**EASTERN UNIVERSITY SRI LANKA**
**FACULTY OF COMMERCE AND MANAGEMENT**
**POSTGRADUATES STUDIES UNIT**

**FIRST YEAR SECOND SEMESTER EXAMINATION IN**
**MASTER OF BUSINESS ADMINISTRATION - 2018/2019 (July 2020) - PROPER / REPEAT**

**MBA 1073 OPERATIONAL RESEARCH FOR MANAGERIAL DECISION MAKING**

**Number of Questions: Five**

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

---

01. (i) Applied technology, Inc. (ATI), produces bicycle frames using two fiberglass materials that improve the strength-to-weight ratio the frames. The cost of the standard grade material is Rs.750 per meter and the cost of the professional grade material is Rs.900 per meter. One meter of the standard grade material and one meter of the professional grade material contain different amount of carbon fiber, and Kevlar as shown in the following table.

|  | Fiber Contribution | |
|---|---|---|
|  | Standard Grade Material (Per meter) | Professional Grade Material (Per meter) |
| Carbon fiber | 10% | 30% |
| Kevlar | 6% | 12% |

ATI signed a contract with a bicycle manufacturer to produce a new frame with a carbon fiber content of at least 60% and a Kevlar content of not greater than 30%. To meet the required weight specification, a total of 3 meters of standard and professional grade materials must be used in new frame.

a) Formulate a linear programming model to determine the number of meters of each grade of fiberglass material that ATI should use in new frame in order to minimize total cost.

b) Graph the feasible region.

c) Determine the coordinates of each extreme point.

d) Compute the total cost at each extreme point.

e) What is the optimal solution?

f) The distributor of the fiberglass material is currently overstocked with the professional grade material. To reduce inventory, the distributor offered ATI the opportunity to purchase the professional grade for Rs.800per meter. Will the optimal solution change?

g) Suppose that the distributor further lowers the price of the professional grade material to Rs.740 per meter. Will the optimal solution change? What effect would an even lower price for the professional grade material have on the optimal solution? Explain.

**(Total 15 Marks)**

**02.** **(i)** Solve the following linear programming model using simplex method.

Maximize $Z = 5X_1 + 5X_2 + 24X_3$

Subject to

$$15X_1 + 4X_2 + 12X_3 \leq 2800$$
$$15X_1 + 8X_2 \leq 6000$$
$$X_1 + 8X_3 \leq 1200$$
$$X_1, X_2, X_3 \geq 0$$

(12 M

**(ii)** Adiron Savings Bank (ASB) has Rs.1 million in new funds that must be allocated to loans, personal loans, and automobile loans. The annual rates of return for three ty loans are 7% for home loans, 12% for personal loans, and 9% for automobile loans bank's planning committee decided that at least 40% of the new funds must be allo to home loans. In addition, the planning committee specified that the amount allo to personal loans cannot exceed 60% of the amount allocated to automobile loans.

a) Formulate a linear programming model that can be used to determine the amou funds ASB should allocate to each type of loan in order to maximize the total a return for the new funds.

b) Transform the model developed in part (a) into standard form.

c) Hence find the initial basic feasible solution of the model and set up the initial sin table only for the model.

(08 M

(Total 20 M

**03.** **(i)** A manufacturing company produces a product at three plants and shipped to warehouses. The supply capacities of the three plants, the demand requirements warehouses, and the shipping costs per unit are as follows:

| Plant | Warehouses | | | Supply |
|---|---|---|---|---|
| | $W_1$ | $W_2$ | $W_3$ | |
| | Shipping cost per unit (in Rs) | | | |
| $P_1$ | 6 | 7 | 4 | 100 |
| $P_2$ | 5 | 3 | 6 | 180 |
| $P_3$ | 8 | 5 | 7 | 200 |
| Demand | 135 | 175 | 170 | |

The company wants to determine the optimal distribution schedule.

a) Find the total transportation cost for initial allocation with least cost cell metho

b) Determine the minimum (optimum) cost shipping schedule using MODI method

c) Find the total minimum shipping cost.

