No. of Printed Pages : 9 **MSTE-002**

POST GRADUATE DIPLOMA IN APPLIED STATISTICS (PGDAST)

Term-End Examination

December, 2020

MSTE-002 : INDUSTRIAL STATISTICS—II

Time : 3 Hours *Maximum Marks : 50*

Note : (*i*) *Question no.* ***1*** *is compulsory.*

(*ii*) *Attempt any* ***four*** *questions from the remaining question nos.* ***2*** *to* ***7****.*

(*iii*) *Use of scientific calculator (non-programmable) is allowed.*

(*iv*) *Use of Formulae and Statistical Table Booklet for PGDAST is allowed.*

(*v*) *Symbols have their usual meanings.*

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1. State whether the following statements are True *or* False. Give reasons in support of your answers : $5 \times 2 = 10$

   (a) The error term e in the regression model :

   $$Y = a + bX + e$$

   always has mean 0 and variance 1.

(b) The forecast values of the following data using exponential smoothing, method with weight $w = 0.1$ are 5, 4.8 and 4.72 respectively :

Year	**Production (in '000)**
2015	5
2016	3
2017	4

(c) A mobile repairman finds that the time spent on his job follows an exponential distribution with average 20 minutes. He repairs mobile sets on the basis of first come first serve pattern. If the arrival of mobiles is approximately Poisson with an average rate of 12 per 12-hour day, then repairmen's expected idle time each day is 8 hours.

(d) A region **R** is convex if and only if, for any two points (x_1, y_1) and (x_2, y_2) on the region **R**, the point :

$$(\lambda x_1 + (1 - \lambda)\, y_1, \lambda x_2 + 1\,(1 - \lambda)\, y_2)$$

lies entirely in R.

(e) If there are 3 equations having 4 variables in an LPP, then the maximum number of possible basic solutions is 4.

2. A manufacturer has three distribution centres at D_1, D_2 and D_3. These centres have availability of 30, 25 and 35 units of products respectively. His/her retail outlets at R_1, R_2, R_3 and R_4 require 20, 10, 20 and 40 units of the products, respectively. The transportation cost (in ₹) per unit between each centre and outlet is given below :

Distribution Centre	Retail Outlet R_1	R_2	R_3	R_4
D_1	19	30	50	10
D_2	70	30	40	60
D_3	40	8	70	20

(a) Find initial basic feasible solution to minimise the cost of transportation using Vogel's approximation method. 4

(b) Determine optimal solution by MODI method. 6

3. A pharmaceutical company is producing a single product and is selling it through five agencies situated in different cities. All of a sudden, there is a demand for the product in another five cities not having any agency of the company. The company is facing the problem in deciding how to assign the existing agencies to dispatch the product to deficit cities in such a way that the travelling distance is minimized. The distance between the agencies and deficit cities (in km) is given in the following table : 10

		Deficit City				
		M	N	O	P	Q
Agency	A	160	130	115	190	200
	B	135	120	130	160	175
	C	140	110	125	170	185
	D	50	50	80	80	110
	E	55	35	80	80	105

Determine the optimum assignment schedule so as to minimise the total travelling distance.

4. A company believes that the number of salespersons employed is a good predictor of sales. The following table exhibits sales (in thousand rupees) and number of salespersons employed for different years :

Sales	**No. of Salespersons**
12	10
13	15
11	12
15	18
18	21
18	22
14	19
13	15

(i) Draw the scatter diagram to the data. 2

(ii) Fit a regression line. 5

(iii) Comment on the goodness of fit of the regression line after calculating the coefficient of determination. 3

5. The following data give the average quaterly prices of a commodity for three years : 10

Quarter \ Year	**2015**	**2016**	**2017**
I	13	14	15
II	12	16	15
III	15	18	18
IV	15	17	19

Compute seasonal indices using ratio to moving average method.

6. (a) A firm makes two types of furniture : chairs and table. The contribution to profit by each product calculated by the account department is ₹ 500 per chair and ₹ 800 per table. Both the products are to be produced on three machines M_1, M_2 and M_3. The time required (in hours) by each product and total time available (in hours) per week on each machine are as given ahead :

Machine	Chair	Table	Available (Time)
M_1	3	3	36
M_2	5	2	50
M_3	2	6	60

How should the manufacturer schedule his production in order to maximize the profit ? 6

(b) A company requires 1500 units per month. The ordering cost is estimated to be ₹ 50 per order. The carrying cost is 5% per unit of average inventory per year. The purchase price is ₹ 50 per unit, Find the economic lot size to be ordered and the total minimum cost. 4

7. (a) A machine operator has to perform two operations, turning and threading, on a number of different jobs. The time required

to perform these operations (in minutes) for each job is given below :

Job	**Time of turning (in minutes)**	**Time of threading (in minutes)**
1	3	8
2	12	10
3	5	9
4	2	6
5	9	3
6	11	1

(i) Determine the order in which the jobs should be processed in order to minimise the total time required to turnout all the jobs. 2

(ii) Find the minimum elapsed time. 3

(b) Compute a 3-year moving average for the following data : 3

Year	Sales
2010	43
2011	47
2012	51
2013	52
2014	49
2015	50
2016	52
2017	54

(c) Define time series with an example. 2