

MBA (Full-Time) I year
Semester I Examination 2021

Paper No: MBFT- 6102 Data Analysis & Decision Tools

Time: 3 hours

Max. Marks: 70

INSTRUCTIONS: The question paper contains seven questions in six pages. Attempt any Five questions selecting at-least TWO questions from each section All questions carry equal marks.

Section A

- 1(a) The daily trading volumes (millions of shares) for stocks traded at the New York Stock Exchange for 12 days in October 2007 are shown here.

917	983	1046	944	723	783
813	1057	766	836	992	973

The probability distribution of trading volume is approximately normal.
What is the probability that on a particular day the trading volume will be less than 800 million shares? If the exchange wants to issue a press release on the top 5% of trading days, what volume will trigger a release? (7)

- (b) Citibank reviews its credit card policy with the intention of recalling some of its credit cards. The data shows that approximately 5% of cardholders defaulted in the past, leaving the bank unable to collect outstanding balances. The bank also found that the probability of missing a monthly payment is 0.2 for customers who do not default. Of course, the probability of missing a payment for those who default is 1.
- (i) What is the probability that the customer will default if he missed a monthly payment?
- (ii) The bank would like to recall its card if the probability that a customer will default is greater than 0.20. Should the bank recall its card if the customer misses a monthly payment? Why or not Why? (7)

- 2(a) Conduct a statistical test to determine is a significant difference between the Mean and variances in the bag weights for the two machines. Use a 10% level of significance when weights are normally distributed. What is your conclusion? Which machine, if either, provides the greater opportunity for quality improvements?

	No of Observations	Mean	Standard Deviation
Machine 1	25	5.9	2
Machine 2	22	6.3	1.9

(7)

- (b) In a study of brand loyalty in the automotive industry, new-car customers were asked whether the make of their new car was the same as the make of their previous car. The breakdown of 600 responses shows the brand loyalty for domestic, European and American cars.

Purchaser	Domestic	European	American
Same make:	125	55	68
Different make:	140	105	107

Test a hypothesis to determine. Whether brand loyalty is independent of the manufacturer. Use level of significance 5%. What is your conclusion? If a significant difference is found, which manufacturer appears to have the greatest brand loyalty?

(7)

3. Use a suitable test to determine whether there is a difference in the average income of families who make purchases from Wal-Mart retail stores and families who do not make purchases from Wal-Mart retail stores, at a 5% level of significance.

Annual income of families making purchases from Wal-Mart (in dollars)	Annual income of families who do not make purchases from Wal-Mart (in dollars)
\$24500	\$41000
39400	32500
36800	33000
43000	21000
57960	40500
32000	32400
61000	16000
34000	21500

43500	39500
55000	27600
39000	43500
62500	51900
61400	27800
53000	----

(7)

- (b) Use a suitable test on the Vaccine testing data given below to determine whether there is a difference in the antibodies produced (in thousands) against the Covid-19 Virus by the four vaccinees in the trials done on the four age groups, at a 5% level of significance.

Vaccine	AGE			
	20-40 Years	40-60 Years	60-80 Years	80 Years and above
CoVaxine	46.00	40.10	46.00	46.70
Covishield	47.70	50.90	49.30	49.40
Sputinik	40.80	36.70	32.70	34.70
mRNA(phizer)	71.30	72.00	68.50	71.50

(7)

Section B

4. The manager of an inspection department has been asked to help reduce a backlog of safety devices that must be inspected. There are two types of safety devices: one for construction workers and one for window washers. The manager will be permitted to select any combination of items because new testing equipment will soon be available that will handle the remaining items. However, in the short run, the manager has been asked to help generate revenue. The revenue for each construction device is \$60 and the same for each window-washing device is \$40. The manager has obtained data on the necessary inspection operations, which are as follows:

Operation	Time per unit (minutes)		Total time available (minutes)
	Construction	Window-washing	
Test #1	$\frac{3}{4}$	$\frac{1}{3}$	75
Test #2	$\frac{1}{4}$	$\frac{1}{2}$	50
Test #3	$\frac{1}{2}$	$\frac{1}{4}$	40

- (i) Formulate the above as a linear programming problem.
- (ii) Determine the optimal values of the decision variables and the revenue that will result.
- (iii) Which testing operations will have slack time? How much?
- (iv) Is any constraint redundant? Which one? Why?

(14)

5. (a) An investment company currently has \$1 million available for investment in five different stocks. The company wants to maximize the interest earned over the next year. The five investment possibilities along with the expected interest earned are shown below. To manage risk, the investment firm wishes to have at least 35% of the investment in stocks A and B. Furthermore, no more than 15% of the investment may be in stock E.

