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MSTE–001

POST GRADUATE DIPLOMA IN APPLIED STATISTICS (PGDAST)

Term-End Examination

December, 2023

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 Question Nos.* ***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 answer : 5×2=10

   (a) Three independent components of a system are connected in series configuration. If the reliabilities of these components are 0.1, 0.2 and 0.3, respectively, the reliability of the system will be 0.606.

(b) If the probability of accepting a lot of unsatisfactory quality is 0.7358, then the consumer's risk will be 0.2642.

(c) If the value of a game is 4, the game is fair.

(d) A manufacturer of ball point pens randomly samples 2000 pens per day. Any pen that does not write smoothly is considered as defective. If average proportion of defective pens per day is 0.165, then upper control limit for proportion defectives is 0.1733.

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

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 interval 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 appropriate control charts, draw conclusions about the process mean and variability by assuming assignable causes for any out of control points. If the process is out of control, construct the revised control charts. 10

3. (a) A manufacturer of CFL tubes produces lots of 100 tubes. A buyer uses a double sampling plan with $n_1 = 5$, $c_1 = 0$, $n_2 = 15$ and $c_2 = 1$ to test the quality of the lots. Given that the incoming quality of a lot is 0.02. Calculate the probabilities of accepting the lot on the first sample and on the second sample. Also calculate the probability of final acceptance. 7

(b) Differentiate between single and double sampling plans. 3

4. A two-person zero-sum game having the following pay-off matrix for Player A is as follows : 10

		Player B			
		B_1	B_2	B_3	B_4
Player A	A_1	5	4	2	1
	A_2	8	3	5	1
	A_3	2	2	1	2

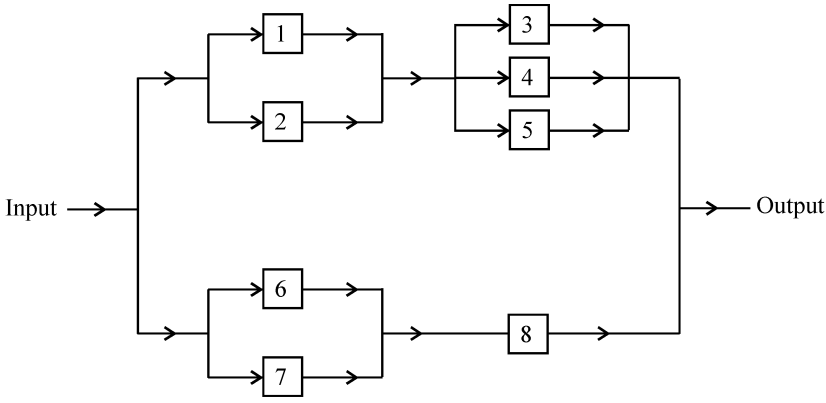
Obtain :

(a) Optimal strategy for Player A,

(b) Optimal strategy for Player B, and

(c) Value of the game.

5. Evaluate the reliability of the system for which the reliability block diagram is shown below :10



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

$R_1 = 0.7$, $R_2 = 0.8$, $R_3 = 0.6$, $R_4 = 0.55$, $R_5 = 0.5$, $R_6 = 0.6$, $R_7 = 0.7$, $R_8 = 0.95$

where R_i denotes the reliability of the ith component, ($i = 1, 2, ..., 8$).

6. (a) Random samples of 100 pencils were taken from the daily production of a factory for 12 days and the number of defective pencils from each sample was recorded as given below : 5

Day	No. of Defective Pencils
1	4
2	5
3	8
4	5
5	10
6	7
7	6
8	15
9	8
10	6
11	9
12	7

On the basis of the information given in the table, construct a suitable control chart. Also interpret, what conclusion do you draw from the control chart ?

(b) A television manufacturer purchases picture tube chips from a company in lots of 300 chips. Twenty picture tube chips are sampled from each lot at random and are inspected for defects. A lot is accepted only if the inspected sample contains at most one defective chip. It is decided that AQL = 0.05 and LTPD = 0.10. If there are 3% defective chips in each lot, compute the : (i) Producer's risk, (ii) Consumer's risk, (iii) AOQ and (iv) Average Total Inspection (ATI). 1+1+2+1

7. (a) Consider the following pay-off table :

States of Nature	**Courses of Action**			
	A_1	A_2	A_3	A_4
N_1	400	900	900	1000
N_2	200	400	700	– 300
N_3	600	200	500	700

Identify the optimum course of action under : 2+3

(i) Pessimistic criterion

(ii) Hurwicz criterion ($\alpha = 0.8$)

(b) The failure density function of a component defined by a random variable T is :

$$f(t) = \begin{cases} 0.01e^{-0.01t}, & t \geq 0 \\ 0, & \text{otherwise} \end{cases}$$

Calculate : 1+1+1+2

(i) Reliability of the component

(ii) Reliability of the component for a 100-hour mission time,

(iii) Mean Time To Failure (MTTF), and

(iv) Median of the random variable T.