MSTE-002

POST GRADUATE DIPLOMA IN APPLIED STATISTICS (PGDAST)

02422   **Term-End Examination**

June, 2017

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 number of possible basic solutions in an LPP of order m × n is (m + n).

(b)   If the arrival rate is 15 per minute and the service rate is 20 per minute, the traffic intensity will be 75%.

(c) In a regression analysis, if $SS_{Reg} = 300$ and $SS_{Res} = 200$, then the coefficient of determination is $0 \cdot 6667$.

(d) The lowest weight is assigned to the latest observation of the series in the exponential smoothing method.

(e) If there are 4 jobs to be performed, one at a time on each of 3 machines, then the possible number of sequences would be 1296.

2. During festival season, a company combines two items A and B to form gift packs. Each pack must weigh 5 kg and should contain at least 2 kg of A and not more than 4 kg of B. The net contribution to the company is ₹ 10 per kg of A and ₹ 12 per kg of B.

Formulate the above as a linear programming problem to maximise the net contribution per pack and solve it using Simplex method.　　　*10*

OR

A company has factories at F_1, F_2 and F_3 which supply to warehouses at W_1, W_2 and W_3. Factories F_1, F_2 and F_3 can supply weekly 160, 150 and 90 units, respectively.

Warehouses W_1, W_2 and W_3 weekly require 160, 110 and 130 units, respectively. Unit shipping costs (in rupees) are as follows :

Factory	Warehouse		
	W_1	W_2	W_3
F_1	16	20	12
F_2	14	8	18
F_3	26	24	16

Determine the optimal distribution for this company to minimise the transportation cost using Vogel and MODI methods. *10*

3. (a) In the modification of a plant layout of a factory, four machines M_1, M_2, M_3 and M_4 are to be installed. Five vacant places, A, B, C, D and E are available. Because of limited space, Machine M_2 cannot be placed at C and Machine M_3 cannot be placed at A. The cost of allocating a machine at a place (in hundred rupees) is as follows :

Machine \ Location	A	B	C	D	E
M_1	9	11	15	10	11
M_2	12	9	–	10	9
M_3	–	11	14	11	7
M_4	14	8	12	7	8

Find the optimal assignment schedule. *5*

(b) A commodity is to be supplied at a constant rate of 200 units per day. Supplies of any amount can be obtained at any required time, where each ordering cost is ₹ 50, cost of holding the commodity in inventory is ₹ 2 per unit per day while the delay in the supply of the item includes a penalty of ₹ 10 per unit per day.

(i) Find the optimal order quantity and reorder cycle time.

(ii) If the penalty cost becomes infinite, find the optimal order quantity and reorder cycle time. 5

OR

(a) Use the graphical method to minimise the time needed to process the following jobs on the machines shown, i.e., for each machine, find the job which should be done first :

Machine

Job 1 $\begin{cases} \text{Sequence:} & A \quad B \quad C \quad D \quad E \\ \text{Time (hrs):} & 2 \quad 3 \quad 4 \quad 6 \quad 2 \end{cases}$

Machine

Job 2 $\begin{cases} \text{Sequence:} & B \quad C \quad A \quad D \quad E \\ \text{Time (hrs):} & 4 \quad 5 \quad 3 \quad 2 \quad 6 \end{cases}$

Also calculate the total elapsed time to complete both the jobs and the idle time for both the jobs. 8

(b) A large service station has a storeroom from where the service mechanics take the parts for the jobs they work upon. The mechanics wait in queue to get the parts that they need. The store is manned by one attendant who can, on an average, attend to 7 mechanics per hour. It is observed that, on an average, the mechanics' average arrival rate at the storeroom is 5 per hour. Assuming that the pattern of mechanics' arrivals is Poisson distributed and the servicing time is exponentially distributed, determine the

(i) average number of mechanics in the system, and

(ii) average time a mechanic has to wait in the queue. *2*

4. A market research firm is planning to develop a model for a new fuel-efficient car for its client. For this purpose, the fuel consumption and the average speed of a car, from a popular company, when it runs with petrol, were recorded from

10 trips of the same distance covered under similar road conditions using the same car. The data are given below :

Trip	Petrol Consumption (in litres)	Speed (km/hr)
1	14	50
2	10	40
3	15	45
4	16	55
5	11	35
6	16	60
7	12	55
8	14	50
9	12	40
10	10	30

(a) Predict the petrol consumption, if the speed of the car is 65 km/hr.

(b) Estimate the variance of error.

(c) Is there any evidence of a linear relationship between petrol consumption and speed at 5% level of significance ? *10*

OR

A sample was selected to develop a linear model for the electricity consumption of a household. The data of electricity consumption (in '00 kWh), size of the house (in '00 square feet), and use of AC (0 for no AC and 1 for having AC) are given below :

Unit (in '00 kWh)	Area (in '00 sq. ft.)	AC
3·6	9	1
2·5	10	0
4·5	9	1
4·0	7	1
4·0	10	0
4·1	11	0
3·8	10	0
4·4	9	1
4·5	6	1
4·6	9	0

(a) Fit a multiple regression model.

(b) Obtain two regression equations for both categories of AC. *10*

5. A State Commission, designed to monitor the energy consumption, assembled the following seasonal data relating to natural gas consumption, in millions of cubic feet :

Year	Winter	Spring	Summer	Fall
2012	280	320	420	540
2013	380	440	640	760
2014	540	620	860	960

Determine the seasonal indices using the ratio to moving average method.   *10*

OR

A series of 10 consecutive results from a process are given as follows :

23, 32, 11, 34, 19, 32, 26, 20, 29, 24

Calculate the mean, autocovariance (c_1) and autocorrelation coefficient (r_1).   *10*