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MSTE-002

POST GRADUATE DIPLOMA IN APPLIED STATISTICS (PGDAST)

Term-End Examination

June, 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 questions 2 to 7.*

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

(iv) Use of Formulae and Statistical Table 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 : 2 each

(a) There are a maximum of 16 possible basic solutions of the system of equations :

$$2x_1 + 6x_2 + 2x_3 + x_4 = 3$$

and $$6x_1 + 4x_2 + 4x_3 + 6x_4 = 2.$$

(b) If customers arrive at a rate of 15 per minute and the service rate is 20 per minute, then the service facility kept busy 50% of the time.

(c) An optimality test can be applied to a feasible solution if it contains 9 allocations in a transportation table consisting of 5 rows and 5 columns.

(d) For a time series with N observations, if the process is purely random, all the autocorrelations (r_k) should be in the range of $\left[\pm 1/\sqrt{N-2}\right]$.

(e) In regression analysis, if R^2 is 0.9717 for a given data of 12 values on Y as dependent variable and X_1 and X_2 as independent variables, then adjusted R^2 will be 0.7454.

2. Use the simplex method to solve the following LPP :

Maximize :

$$Z = 7x_1 + 5x_2$$

Subject to the constraints :

$$x_1 + 2x_2 \le 6$$

$$4x_1 + 3x_2 \le 12$$

$$x_1, x_2 \ge 0.$$

Also obtain the solution by the graphical method. 10

3. Consider the problem of assigning five jobs to five persons. The assignment costs are given as follows :

Persons	Job				
	1	2	3	4	5
A	8	4	2	6	1
B	0	9	5	5	4
C	3	8	9	2	6
D	4	3	1	0	3
E	9	5	8	9	5

Determine the optimum assignment schedule. 10

4. The annual sales revenue (in crores of rupees) of product as a function of sales force (number of salespersons) and annual advertising

expenditure (in lakhs of rupees) for the past 10 years are given in the table below. Obtain a regression model, by the matrix method, to forecast the annual sales revenue of the product : 10

Annual sales revenue (Y)	Sales force (X_1)	Annual advertising expenditure (X_2)
20	8	28
23	13	23
25	8	38
27	18	16
21	23	20
29	16	28
22	10	23
24	12	30
27	14	26
35	20	32

5. The following data gives the number of units produced by a watch manufacturing company in different years :

Year	Production
1996	120
1997	112
1998	136
1999	125
2000	155
2001	159
2002	165
2003	150
2004	145
2005	167
2006	170
2007	180

Use the exponential smoothing method, with $\alpha = 0.3$ and 0.5, to forecast the production of watches. 10

6. (a) Consider an autoregressive AR (2) model :

$$X_t = 0.60\, X_{t-1} - 0.20\, X_{t-2} + a_t$$

Verify whether the series is stationary or not. Also (i) obtain ρ_k for $k = 1, 2, \ldots, 5$ and (ii) plot the correlelogram. 5

(b) We have seven jobs each of which has to go through the machines M_1 and M_2 in the order M_1, M_2. Processing times (in hours) are given as :

Job	Machine M_1	Machine M_2
1	3	8
2	12	10
3	15	10
4	6	6
5	10	12
6	11	01
7	09	03

Determine a sequence of these jobs that will minimise the total elapsed time T. 5

7. (a) Obtain an initial basic feasible solution of the following transportation problem using the Vogel's approximation method : 6

Warehouses	Stores				Availability
	I	II	III	IV	
A	5	1	3	3	34
B	3	3	5	4	15
C	6	4	4	3	12
D	4	–1	4	2	19
Requirement	21	25	17	17	80

(b) A TV technician finds that the time spent on her jobs has an exponential distribution with mean 30 minutes. If she repair sets in the order in which they came in, and if the arrival of sets is approximately Poisson distributed with an average rate of 10 per 8-hour day, what is the technician's expected idle time each day ? How many jobs are ahead of the average set just brought in ? 4

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