(10 M

## Area Under Standard Normal Curve



P(0 < Z < z)
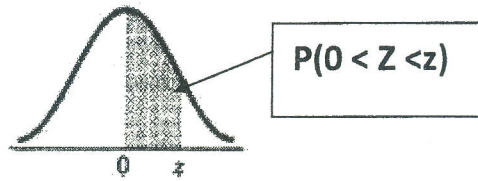
| z | .00 | .01 | .02 | .03 | .04 | .05 | .06 | .07 | .08 | .09 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.0 | .0000 | .0040 | .0080 | .0120 | .0160 | .0199 | .0239 | .0279 | .0319 | .0359 |
| 0.1 | .0398 | .0438 | .0478 | .0517 | .0557 | .0596 | .0636 | .0675 | .0714 | .0753 |
| 0.2 | .0793 | .0832 | .0871 | .0910 | .0948 | .0987 | .1026 | .1064 | .1103 | .1141 |
| 0.3 | .1179 | .1217 | .1255 | .1293 | .1331 | .1368 | .1406 | .1443 | .1480 | .1517 |
| 0.4 | .1554 | .1591 | .1628 | .1664 | .1700 | .1736 | .1772 | .1808 | .1844 | .1879 |
| 0.5 | .1915 | .1950 | .1985 | .2019 | .2054 | .2088 | .2123 | .2157 | .2190 | .2224 |
| 0.6 | .2257 | .2291 | .2324 | .2357 | .2389 | .2422 | .2454 | .2486 | .2517 | .2549 |
| 0.7 | .2580 | .2612 | .2642 | .2673 | .2704 | .2734 | .2764 | .2794 | .2823 | .2852 |
| 0.8 | .2881 | .2910 | .2939 | .2967 | .2995 | .3023 | .3051 | .3078 | .3106 | .3133 |
| 0.9 | .3159 | .3186 | .3212 | .3238 | .3264 | .3289 | .3315 | .3340 | .3365 | .3389 |
| 1.0 | .3413 | .3438 | .3461 | .3485 | .3508 | .3531 | .3554 | .3577 | .3599 | .3621 |
| 1.1 | .3643 | .3665 | .3686 | .3708 | .3729 | .3749 | .3770 | .3790 | .3810 | .3820 |
| 1.2 | .3849 | .3869 | .3888 | .3907 | .3925 | .3944 | .3962 | .3980 | .3997 | .4015 |
| 1.3 | .4032 | .4049 | .4066 | .4082 | .4099 | .4115 | .4131 | .4147 | .4162 | .4177 |
| 1.4 | .4192 | .4207 | .4222 | .4236 | .4251 | .4265 | .4279 | .4292 | .4306 | .4319 |
| 1.5 | .4332 | .4345 | .4357 | .4370 | .4382 | .4394 | .4406 | .4418 | .4429 | .4441 |
| 1.6 | .4452 | .4463 | .4474 | .4484 | .4495 | .4505 | .4515 | .4525 | .4535 | .4545 |
| 1.7 | .4554 | .4564 | .4573 | .4582 | .4591 | .4599 | .4608 | .4616 | .4625 | .4633 |
| 1.8 | .4641 | .4649 | .4656 | .4664 | .4671 | .4678 | .4686 | .4693 | .4699 | .4706 |
| 1.9 | .4713 | .4719 | .4726 | .4732 | .4738 | .4744 | .4750 | .4756 | .4761 | .4767 |
| 2.0 | .4772 | .4778 | .4783 | .4788 | .4793 | .4798 | .4803 | .4808 | .4812 | .4817 |
| 2.1 | .4821 | .4826 | .4830 | .4834 | .4838 | .4842 | .4846 | .4850 | .4854 | .4857 |
| 2.2 | .4861 | .4864 | .4868 | .4871 | .4875 | .4878 | .4881 | .4884 | .4887 | .4890 |
| 2.3 | .4893 | .4896 | .4898 | .4901 | .4904 | .4906 | .4909 | .4911 | .4913 | .4916 |
| 2.4 | .4918 | .4920 | .4922 | .4925 | .4927 | .4929 | .4931 | .4932 | .4934 | .4936 |
| 2.5 | .4938 | .4940 | .4941 | .4943 | .4945 | .4946 | .4948 | .4949 | .4951 | .4952 |
| 2.6 | .4953 | .4955 | .4956 | .4957 | .4959 | .4960 | .4961 | .4962 | .4963 | .4964 |
| 2.7 | .4965 | .4966 | .4967 | .4968 | .4969 | .4970 | .4971 | .4972 | .4973 | .4974 |
| 2.8 | .4974 | .4975 | .4976 | .4977 | .4977 | .4978 | .4979 | .4979 | .4980 | .4981 |
| 2.9 | .4981 | .4982 | .4982 | .4983 | .4984 | .4984 | .4985 | .4985 | .4986 | .4986 |
| 3.0 | .4987 | .4987 | .4987 | .4988 | .4988 | .4989 | .4989 | .4989 | .4990 | .4990 |

