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MSTE-002

POST GRADUATE DIPLOMA IN APPLIED STATISTICS (PGDAST)

Term-End Examination

01681

June, 2019

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 meanings.

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

(a) Adding a constraint to a linear programming problem increases the size of the feasible region.

(b) Consider $Y_i = \tilde{B}_0 + B_1 (X_i - a) + e_i$, where $\tilde{B}_0 = B_0 + a B_1$. If we replace a by $\bar{X}$, then $E(Y_i) = E(\tilde{B}_0)$.

(c) A redundant constraint decreases the feasible region.

(d) Water level in a tank at the end of each hour is a continuous parameter process.

(e) Only 0 or 1 births or deaths can occur in a small interval of time Δt in a birth-death process.

2. A company is spending ₹ 1,000 on transportation of its units from three plants to four distribution centres. The availability of units per plant and requirement of units per distribution centre, with unit cost of transportation are given as follows :

Plants \ Centres	D_1	D_2	D_3	D_4	Availability
P_1	19	30	50	12	7
P_2	70	30	40	60	10
P_3	40	10	60	20	18
Requirement	5	8	7	15	

What is the maximum possible saving by optimum distribution using the Stepping-Stone method to solve the problem ? *10*

3. (a) Arrivals of machinists at a tool crib are considered to be Poisson distributed at an average rate of 6 per hour. The length of time the machinists must remain at the tool crib is exponentially distributed with average time of 0·05 hours.

(i) What is the probability that a machinist arriving at the tool crib will have to wait ?

(ii) What is the average number of machinists at the tool crib ?

(iii) 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.

(iv) At what rate should the arrival of machinists to the tool crib increase to justify the addition of a second crib ? *2+1+1+1*

(b) A repairman is to be hired to repair machines which break down at an average rate of 3 per hour. The breakdown follows a Poisson distribution. Non-productive time of a machine is considered to cost ₹ 10 per hour. Two repairmen have been interviewed of whom one is slow but charges less and the other is fast but more expensive. The slow repairman charges ₹ 5 per hour and services breakdown machines at the rate of 4 per hour. The fast repairman demands ₹ 7 per hour, but services breakdown machines at an average rate of 6 per hour. Which repairman should be hired ? *5*

4. A firm wants to know whether there is a linear relationship between the size of its sales force (X) in hundreds and its yearly sale revenue (Y) in thousand rupees. The records of 10 years were examined and the following results were obtained :

$\Sigma X = 265$, $\Sigma Y = 27{\cdot}73$, $SS_X = 485{\cdot}6$, $SS_Y = 6{\cdot}978$, $SS_{XY} = 57{\cdot}456$

(a) Fit a regression line taking Y as the dependent variable and X as the independent variable.

(b) Test whether the sales force has any effect on Y by testing the significance of regression coefficient b at 5% level of significance.

(c) Find the coefficient of determination R^2 and comment on the goodness of fit of the regression line.

(d) Estimate the sales value (Y) for X = 40.

(e) Find the 95% confidence interval for b.

2+2+2+1+3

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 (in 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^{th} month using Exponential smoothing technique for $\omega = 0 \cdot 2$.

(b) Compute the 3-monthly moving average for above data.

(c) Plot the demands obtained by 3-monthly moving average and Exponential smoothing method along with given data. *5+3+2*

6. (a) A series of 10 consecutive yields from a batch of chemical processes are given as follows :

47 64 23 71 38 64 55 41 59 48

Calculate the mean, autocovariance c_1 and autocorrelation coefficients r_1, r_2, r_3, r_4 and r_5 and plot the correlogram. 7

(b) An enterprise requires 1000 units per month. The ordering cost is estimated to be ₹ 50 per order. In addition to ₹ 1, the carrying costs are 5% per unit of average inventory per year. The purchase price is ₹ 20 per unit. Find the economic lot size to be ordered and the total minimum cost. 3

7. (a) Using simplex method, solve the following LPP : 6

Maximise $z = 3x_1 + 9x_2$

subject to

$$x_1 + 4x_2 \le 8$$

$$x_1 + 2x_2 \le 4$$

$$x_1 \ge 0, x_2 \ge 0.$$

(b) A readymade garments manufacturer has to process five items through 2 stages of production, viz., cutting and sewing. The time taken for each of these items at the different stages is given below (in hours) :

	Item	1	2	3	4	5
Processing Time (hours)	Cutting	5	7	3	4	6
	Sewing	2	6	7	5	9

Find an order in which these items should be processed so as to minimize the total processing time. Also calculate the various idle times. *4*