POST GRADUATE DIPLOMA IN APPLIED STATISTICS (PGDAST)

Term-End Examination

June, 2022

MSTE-001 : INDUSTRIAL STATISTICS – I

Time : 3 hours   *Maximum Marks : 50*

Note :

- *(i)* *Question no. **1** is **compulsory**.*
- *(ii)* *Attempt any **four** questions from the remaining questions no. 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.*

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

   (a) "Natural patterns of variation" is only a type of pattern of sample points on the control chart.

   (b) The natural limits are the limits specified by the producer or set by the management or the manufacturing engineers.

(c) Product control is a technique used for understanding and monitoring the process by collecting the data on quality characteristics periodically from the process, analysing them and taking suitable actions whenever there is a difference between actual quality and the specifications.

(d) For the following game :

		Player B		
		B_1	B_2	B_3
Player A	A_1	5	7	4
	A_2	4	2	0
	A_3	6	1	3

The value of the game is 4.

(e) A k-out-of-n system is said to be a non-redundant system of $1 \leq k < n$.

2. (a) Prove that $R(t) = e^{-\int_0^t \lambda(t)\,dt}$

where $R(t)$ = reliability function, and

$\lambda(t)$ = rate of failure at time t.

(b) Show that if the hazard rate of a component is constant, say λ, then the failure distribution of the component follows exponential distribution. Also show that $MTTF = \dfrac{1}{\lambda}$.

(c) Define reliability of a series system and a parallel system in general.   *5+3+2*

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3. In the following payoff table, the payoff values represent losses :

State of Nature	Courses of Action		
	A_1	A_2	A_3
N_1	1500	1800	2500
N_2	2400	1600	2000
N_3	1200	2000	3000
N_4	800	1000	400

On the basis of this information, identify the optimum course of action under each of the following criteria : *10*

(a) Optimistic Criterion

(b) Pessimistic Criterion

(c) Hurwitz Criterion (for $\alpha = 0 \cdot 7$)

(d) Regret Criterion

(e) Laplace Criterion (assuming that we have no information that the states of nature N_1, N_2, N_3, N_4 have different probabilities)

4. (a) Solve the game whose payoff matrix is given below : 7

		Player B			
		B_1	B_2	B_3	B_4
	A_1	3	2	4	0
	A_2	3	4	2	4
Player A	A_3	4	2	4	0
	A_4	0	4	0	8

(b) Differentiate between Accepting sampling plan and Rectifying sampling plan. *3*

5. (a) In a recently started process of producing containers, their volume is subject to a quality control. The $\overline{X}$ and S values for 15 random samples of size 5 are given as follows :

Sample No.	$\overline{X}$	S
1	62·34	0·05
2	62·29	0·06
3	62·32	0·08
4	62·30	0·04
5	62·32	0·05
6	62·30	0·04
7	62·30	0·03
8	62·33	0·02
9	62·33	0·01
10	62·30	0·01
11	62·32	0·02
12	62·30	0·01
13	62·30	0·04
14	62·30	0·03
15	62·34	0·04

Construct the suitable control charts and state whether the process is under control. If not, compute revised control limits. *8*

(b) Differentiate between Single sampling plan and Double sampling plan. *2*

6. (a) A manufacturing process produces a certain type of bolt of mean diameter 2 inch with a standard deviation of 0·05 inch. The lower and upper specification limits of the process are 1·90 and 2·05 inch. Calculate the process capability. Does it appear that the manufacturing process is capable of meeting the specification requirements ? *2*

(b) An automatic machine is used to fill and seal 20 mL tubes of medicine. The process is sampled in samples of four and the values of $\overline{X}$ and R are computed for each sample. After 25 samples, $\Sigma \overline{\overline{X}} = 525$ and $\Sigma R = 30$. If the specification limits are $20 \pm 1·5$, what are the conclusions regarding the ability of the process to produce medicine tubes conforming to specifications ? It is given that $d_2 = 2·059$ for n = 4. *4*

(c) A mobile manufacturer inspects 30 mobiles at the end of the day of production and notes the number of defective mobiles. This procedure is continued up to 12 days and 2, 1, 3, 0, 2, 1, 0, 5, 2, 0, 3, 1 defective mobiles are found. Is the production process under control with respect to the proportion defective ? *4*

7. (a) For a sampling plan with n = 5 and c = 0, find the probability of accepting a lot that has 2% defective units by assuming that the number of defective units in a sample follows the binomial distribution. Further, if AQL and LTPD are 1% and 5% respectively, calculate the producer's risk and the consumer's risk for this plan. *5*

(b) Suppose a mobile phone company produces mobile phones in lots of 400 phones each. To check the quality of the lots, the quality inspector of the company uses a double sampling plan with n_1 = 15, c_1 = 1, n_2 = 30 and c_2 = 3. Explain the procedure for implementing it under acceptance sampling plan. *5*

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