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MSTE-002

**POST GRADUATE DIPLOMA IN
APPLIED STATISTICS (PGDAST)**

Term-End Examination

December, 2021

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 questions 2 to 7.*

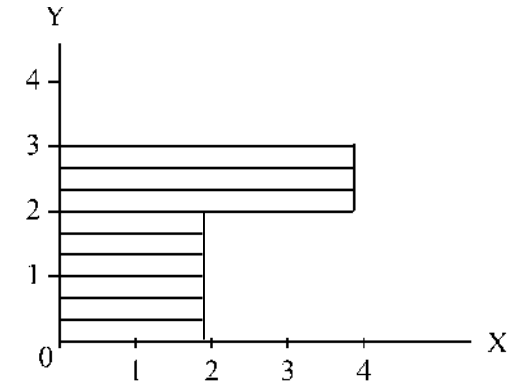
(iii) *Use of scientific calculator (non-programmable) is allowed.*

(iv) *Use of Formulae and Statistical Tables booklet for PGDAST is allowed.*

(v) *Symbols have their usual meanings.*

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

(a) The region given below is convex.



- (b) Customers arrive at a railway ticket window, according to Poisson distribution with mean 30 customers per hour. Service time per customer is exponential with mean 90 seconds. The average waiting time of a customer in a queue is 4.5 minutes.
- (c) In stepwise method of selection of variables in regression analysis, we start with inclusion of all independent variables in the model and extract variables from the model one at a time.

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(d) If production of a company is stopped due to the strike of workers of the company, then we can say that seasonal component is present in the time series of production of the company.

(e) An auto-regressive AR (2) model :

$$X_t = 0.80 X_{t-1} - 0.60 X_{t-2} + a_t$$

is stationary.

2. Find the solution of the following LPP : 10

max :

$$z = 5x_1 + 10x_2 + 8x_3$$

subject to :

$$3x_1 + 5x_2 + 2x_3 \leq 60$$

$$x_1 + x_2 + x_3 \leq 18$$

$$2x_1 + 4x_2 + 5x_3 \leq 100$$

and

$$x_1, x_2, x_3 \geq 0.$$

3. (a) A project work consists of four major jobs for which an equal number of contractors have submitted tenders. The tender

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amount quoted (in lakhs of rupees) is given in the following matrix :

		Job			
		<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>
Contractor	1	10	24	30	15
	2	16	22	28	12
	3	12	20	32	10
	4	9	26	34	16

Find the assignment which minimises the total cost of the project. 7

(b) The production department of a company requires 3600 kg of raw material for manufacturing a particular item per year. It has been estimated that the cost of a placing an order is ₹ 36 and the cost of carrying inventory is 25 percent of the investment in the inventories. The price of the inventory is ₹ 10 per kg. Find the lot size to be ordered and total minimum cost. 3

P. T. O.

4. The following data represent a sample of water consumption of a day and high temperature for that day :

Water use (millions of gallons)	Temperature (degree Fahrenheit)
219	103
56	39
106	77
129	78
68	50
184	96
150	90
112	75

If a researcher observed that $SS_{XY} = 8105$, $SS_X = 21426$, $\bar{X} = 128$ and $\bar{Y} = 76$, then :

- (i) Develop a regression line to predict the amount of water used in a city for the given high temperature. 2
- (ii) Find out the residuals and standardised residuals for the fitted regression model. 3

- (iii) Draw the corresponding residual plot and give your conclusion on the basis of the plot. 2
- (iv) Test the significance of the fitted regression model. 3
5. A series of 8 consecutive yields from a batch of chemical process are given as follows :
40, 45, 47, 38, 50, 42, 45, 45
Calculate mean autocovariance c_1, c_2, c_3 and autocorrelation coefficient r_1, r_2, r_3 . Also plot correlogram for lag 1 to 3. 10
6. (a) The time series of annual output (in '000) of a factory for the period 2013-2018 is given below :

Year	Output
2013	15
2014	20
2015	18
2016	16
2017	20
2018	22

Use the smoothing coefficient 0.4 to compute the exponentially smoothed series. Also calculate forecast error. 5

- (b) A company has factories F_1, F_2 and F_3 which supply to warehouses at W_1, W_2 and W_3 . Weekly factory capacities are 200, 160 and 90 units, respectively. Weekly warehouse requirements are 180, 120 and 150 units respectively. Unit shipping costs (in rupees) are as follows : 5

	W_1	W_2	W_3
F_1	16	20	12
F_2	14	8	18
F_3	26	24	16

Find the basic feasible solution using least cost method.

7. (a) In a study of 10 firms, the dependent variable was the total delivery time (Y) and the independent variables were the distance covered (X_1) and the packing time (X_2). The results obtained were :

$$\begin{aligned} \Sigma Y &= 166, \quad \Sigma X_1 = 747, \quad \Sigma X_2 = 260, \\ \Sigma Y^2 &= 2908, \quad \Sigma X_1^2 = 58189, \quad \Sigma X_2^2 = 7500, \\ \Sigma X_1 Y &= 11901, \quad \Sigma X_2 Y = 4535, \\ \Sigma X_1 X_2 &= 18610. \end{aligned}$$

Estimate the regression coefficients. Also find the regression equation.

P. T. O.

- (b) Find the sequence that minimises the total elapsed time required to complete the following tasks on two machines : 5

Task	Machine I	Machine II
A	2	6
B	5	8
C	4	7
D	9	4
E	6	3
F	8	9
G	7	3
H	5	8
I	4	11

Also calculate the idle time on machine I and machine II. 5