<u>Investment</u>	<u>Expected Interest Earned (%)</u>
Stock A	7
Stock B	9
Stock C	8
Stock D	10
Stock E	11

Sensitivity Report

Adjustable Cells

Cell	Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowable Decrease
\$B\$4	Stock A	0	-0.02	0.07	0.02	1E+30
\$C\$4	Stock B	350000	0	0.09	0.01	0.02
\$D\$4	Stock C	0	-0.02	0.08	0.02	1E+30
\$E\$4	Stock D	500000	0	0.1	0.01	0.01
\$F\$4	Stock E	150000	0	0.11	1E+30	0.01

Constraints

Cell	Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowable Decrease
\$G\$7	Constraint 1	1000000	0.1	1000000	1E+30	500000
\$G\$8	Constraint 2	350000	-0.01	350000	500000	350000
\$G\$9	Constraint 3	150000	0.01	150000	500000	150000

Answer the following questions:

- (i) What is the optimal total expected interest earned for next year?
- (ii) Which constraints are binding? Which constraints are not binding?
- (iii) What would be the impact on the optimal allocation if the expected interest earned on stock A decreases to 6%?
- (iv) What would be the impact on the optimal allocation if the expected interest earned on stock A increases to 10%?
- (v) What would be the impact on the optimal allocation and the objective function value if

the expected interest earned on stock B decreases by 1%?

- (vi) Suppose that total investment in stocks A and B must be at least 40% of the total amount available for investment (i.e., \$400,000). What impact would this have on the current optimal objective function value?
- (vii) Is the solution to the problem unique or are there alternate optimal solutions?
- (viii) Is the solution to the problem unique or are there alternate optimal solutions?

(b) What do you understand by reduced cost?

(12+2=14)

6. (a) An airline with operations in San Diego, California must staff its ticket counters inside the airport. Ticket attendants work 6-hour shifts at the counter. There are two types of agents: those who speak English as a first language and those who are fully bilingual (English and Spanish). The requirements for the number of agents depend on the number of people expected to pass through the airline's ticket counters during various hours. The airline believes that the need for agents between the hours of 6 am and 9 pm are as follows:

	6 to 9 am	9 to 12 noon	12 noon to 3 pm	3 to 6 pm	6 to 9 pm
Agents needed	12	20	16	24	12

Agents begin work either at 6 am, 9 am, 12 noon or 3 pm. The shifts are designated as shifts A, B, C and D respectively. It is the policy of the airline that at least half of the agents needed in any time period will speak English as their first language. Further, at least one-quarter of the agents needed at any time should be fully bilingual. How many and what type of agents should be hired for each shift to meet the language and staffing requirements for the airline so that the total number of agents is minimized? Formulate the above problem as a linear programming problem. You are not required to find out the solution to the above problem.

(b) The owner of a new cab company wants to determine locations for cab waiting points. He has gathered the following information:

Location	Can serve areas	Cost per day
1	A,E	\$400
2	A,C,D	500
3	B,C,E	450
4	B,D	440
5	D,E	430

The owner wants to be sure that all areas can be served, yet he wants this done for as little cost as possible. Formulate the above problem.

(8+6 = 14)

7. (a) An investment corporation has identified four small apartment buildings in which it would like to invest. The three banks generally used by the investment corporation have provided the quotes on the interest rates they would charge to finance each purchase. The banks have also advised the Corporation of the maximum amount of money they are willing to lend at this time. The Corporation would like to purchase as many buildings as possible while paying the lowest possible amount in total interest. More than one bank can be used to finance the same property. What should the Corporation do? You may use excel solver to find out the solution.

Banks	Property (Interest rates)				Max credit
	Hill Street	Banks Street	Park Avenue	Drury Lane	
First Homestead	8%	8%	10%	11%	\$80,000
Commonwealth	9%	9%	12%	10%	\$100,000
Washington Federal	9%	11%	10%	9%	\$120,000
Loan required	\$60,000	\$40,000	\$130,000	\$70,000	

- (b) A trauma centre keeps ambulances at locations throughout the east side of a city in an attempt to minimize the response time in the event of an emergency. The times, in minutes, from the ambulance locations to the population centres are given in the following table.

Ambulance locations	Population centres			
	East	North-East	South-East	Central
Site 1	12	8	9	13
Site 2	10	9	11	10
Site 3	11	12	14	11
Site 4	13	11	12	9

Find the optimal assignment of ambulances to population centres that will minimize the total emergency response time. Use Hungarian method of assignment to find out the optimal assignment.

$$(7+7 = 14)$$