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MSTE-002

POST GRADUATE DIPLOMA IN APPLIED STATISTICS (PGDAST)

Term-End Examination

June, 2018

00865

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.

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

(a) The solution of a transportation problem with 5 rows (supplies) and 4 columns (destinations) is feasible if number of possible allocations are 8.

(b) The moving averages of suitable period in a time-series are free from the influences of seasonal and cyclic variations.

(c) If the basic solutions for a system of equations are (– 2, 0, 1), (0, 1, 3), (– 2, 3, 0), then only (0, 1, 3) is feasible.

(d) In the stepwise selection method of multiple regression model, once a variable enters in the model then it always remains in the model.

(e) An enterprise requires 1000 units per month. The ordering cost is estimated to be ₹ 50 per order. The purchase price is ₹ 20 per unit and the carrying cost per unit is 10% of it. Then the economic lot size to be ordered is 775.

2. Use the penalty (Big M) method to solve the following LP problem : *10*

Minimise $z = 5x_1 + 3x_2$

subject to the constraints

$2x_1 + 4x_2 \leq 12$

$2x_1 + 2x_2 = 10$

$5x_1 + 2x_2 \geq 10$

$x_1, x_2 \geq 0.$

OR

A company has three production facilities S_1, S_2 and S_3 with production capacity of 7, 9 and 18 units (in 100s) per week of a product, respectively. These units are to be shipped to four warehouses D_1, D_2, D_3 and D_4 with requirement of 5, 6, 7 and 14 units (in 100s) per week, respectively. The transportation costs (in ₹) per unit between factories to warehouses are given in the table below :

	D_1	D_2	D_3	D_4	Capacity
S_1	19	30	50	10	7
S_2	70	30	40	60	9
S_3	40	8	70	20	18
Demand	5	8	7	14	34

Obtain optimal solution by the MODI method. *10*

3. Four professors are capable of teaching any one of four different courses. Class preparation time in hours for different topics varies from professor to professor and is given in the table below :

Professor	A	B	C	D
Linear Programming	2	15	13	4
Queuing Theory	10	4	14	15
Transportation Problem	9	14	16	13
Regression Analysis	7	8	11	9

Each professor is assigned only one course. Determine an assignment schedule so as to minimise the total course preparation time for all courses. *10*

OR

(a) In a railways marshalling yard, goods trains arrive at a rate of 36 trains per day. Assuming that the inter-arrival and service time distributions both follow exponential distribution with an average of 30 minutes, calculate the following : *1+1+2=4*

(i) Traffic intensity

(ii) The mean queue length

(iii) Probability that the queue size exceeds 8

(b) Using the graphical method to minimise the time required to process Job 1 and Job 2 on five machines A, B, C, D and E, find the minimum elapsed times and idle times to complete both jobs. *6*

Job 1	Sequence	A	B	C	D	E
	Time (in hours)	1	2	3	5	1
Job 2	Sequence	C	A	D	E	B
	Time (in hours)	3	4	2	1	5

4. A firm wants to know whether there is any linear relationship between the sales (X) and its yearly revenue (Y). The records for 10 years were examined and the following results were obtained :

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

and $SS_{XY} = 57{\cdot}456$

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

(b) Test whether the sales have any effect on revenue at 5% level of significance.

(c) Comment on the goodness of fit of the regression line. *3+5+2=10*

OR

A researcher is interested in developing a linear model for the electricity consumption of a household having an AC (1·5 ton) so that she can predict the electricity consumption. For this purpose, she selects 25 houses and records the electricity consumption (in kWh), size of house (in square feet) and AC hours for one month during summers. The results obtained are :

$\hat{B}_0 = 22{\cdot}38$, $\hat{B}_1 = 1{\cdot}6161$, $\hat{B}_2 = 0{\cdot}0144$,

$SS(B_0) = 12526{\cdot}08$, $SS(B_0, B_1) = 17908{\cdot}47$,

$SS(B_0, B_2) = 17125{\cdot}23$, $SS(B_0, B_1, B_2) = 18079{\cdot}0$,

$\hat{\sigma}^2 = 10{\cdot}53$, $SE(\hat{B}_1) = 0{\cdot}17$ and $SE(\hat{B}_2) = 0{\cdot}0035$.

Build a regression model by selecting appropriate regressors in the model using the Stepwise selection method. *10*

5. The following table represents the sales (in thousands) of mobile sets of a shop for 16 quarters over four years :

Quarter / Year	Q_1	Q_2	Q_3	Q_4
2011	554	590	616	653
2012	472	501	521	552
2013	501	531	553	595
2014	403	448	460	480

(a) Compute the seasonal indices for four quarters by Simple average method.

(b) Obtain deseasonlised values. *6+4=10*

OR

Seven successive observations on a stationary time-series are as follows :

12, 14, 13, 10, 15, 12, 15

(a) Calculate auto-covariances C_0, C_1, C_2, C_3 and C_4.

(b) Calculate auto-correlation coefficients r_1, r_2, r_3 and r_4.

(c) Plot the correlogram. *6+2+2=10*