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MSTE–001

**POST GRADUATE DIPLOMA IN
APPLIED STATISTICS (PGDAST)**

Term-End Examination

June, 2024

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) If a lot of 200 cricket balls has 10 defective balls, then the lot quality will be 0.45.

(b) Two independent components of a system are connected in parallel configuration. If

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the reliabilities of these components are 0.2 and 0.3, respectively, reliability of the system will be 0.44.

- (c) The process capability of an automatic machine for which 25 samples each of size 4 are selected, having the values of $\Sigma\bar{X}=525$ and $\Sigma R=30$ will be 3.50.
- (d) If the value of the game is 100, it is fair.
- (e) If the average fraction defective of a process in which we inspect 20 samples of size 50 each is 0.10, the centre line of np-chart will be 5.
2. A factory produces inverter batteries. Ten samples of 3 inverter batteries each drawn at regular intervals. The life of each sampled battery is measured and is given below :

Samples Number	Life of Batteries (in thousand hours)		
	1	25	22
2	19	20	22
3	21	24	20
4	28	26	22
5	24	24	20

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6	15	16	14
7	26	24	23
8	28	25	24
9	20	23	23
10	24	20	23

Test whether the process is under statistical control with respect to the average life of inverter batteries. If the process is out of control, calculate the revised limits to bring the process under statistical control. 10

3. A Wi-Fi modern manufacturing company supplies modems in lots of size 400 to the buyer. A single sampling plan with $n = 15$ and $C = 0$ is being used for the lot inspection. The supplier and the buyer's quality control inspector decide that $AQL = 0.01$ and $LTPD = 0.10$, then : 4+6

- (a) Compute the producer's risk and consumer's risk for this plan.
- (b) If the rejected lots are screened and all defective Wi-Fi modems are replaced by non-defective ones, construct AOQ curve.

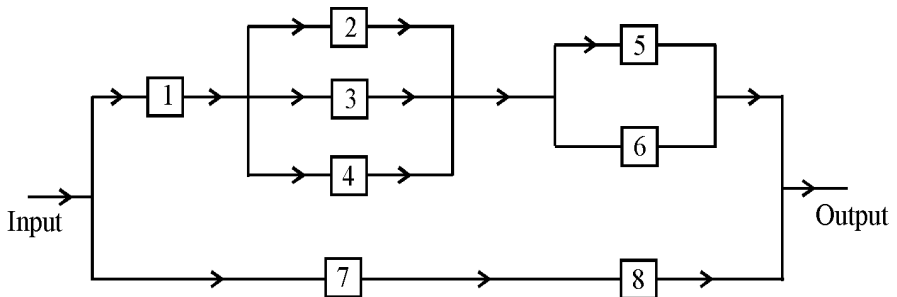
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4. Two fast food manufactures, say A and B are competing for an increased market share. The payoff matrix, shown in the following table, describes the increase in market share for A and decrease in market share for B :

Manufactures	Manufacturer B			
	B ₁	B ₂	B ₃	B ₄
A				
A ₁	2	-2	4	1
A ₂	6	1	12	3
A ₃	-3	2	0	6
A ₄	2	-3	7	1

Determine optimal strategies for both the manufacturers and the value of the game. 10

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



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

$R_1 = 0.80$, $R_2 = 0.075$, $R_3 = 0.50$, $R_4 = 0.65$,
 $R_5 = 0.76$, $R_6 = 0.60$, $R_7 = 0.95$ and $R_8 = 0.92$
 where R_i ($i = 1, 2, \dots, 8$) denotes reliability of component i . 10

6. (a) An analyst takes 10 samples of bean bags from a production line over a shift. The number of minor defects in each sample of recorded as follows :

Sample	No. of Defects
1	4
2	7
3	2
4	8
5	6
6	3
7	5
8	4
9	2
10	6

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

- (b) A cricket ball manufacturing company formed lots of 200 balls. To check the quality of lots the buyer uses a double sampling plan with $n_1 = 10, c_1 = 0, n_2 = 15$ and $c_2 = 1$. Given that the incoming quality of the lot is 0.04, what is the probability of accepting the lot on :

2+3

(i) The first sample ?

(ii) The second sample ?

7. (a) The profits of the milk booth of a particular brand under small, medium and large orders subject to low, moderate and high demands, respectively are shown in the following table :

Order for	Demand of Milk at the Booth		
	Low	Moderate	High
Milk			
Small	1000	1000	1000
Medium	800	1300	1300
Large	600	1100	1600

Specify the courses of action along with the states of nature and express these in the payoff table. Also take a decision as to which order is more beneficial for the owner under : 5

- (i) Optimistic criterion and
 - (ii) Pessimistic criterion
- (b) The failure density function of the random variable T , describing the life of a component, is given by : 1.5+1.5+2

$$f(t) = \begin{cases} 0.12e^{-0.012t}, & t \geq 0 \\ 0, & \text{otherwise} \end{cases}$$

Calculate :

- (i) reliability of the variable T ,
- (ii) Mean time to failure (MTTF)
- (iii) Median of the random variable T .