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**MSTE–002**

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

**Term-End Examination**

**June, 2024**

**MSTE-002 : INDUSTRIAL STATISTICS—II**

*Time : 3 Hours*

*Maximum Marks : 50*

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**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 Tables 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 answer :

$$5 \times 2 = 10$$

(a) If a system of simultaneous equations is given as :

$$2x_1 + 3x_2 + 4x_3 = 5 \text{ and}$$

$$3x_1 + 4x_2 + 5x_3 = 6$$

then the maximum number of basic solutions of the system of equations is 4.

**P. T. O.**

- (b) A company has a steady demand of a product of 40 items per month. The purchase cost is ₹ 6 per item and the cost of ordering and procuring the material is ₹ 15 per occasion. If holding cost is 20% per annum, the company should replenish stock 4.36 times per year.
- (c) For the given five values 15, 24, 18, 33, 42, the three year moving averages are 19, 30, 31.
- (d) For a multiple regression model, the following information are given :  
 $R^2 = 0.933$ ,  $n = 10$  and  $k = 2$   
 The adjusted  $R^2$  will be 0.925 for this model.
- (e) A stationary process  $Y_t = X_t + \mu$  is said to be an autoregressive process, if :

$$X_t = \alpha_1 X_{t-1} + \alpha_2 X_{t-2}^2 + \dots + \alpha_p X_{t-p}^p + a_t$$

2. Use simplex method to maximize : 10

$$Z = 5x_1 + 4x_2$$

Subject to :

$$4x_1 + 5x_2 \leq 10$$

$$3x_1 + 2x_2 \leq 9$$

$$8x_1 + 3x_2 \leq 12$$

$$x_1, x_2 \geq 0.$$

3. (a) Solve the following transportation problem : 5

		Destination				Availability
		1	2	3	4	
Source	1	21	18	25	13	11
	2	17	16	14	23	13
	3	32	27	18	41	19
Requirement		6	10	12	15	43

- (b) A department head has four subordinates and four tasks have to be performed. Subordinates differ in efficiency and tasks differ in their intrinsic differently. The time taken by each subordinate to perform each task is given in the effectiveness matrix given as follows : 5

		Subordinates			
		I	II	III	IV
Tasks	A	8	26	17	11
	B	13	28	4	26
	C	38	19	18	15
	D	19	26	24	10

How should the tasks be allocated, one to man, so as to minimize to total man hours ?

4. The arrivals of a machinist at a tool crib is considered to be Poisson distributed at an average rate 6 per hour. The duration of time, the machinist must remain at the tool crib is exponentially distributed with average time of 0.05 hours.
- (a) What is the probability that a machinist arriving at the tool crib will have to wait ?
  - (b) What is an average number of machinists at the tool crib ?
  - (c) The company will install a second tool crib when convinced that a machinist would have to spend 6 minutes in waiting and being served at the tool crib. At what rate should the arrival of machinists to the tool crib be increased to justify the addition of second crib ?
5. The sales data of 10 months for a coffee house situated near a prime location of city comprising the number of customers (in hundreds) and monthly sales (in thousand rupee) are given as follows :

S. No.	Number of Customers (in hundred)	Monthly Sales (in thousand ₹)
1	6.0	01
2	6.1	06
3	6.2	08
4	6.3	10
5	6.5	11
6	7.1	20
7	7.6	21
8	7.8	22
9	8.0	23
10	8.1	25

Calculate SSRes as an estimate of  $\sigma^2$ . Use this estimate for calculating the variances of  $\hat{a}$  and  $\hat{b}$ .

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6. (a) A statistician collected data of 78 values with two independent variables  $X_1$  and  $X_2$ . The following four models were considered one at a time :
- (i)  $Y = B_0 + e$
  - (ii)  $Y = B_0 + B_1 X_1 + e$
  - (iii)  $Y = B_0 + B_2 X_2 + e$

$$(iv) Y = B_0 + B_1 X_1 + B_2 X_2 + e$$

The results obtained were  $SS(B_0) = 652.42$ ,  
 $SS(B_0B_1) = 679.34$ .  $SS(B_0, B_2) = 654.00$ ,  
 $SS(B_0, B_1, B_2) = 687.79$  and  $\hat{\sigma}_2 = 0.91$ .

Find the additional contribution of  
 (i)  $X_2$  over  $X_1$  (ii)  $X_1$  over  $X_2$ .

Test whether their inclusion in the model  
 is justified. 5

- (b) The average quarterly prices of a  
 commodity for four year are given as  
 follows :

Years	Quarter I	Quarter II	Quarter III	Quarter IV
2009	544	590	616	653
2010	472	501	521	552
2011	501	531	553	595
2012	403	448	460	480

Determine the seasonal indices for the  
 given data. 5

7. (a) Ten successive observations on a  
 stationary time services are as follows :  
 1.6, 0.8, 1.2, 0.5, 0.6, 1.5, 0.8, 1.2, 0.5, 1.3  
 Plot the observations and calculate  $r_1$ . 7
- (b) Differentiate between additive and  
 multiplicative models with examples. 3

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