

Faculty of Management Studies, University of Delhi

MBA FT - November, 2019

Paper 6102: Quantitative Methods for Management

Time: 3 hours

Max. Marks: 50

INSTRUCTIONS

- 1 This is a Close-book examination. You are allowed to carry probability distribution tables. Electronic calculator is allowed.
- 2 This question paper contains Four pages and Two sections.
- 3 Attempt any Five questions selecting at least Two from each section. All questions carry equal marks.

Section A

1. (a) A production manager is faced with the problem of how to allocate the manufacturing of a microwave oven between his company and a subcontractor because neither firm can handle the demand alone. Fabrication costs are \$10 per unit within the company and \$20 per unit from the subcontractor; assembly costs are \$8 per unit within the company and \$5 per unit from the subcontractor; and inspection costs are \$3 per unit within the company and \$1 per unit from the subcontractor. The company has a budget of \$120,000 for fabrication, \$40,000 for assembly and \$12,000 for inspection. The contribution to profits is \$60 per unit regardless of which firm does the work.

(i) Formulate the above problem as a linear programming problem.

(ii) What is the optimal solution? How much profit will it yield?

(iii) How much of the total budget will remain unused by the optimal solution?

- (b) Under what circumstances, does an LPP give rise to an unbounded solution?

2. (a) The load master for a freighter wants to determine the mix of cargo to be carried on the next trip. The ship's volume limit for cargo is 100,000 cubic meters and its weight capacity is 2310 tons. The master has five different types of cargo from which to select and wishes to maximize the value of the selected shipment. However, to make sure that none of his customers are ignored, the load master would like to make sure that at least 20% of each cargo's available weight is selected. The specifications for the five cargoes are shown in the following table.

Cargo type	Tons Available	Value per ton	Volume per ton (Cu. Mt.)
A	970	\$1350	26
B	850	\$1675	54
C	1900	\$1145	28
D	2300	\$850	45
E	3600	\$1340	37

Formulate the above problem as a linear programming problem. You are not required to find out solution to the above problem.

- ✓ (b) A group of investors is contemplating opening a number of restaurants in a large metropolitan area. Some of these will offer full-service and some take-out service only. The group has identified five potential locations for take-out restaurants, of which it will select at least three and it has identified six potential locations for full-service restaurants, of which it will select at least two. Operating costs will be \$15,000 per month for take-out service only and \$25,000 per month for full-service restaurants. The group has a monthly budget of \$195,000 for operating costs. Estimated profits are \$5000 per month for take-out service and \$7000 per month for full-service restaurants. The group needs to know how many of each type of restaurant to select with a view to maximizing the profit.

Formulate the above problem as an integer linear programming problem. You are not required to find out solution to the above problem.

(6+4 = 10)

- ✓ 3. (a) Formulate the dual of the following problem.

$$\text{Max } Z = 50X_1 + 80X_2$$

Subject to

$$3X_1 + 5X_2 \leq 45$$

$$4X_1 + 2X_2 \geq 16$$

$$6X_1 + 6X_2 = 30$$

$$X_1, X_2 \geq 0$$

- ✓ (b) A distributor imports olive oil from Spain and Italy in large casks. He then mixes these oils in different proportions to create three grades of olive oil that are sold domestically in the US. The domestic grades include (i) commercial, which must be no more than 35% Italian; (ii) virgin, which may be any mix of the two olive oils; and (iii) extra virgin, which must be at least 55% Spanish. The cost to the distributor for Spanish Olive oil is \$6.50 per gallon. Italian olive oil costs him \$5.75 per gallon. The weekly demand for the three types of olive oils is 700 gallons of commercial, 2200 gallons of virgin and 1400 gallons of extra virgin. How should he blend the two olive oils to meet his demand most economically?

Formulate the above problem as a linear programming problem. You are not required to find out solution to the above problem.

