

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

**Term-End Examination**

**December, 2016**

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

*Time : 3 hours*

*Maximum Marks : 50*

**Note :**

- (i) *Attempt all questions. Questions no. 2 to 5 have internal choices.*
- (ii) *Use of scientific calculator is allowed.*
- (iii) *Use of Formulae and Statistical Tables Booklet for PGDAST is allowed.*
- (iv) *Symbols have their usual meaning.*

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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 number of possible basic solutions in an LPP of order  $2 \times 3$  is 5.
    - (b) If there are 3 jobs to be performed, one at a time on each of the 2 machines, then the possible number of sequences would be 36.
    - (c) If the average expenditure of 10 families is ₹ 5,000, the average number of family members is 4 and the slope is 200.5 for a regression equation of monthly expenditure on the number of family members, then the value of the intercept will be 580.

(d) A correlogram suggests that the observations with larger lag are positively correlated.

(e) The average queue length of an  $M/M/1$  queue is 2, where 2 per minute is the arrival rate and 4 per minute is the service rate.

2. An electronic firm manufactures transistors, resistors and carbon tubes with a profit of ₹ 10, ₹ 6 and ₹ 4, respectively, for a shipment. To produce a shipment of transistors, 1 hour of engineering, 10 hours of direct labour and 2 hours of administrative services are required. To produce one shipment of resistors, 1, 4 and 2 hours are required for engineering, direct labour and administrative services, respectively. To produce one shipment of tubes, 1 hour of engineering, 5 hours of direct labour and 6 hours of administrative services are required. There are 100 hours of engineering, 600 hours of direct labour and 300 hours of administrative services. What is the most profitable mix using the Simplex Method ?

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**OR**

A manufacturer has distribution centres at X, Y and Z. These centres have availability of 30, 25 and 35 units of the product, respectively. His retail outlets at A, B, C and D require 20, 10, 20 and 40 units, respectively. The transport cost (in ₹) per unit between each centre outlet is given below :

Distribution Centre	Retail Outlets			
	A	B	C	D
X	55	35	40	50
Y	35	30	50	45
Z	40	60	45	35

Determine the optimal distribution to minimise the cost of transportation using Vogel and MODI methods.

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3. (a) A private firm employs typists on an hourly rate for their daily work. Five typists are working in that firm and their charges and speeds are different. Only one job is given to one typist. Find the least cost allocation and minimum cost for the following data :

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Typist \ Job	Job				
	1	2	3	4	5
A	75	65	55	75	65
B	80	90	56	80	68
C	65	56	47	65	59
D	70	62	50	70	62
E	66	54	46	62	58

- (b) A supermarket has a single cashier. During the peak hours, customers arrive at a rate of 20 customers per hour. The average number of customers that can be processed by the cashier is 24 per hour.

Calculate :

- (i) The average number of customers in the system
- (ii) Average waiting time of a customer in queue

1+1

**OR**

- (a) Seven jobs go first over Machine 1 and then over Machine 2. Processing times in hours are given as follows :

Job	A	B	C	D	E	F	G
Machine I	6	24	30	12	20	22	18
Machine II	16	20	20	12	24	2	6

Find the optimum sequence in which the jobs should be processed. Also obtain the minimum elapsed time and the idle time for each machine.

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- (b) The production department of a company requires 7200 kg of raw material for manufacturing a particular item per year. It has been estimated that the cost of placing an order is ₹ 72 and the cost of carrying inventory is 25 percent of the cost of the

inventory. The price is ₹ 20 per kg. The purchase manager wishes to determine an ordering policy for raw material. Find the (i) economic lot size, (ii) number of orders placed per year, and (iii) total minimum cost. 3

4. The marketing manager of a large supermarket chain would like to use shelf space to predict the sales of pet food. A random sample of 12 equal sized stores is selected, with the following results :

Store	Shelf Space (X) (in feet)	Weekly Sales (Y) (in '000 ₹)
1	5	16
2	5	22
3	5	14
4	10	19
5	10	24
6	10	26
7	15	23
8	15	27
9	15	28
10	20	26
11	20	29
12	20	31

- (a) Predict the weekly sales of the pet food for stores with 8 feet of shelf space for pet food.

- (b) Estimate the variance of error.
- (c) Is there any evidence of a linear relationship between shelf space and sales at 5% level of significance ?

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**OR**

A firm conducted a study on its employees to examine the relationship between their personality and IQ. For this purpose, ten employees were selected and one IQ as well as two different personality tests were given to them. The results obtained on IQ level ( $y$ ), test I ( $x_1$ ) and test II ( $x_2$ ) are given below :

$$n = 10, \sum y = 900, \sum x_1 = 70, \sum x_2 = 80,$$

$$\sum x_1 y = 6400, \sum x_2 y = 7100, \sum x_1^2 = 510,$$

$$\sum x_2^2 = 650, \sum x_1 x_2 = 560 \text{ and } \sum y^2 = 82700$$

Using the matrix method,

- (a) fit a multiple linear regression model.
- (b) compute the value of the coefficient of determination and interpret the result.

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5. A company is interested in forecasting the demand for one of its products. The data on demand for the last 12 months are given below :

Month	Demand (100 units)
1	15
2	14
3	16
4	17
5	15
6	18
7	20
8	22
9	23
10	21
11	24
12	26

- (a) Forecast the demand for the 13<sup>th</sup> month using exponential smoothing technique for  $w = 0.2$ .
- (b) Compute the 3-monthly moving average for this data.
- (c) Plot the demands obtained by 3-monthly moving average and exponential smoothing method along with the given data. 5+3+2

**OR**

- (a) Define Autoregressive process.
- (b) For the following Autoregressive model

$$X_t = 0.7 X_{t-1} - 0.4 X_{t-2} + a_t,$$

- (i) Verify whether the series is stationary.
- (ii) Obtain  $\rho_k$  :  $k = 1, 2, 3, 4$  and  $5$ .
- (iii) Plot the correlogram. 2+8

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