(ii)    Five machines are available to process five jobs. Their processing times in hours are given below.

a) Determine the assignment(s) that will minimize the total processing time.
b) What is the total processing time for optimal assignment(s)?
c) If the machine burden rate is Rs.100 per machine hour, for each machine, what is the total optimal machine cost?

**Processing Time in Hours**

| Machines | A | B | C | D | E |
|----------|---|----|----|---|---|
| M1 | 3 | 10 | 3 | 1 | 8 |
| M2 | 7 | 9 | 8 | 1 | 7 |
| M3 | 5 | 7 | 6 | 1 | 4 |
| M4 | 5 | 3 | 8 | 1 | 4 |
| M5 | 6 | 4 | 10 | 1 | 6 |

(12 Marks)
(Total 22 Marks)

04. (i)    a) Each unit of an item costs a company Rs.4,000 with annual holding costs of 18 percent of unit cost for interest charges, 1 percent for insurance, 2 percent allowance for obsolescence, Rs.200 for building overheads, Rs.150 fór damage and loss and Rs.400 miscellaneous costs. If the annual demand for the item is constant at 1,000 units and each order costs Rs.10,000 to place, calculate the economic order quantity and the total cost of stocking the item.

b) If the supplier will only deliver batches of 250 units, how does this affect the costs?

(10 Marks)

(ii)    Tele-Reco is a new store that sells television sets, video games, and other television related products. A new Japanese-manufactured video game costs Tele-Reco Rs.600 per unit. Tele-Reco's annual holding cost is 22% of the value of the inventory. Ordering cost is estimated to be Rs.70 per order.

a) If demand for the new video game is expected to be constant with a rate of 20 units per month, what is recommended order quantity for the video game?
b) What are the estimated annual inventory holding and ordering costs associated with your recommended order quantity?
c) How many orders will be placed per year?
d) With 250 working days per year, what is the cycle time for this product?

(10 Marks)
(Total 20 Marks)

05. (i) A project involving the installation of a computer system comprises eight activitie following table lists immediate predecessors and activity times (in weeks).

| Activity | Immediate predecessors | Time |
|----------|------------------------|------|
| A | - | 6 |
| B | - | 8 |
| C | A, B | 12 |
| D | C | 4 |
| E | C | 6 |
| F | D, E | 15 |
| G | E | 12 |
| H | F, G | 8 |

a) Draw the network diagram for the given project.
b) Identify the critical path.
c) What is the expected completion time for the project?

(13 M

(ii) The following estimates of activity times (in days) are available for a small project

| Activity | Optimistic Time | Most Likely Time | Pessimistic Time |
|----------|-----------------|------------------|------------------|
| A | 4 | 5 | 6 |
| B | 8 | 9 | 10 |
| C | 7 | 7.5 | 11 |
| D | 7 | 9 | 10 |
| E | 6 | 7 | 9 |
| F | 5 | 6 | 7 |

a) Compute the expected activity completion times and variance for each activity
b) An analyst determined that the critical path consists of activities B-D-F. Compu expected project completion time and the variance.
c) What is the probability that this project is completed within 23 days?

(10 M

(Total 23 M