## Q3

(A)   Solve the following maximization problem:
Find the maximum value of

$$Z = 30x_1 + 20x_2 + 30x_3,$$ subject to the constraints:

$$3X_1 + X_2 + 6X_3 \leq 12$$

$$X_1 + X_2 + 2X_3 \leq 8$$

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

(10 Ma[...]

**(B)** Solve the following minimization problem:

Find the minimum value of

$Z = 10x_1 + 3x_2 + 10x_3$, subject to the constraints:

$$4X_1 + X_2 + X_3 \geq 30$$

$$2X_1 + X_2 + 5X_3 \geq 20$$

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

**(10 Marks)**

**(Total 20 Marks)**

**Q4.**

The Road Development Authority (RDA) of Sri Lanka has decided, as a matter of top priority, to build a new road joining the two main cities of Batticaloa and Trincomalee. Because of the need to complete the project as quickly as possible, the work has been divided into five stages which are to be built simultaneously. Within Sri Lanka there are six companies large enough to undertake the construction of any of the five stages and each company has been invited to submit a tender for each stage of the project. The tenders (in millions of Sri Lankan Rupees) are as follows:

| Company | Stage | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| A | 49 | 84 | 63 | 82 | 68 |
| B | 53 | 92 | 62 | No bid | 67 |
| C | 54 | 86 | 67 | 78 | 68 |
| D | 46 | 86 | 62 | 76 | No bid |
| E | 57 | 94 | 66 | 83 | 70 |
| F | 50 | 82 | 65 | 80 | 72 |

**Required:**

(a) Assuming that none of the companies is large enough to undertake the work of more than one stage, advise the RDA how the five contracts should be allocated. What is the minimum total cost for the project?

(b) On speaking to representatives of the six companies, it is discovered that **A, B, D** and **F** have the capacity to undertake any 2 stages simultaneously and that '**C**' can undertake any 3 stages simultaneously. Show how the problem will be solved in this context. What is now the minimum cost allocation of contracts?

**(Total 20 Marks)**

**Q5. Multiple Choice Questions: Select <u>Most Suitable</u> Answer and <u>Provide reason</u> <u>justification (you must show the calculation steps) for your selection.</u>**

(1) The order cost per order of an inventory is Rs. 400/= with an annual carrying cos
Rs.10/= per unit. The Economic Order Quantity (EOQ) for an annual demand of 2
units is:

(A) 600

(B) 400

(C) 500

(D) 550

(E) 480

(2) A company follows an EOQ system for its inventory. The annual demand **(D)** for or
the components that it uses is 5000 units. The cost of the component is Rs. 80 per unit
the cost of order **(Co)** is Rs. 400. The company estimates its carrying costs to be
0.25Q per unit per year. What is EOQ of that component?

(A) 400

(B) 200

(C) 500

(D) 600

(E) 300

(3) If **4** apples and **6** bananas cost **Rs.156** and **9** apples and **7** bananas cost **Rs.260**, what i
cost of **one apple** and **one banana**?

(A) 1 apple costs Rs. 18 and 1 banana costs Rs.14.

(B) 1 apple costs Rs. 14 and 1 banana costs Rs.18.

(C) 1 apple costs Rs. 12 and 1 banana costs Rs.15.

(D) 1 apple costs Rs. 19 and 1 banana costs Rs.16.

(E) 1 apple costs Rs. 10 and 1 banana costs Rs.12.

(4) Demand for the Child Cycle at Best Buy is 500 units per month. Best Buy incurs a fixed order placement, transportation, and receiving cost of Rs. 4,000 each time an order is placed. Each cycle costs Rs. 500 and the retailer has a holding cost of 20 percent. Evaluate the number of computers that the store manager should order in each replenishment lot?

(A) EOQ = 793 units

(B) EOQ = 695 units

(C) EOQ = 693 units

(D) EOQ = 690 units

(E) EOQ = 694 units

(5) The annual demand (D) for a product is 5000 units. The purchasing price of the product is Rs. 80 per unit and the cost of order (Co) is Rs. 400. The company estimates its carrying costs of that product to be (CH) 0.25Q per unit per year. What is the total cost of inventory of that product at EOQ level (including purchasing cost)?

(A) Rs. 430,000

(B) Rs. 415,000

(C) Rs. 200,000

(D) Rs. 397,917

(E) Rs. 420,000

(6) ABC Ltd. uses EOQ logic to determine the order quantity for its various components and is planning its orders. The Annual consumption is 80,000 units, Cost to place one order is Rs. 1,200, Cost per unit is Rs. 50 and carrying cost is 6% of Unit cost. What is the number of order per year?

(A) 10 Orders per year

(B) 11 Orders per year

(C) 12 Orders per year

(D) 14 Orders per year

(E) 13 Orders per year

(7)   The Memorial Casket Company, which has annual sales (D) of 20,000 units. Ordering co
      is Rs. 200 per order. Their purchase cost per unit is Rs. 80, and inventory holding cost
      10% of the price per unit per year. Given the 1000-order quantity, what would be the tot
      annual inventory cost (including purchasing cost)?
      (A)   Rs. 1618,000
      (B)   Rs. 1708,100
      (C)   Rs. 1608,200
      (D)   Rs. 1508,000
      (E)   Rs. 1608,000

(8)   The Memorial Casket Company, which has annual sales (D) of 20,000 units. Ordering co
      is Rs. 200 per order. Their purchase cost per unit is Rs. 80, and inventory holding cost
      10% of the price per unit per year. Memorial's supplier offers a 5% volume discount (pr
      break) on orders of 2000 units or more. What would be the total annual inventory c
      (including purchasing cost)?
      (A)   Rs. 1,618,000
      (B)   Rs. 1,529,600
      (C)   Rs. 1,608,200
      (D)   Rs. 1,508,000
      (E)   Rs. 1,698,000

(9)   A solution that satisfies all the constraints of a linear programming problem except
      nonnegativity constraints is called
      (A)   optimal.
      (B)   feasible.
      (C)   infeasible.
      (D)   semi-feasible.
      (E)   optional.

(10)  Slack
      (A)   is the difference between the left and right sides of a constraint.
      (B)   is the amount by which the left side of a ≤ constraint is smaller than the right side.
      (C)   is the amount by which the left side of a ≥ constraint is larger than the right side.
      (D)   exists for each variable in a linear programming problem.
      (E)   is the amount of shortage in a linear programming problem.

                                                                          (Total 20 Ma