(4+6 = 10)

4. A company can ship its product from any of its three factories, F1, F2, and F3, to any of its retail outlets, R1, R2, and R3. The capacity, demand, and shipping cost information is provided as follows:

Demand (units)

Capacity (units)

R1: 300 F1: 250
R2: 500 F2: 350
R3: 200 F3: 400

Shipping Cost/unit (\$)			
	R1	R2	R3
F1	1	3	2
F2	3	4	2
F3	2	2	3

The company wants to come up with an optimal shipping strategy that will allow it to minimize its total shipping cost.

Sensitivity Report

Adjustable Cells

Cell	Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowable Decrease
\$B\$9	X1	250	0	1	1	1E+30
\$C\$9	X2	0	1	3	1E+30	1
\$D\$9	X3	0	2	2	1E+30	2
\$B\$10	X4	50	0	3	1	1
\$C\$10	X5	100	0	4	1	1
\$D\$10	X6	200	0	2	2	1E+30
\$B\$11	X7	0	1	2	1E+30	1
\$C\$11	X8	400	0	2	1	1E+30
\$D\$11	X9	0	3	3	1E+30	3

Constraints

Cell	Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowable Decrease
\$E\$9	F1	250	-2	250	50	0
\$E\$10	F2	350	0	350	0	1E+30
\$E\$11	F3	400	-2	400	100	0
\$B\$12	R1	300	3	300	0	50
\$C\$12	R2	500	4	500	0	100
\$D\$12	R3	200	2	200	0	200

Use the Sensitivity Report to answer the following questions:

- Will any of the retail outlets experience any shortages in meeting their demand requirements if we implement the optimal solution?
- Will any of the factories have any remaining quantities of the product if we implement the optimal solution?
- What is the total minimal shipping cost?
- Suppose that the shipping cost per unit for variable X1 (i.e., route F1-R1) increases to \$2.00. What impact will this have on the current optimal solution and the objective function value?
- Suppose that the shipping cost per unit for variable X6 (i.e., route F2-R3) increases by \$2.00 to \$5.00. What impact will this have on the current optimal solution and the objective function value?

Section B

A market research firm used a sample of individuals to rate the purchase potential of a particular product before and after the individuals saw a new television commercial about the product. The purchase potential ratings were based on 0 to 10 scale, with higher values indicating a higher purchase potential. Test the hypothesis that the commercial improved the mean purchase potential rating. Use level of significance 5% and comment on the value of the commercial.

Individual:	1	2	3	4	5	6	7	8
Purchase rating: After	6	6	7	4	3	9	7	6
Purchase rating: Before	5	4	7	3	5	8	5	6

f-value - ✓

Each day the major stock markets have a group of leading gainers in price (stocks that go up the most). On one day the standard deviation in the percent change for a sample of 12 NASDAQ leading gainers was 15.2. On the same day, the standard deviation in the percent change for a sample of 12 NYSE leading gainers was 8.9. Conduct a significance test for equal population variances to see whether it can be concluded that there is a difference in the volatility of the leading gainers on the two exchanges. What is your conclusion at 5% level of significance? (6, 4)

The ABC Investment Company is in the business of making bids on investments offered by various firms that desire additional financing. The company has collected the following data on yearly investments and interest rates

Year :	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Investments:	1060	940	920	1110	1590	2050	2070	2030	1780	1420
Interest rates(%):	4.8	5.1	5.9	5.1	4.8	3.8	3.7	4.5	4.9	6.2

Is the relationship between these variables significant? If the average interest rate is 4% five years from now, can yearly investment be forecast for 2019?

(10)

Security investments use three methods to select stocks for their portfolio. Use at 5% level of significance, to determine if there is a significant difference in the rates of return for each method based on the following data.

Portfolio	Rate of return						
A	29	17	14	28	27	22	22
B	27	20	13	15	22	21	--
C	38	28	27	34	32	---	---

A vending machine automatically pours soft drinks into cups. The amount of soft drink dispensed into a cup is normally distributed with mean 7.6 oz and standard deviation 0.4 oz.

- Estimate the probability that the machine will overflow an 8 oz cup
- Estimate the probability that the machine will not overflow an 8 oz cup
- The machine has just been loaded with 850 cups. How many of these do you expect will overflow when served? (7,3)