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MSTE-001

POST GRADUATE DIPLOMA IN APPLIED STATISTICS (PGDAST)

Term-End Examination

01316

June, 2016

MSTE-001 : INDUSTRIAL STATISTICS I

Time : 3 hours *Maximum Marks : 50*

Note :

(i) ***All** questions are **compulsory**. 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 meaning.*

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

(a) If the average fraction defective in a sample of size 50 is 0·10, the centre line of np-chart will be 5.

(b) If points on a control chart have continuous upward movement, the process is under control.

(c) The probability of accepting a lot of unsatisfactory quality is known as producer's risk.

(d) Two independent components of a system are connected in series configuration. If the reliabilities of these components are 0·5 and 0·3 respectively, the reliability of the system will be 0·8.

(e) If the maximin value = minimax value of the payoff matrix of a game, it has no saddle point.

2. A small electronic device is designed to emit an automatic signal of 200 milliseconds (ms) duration. In the production of this device, 10 subgroups of 03 units are taken at periodic intervals and tested. The results are shown in the following table :

Subgroup Number	Duration of Automatic Signal (in ms)		
	A	B	C
1	205	208	194
2	195	195	205
3	200	198	195
4	210	197	198
5	200	202	195
6	211	198	193
7	201	197	206
8	200	202	204
9	205	190	199
10	203	201	209

Using $\bar{X}$ and R-charts, draw conclusion about the process by assuming assignable causes for any out-of-control points. If the process is out-of-control, calculate the revised centre line and control limits to bring the process under statistical control. *10*

OR

(a) As a part of an overall quality improvement programme, a textile manufacturer decides to monitor the number of defects found in each inspected bolt (large bundle) of cloth. The data from 10 inspections are recorded in the table given below :

Bolt of Cloth	Number of Defects
1	8
2	19
3	5
4	11
5	2
6	8
7	7
8	13
9	3
10	2

(i) Which control chart should be used in this case ?

(ii) Calculate the control limits for this chart.

(iii) Draw the control chart. Are these data from a controlled process ? *1+1+3*

(b) To check the quality of bolts, a bolt manufacturer selected 8 random samples of same size 100 from the manufacturing process from time to time. Each selected bolt was visually inspected for certain defects. The following data were obtained :

Sample Number	Proportion of Defective
1	0·10
2	0·04
3	0·08
4	0·15
5	0·05
6	0·02
7	0·10
8	0·01

Construct the appropriate control chart and state whether the process is under statistical control. *5*

3. A tennis ball manufacturing company formed lots of 300 balls. To check the quality of lots, a buyer draws 20 balls from each lot and accepts the lot if the sample contains at most one defective ball. Otherwise, it is rejected. The manufacturer and the buyer decide that AQL = 0·05 and LTPD = 0·10. If the incoming quality of the lot is 0·03, compute the

(i) probability of accepting the lot,

(ii) producer's risk,

(iii) consumer's risk,

(iv) Average Outgoing Quality (AOQ), if the rejected lots are screened and all defective balls are replaced by non-defectives, and

(v) Average Total Inspection (ATI). *2+2+2+2+2*

OR

(a) Explain the following terms :

(i) Operating Characteristic (OC) Curve

(ii) Acceptance Quality Level (AQL) *2+2*

(b) A company produces mobile phones in lots of 400. To check the quality of lots, the quality inspector of the company uses a Double sampling plan with $n_1 = 10$, $c_1 = 0$, $n_2 = 25$, $c_2 = 1$. If the incoming quality of the lot is 0·04, what is the probability of accepting the lot on the first sample ? What is the probability of final acceptance ? *6*

4. The failure data of an expensive part of an equipment is given in the following table :

Number of failures	0	1	2	3 and more
Probability of failure	0·70	0·20	0·10	0

If a company purchases spares of this part at the time of purchasing the equipment, it costs ₹ 6,000 per unit. If it is ordered after the failure of the part during its operation, the total cost including the cost of downtime of the equipment is ₹ 30,000. Assume that there is no scrap value of the part. On the basis of this information, what is the optimal number of spares that the company should buy at the time of purchasing the equipment using the EMV criterion ? *10*

OR

Solve the two-person zero-sum game having the following payoff matrix for player A : *10*

		Player B			
		B_1	B_2	B_3	B_4
Player A	A_1	4	3	2	1
	A_2	6	4	5	0
	A_3	1	2	0	3

5. The failure density function of the random variable T, describing the life of a component, is given by

$$f(t) = \begin{cases} 0{\cdot}012\, e^{-0{\cdot}012t}, & t \geq 0 \\ 0, & \text{otherwise} \end{cases}$$

Calculate the

(i) reliability of the variable T,

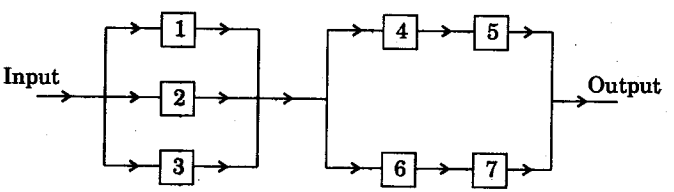
(ii) mean time to failure (MTTF),

(iii) median of the random variable T, and

(iv) life of the component, if reliability of 0·96 is desired. *2+2+3+3*

OR

Evaluate the reliability of the system for which the reliability block diagram is shown in the figure given below :



Assume that all components are independent and the reliability of each component is given as follows :

$R_1 = 0{\cdot}40$, $R_2 = 0{\cdot}30$, $R_3 = 0{\cdot}60$, $R_4 = 0{\cdot}80$,

$R_5 = 0{\cdot}85$, $R_6 = 0{\cdot}60$, $R_7 = 0{\cdot}70$,

where R_i = (i = 1, 2, ..., 7) denotes the reliability of component i. *10*