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MSTE-002

POST GRADUATE DIPLOMA IN APPLIED STATISTICS (PGDAST)

Term-End Examination

December, 2019

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.

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1. State whether the following statements are **True** or **False**. Give reasons in support of your answers. 5x2=10

   (a) The maximum number of possible basic solutions of the system of equations $3x_1+5x_2+x_3=15$ and $5x_1+2x_2+x_4=10$ are 3.

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

   (c) The test statistic for testing the significance of regression coefficient 'b' is "$F=b/s_b$".

   (d) For the given five values 15, 24, 18, 33, 42, the 3 - year moving averages are 19, 24, 33.

   (e) The economic order quantity with uniform demand is directly proportional to the carrying cost.

2. (a) A farm is engaged in breeding sheep. The animals are fed on various products grown on the farm. In view of the need to ensure certain nutrient constituents (call them X, Y and Z), it is necessary to buy two additional products, say A and B. One unit of product A contains 36 units of X, 3 units of Y and 20 units of Z. One unit of product B contains 6 units of X, 12 units of Y and 10 units of Z. The minimum requirement of X, Y and Z is 108 units, 36 units and 100 units, respectively. Product A costs ₹ 20 per unit, and product B costs ₹ 40 per unit. Formulate the above as a linear programming problem to minimise the total cost. Further solve the problem using the graphical method. 5

   (b) Obtain an initial basic feasible solution for the following transportation problem using the North-West Corner Rule. 5

	D_1	D_2	D_3	D_4	Availability
O_1	11	13	17	14	250
O_2	16	18	14	10	300
O_3	21	24	13	10	400
Requirement	200	225	275	250	

3. A department head has four subordinates and four tasks to be performed. The subordinates differ in efficiency, and the tasks differ in their intrinsic difficulty. Her estimate, of the time each person would take to perform each task is given in the table below : 10

Tasks	Persons			
	E	F	G	H
A	18	26	17	11
B	13	28	14	26
C	38	19	18	15
D	19	26	24	10

How should the tasks be allocated, one to a person so as to minimize the total human-hours ?

4. A health care business researcher decided to develop a regression model in an attempt to predict the number of Full-Time Employees (FTEs) of a hospital by the number of beds. She surveyed 12 hospitals in a city and obtained the following data : 10

Number of Beds	FTEs	Number of Beds	FTEs
23	69	50	138
29	95	54	178
29	102	64	156
35	118	66	184
42	126	76	176
46	125	78	225

Find the Linear regression model for the given data. Also, compute standard error. Check whether residuals follow the normal distribution or not.

5. Plot the number of units produced by a company for five years for all four quarters of the year. Calculate the seasonal indices for the given data after validating from the plot : 10

Year	Quarter			
	I	II	III	IV
2001	2022	2100	2150	2120
2002	2200	2250	2150	2340
2003	2250	2300	2350	2250
2004	2400	2450	2300	2270
2005	2500	2560	2400	2350

6. (a) A contractor has to supply 10,000 bearings per day to an automobile manufacturer. She finds that, when she starts a production run, she can produce 25,000 bearings per day. The cost of holding a bearing in stock for one year is ₹ 2 and the set-up cost of a production run is ₹ 1800. How frequently should production runs be made ? (Consider there are 300 working days in a year) 5

(b) For the AR(2) process, 5

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

State whether the model is stationary or not. Also calculate PACF (1) and PACF (2).

7. (a) Describe the ARMA model in time series forecasting, and show how the auto correlation function decays exponentially. 5

(b) In a railway marshalling yard, goods trains arrive at a rate of 30 trains per day. Assume that the inter-arrival time follows an exponential distribution and the service time distribution is also exponential with an average 36 minutes. Calculate the following : (i) the mean queue size (line length), and (ii) the probability that the queue size exceeds 10. 5