No. of Printed Pages : 6

MST–014

M. SC. (APPLIED STATISTICS)
(MSCAST)
Term-End Examination
June, 2024

MST-014 : STATISTICAL QUALITY CONTROL AND TIME SERIES ANALYSIS

Time : Three Hours *Maximum Marks : 50*

Note **:** (*i*) *Question No.* ***1*** *is compulsory.*

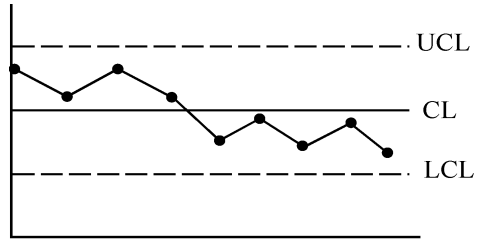
(*ii*) *Attempt any* ***four*** *questions from the remaining question nos. 2 to 6.*

(*iii*) *Use of scientific calculator (non-programmable) is allowed.*

(*iv*) *Symbols have their usual meanings.*

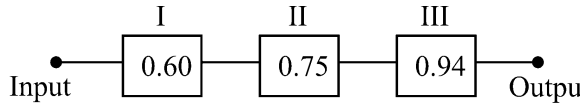
1. State whether the following statements are *True* or *False*. Give reasons in support of your answers : 5×2=10

   (a) If the control chart of a manufacturing process is as shown in the following figure :



   then the process is said to be under control.

(b) If a reliability engineer has a system of three components which are connected as :



then the reliability of the system will be 0.4275.

(c) In a single sampling plan, the Average Sample Number (ASN) changes with quality of the lot.

(d) The moving average method of suitable period in time series removes only irregular effects.

(e) Phase II control charts are used to detect large shifts in the process.

2. A company wants to monitor the length (in mm) of a bolt produced by a machine. Twenty random samples of size 4 were taken and mean length of each sample is calculated which are given as follows : 10

18.75, 18.25, 19.50, 22, 19.75, 20.50, 21, 20.50, 19, 20.25, 22.75, 21.75, 22.75, 22, 21.75, 20, 22.50, 22.75, 21.25, 22.0

Construct an EWMA control chart with $\lambda = 0.3$, $\mu = 20$, $\sigma = 2$ and interpret the results.

3. A computer manufacturing company purchases RAM from a company in lots of 2000. Twelve RAMs are sampled randomly and inspected for certain defects. The manufacturing company accepts the lots if the inspected sample contains at most one defective RAM, otherwise it rejects the lot : 10

   (i) Find the probability of accepting the lot if the value of incoming lot quality is 0.04.

   (ii) If AOQ = 0.03 and LTPD = 0.06, find producer's risk and consumer's risk.

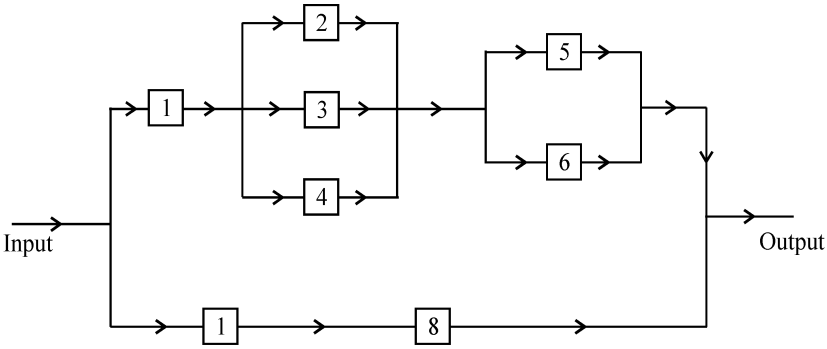
   (iii) If all defectives are repaced by non-defectives, calculate AOQ and ATI :

   (Given $\sum_{x=0}^{1} {}^{12}C_x (p)^x (1 - p)^{12-x}$

   = 0.9191 for $p = 0.04$
   = 0.9514 for $p = 0.03$
   = 0.8405 for $p = 0.06$)

   (iv) Calculate ASN.

4. Evaluate the reliability of the system for which the reliability block diagram is given in the figure below : 10



for a mission of 100 hours. Assume that all components are independent and the reliability of each component is given as follows :

$R_1 = 0.80$, $R_2 = 0.75$, $R_3 = 0.50$, $R_4 = 0.65$, $R_5 = 0.76$, $R_6 = 0.60$, $R_7 = 0.95$, $R_8 = 0.90$.

5. A company is interested in forecasting the demand for one of its products. The data on demand (in 100 units) for the last 12 months are given below :

Month	Demand
Jan.	15
Feb.	14

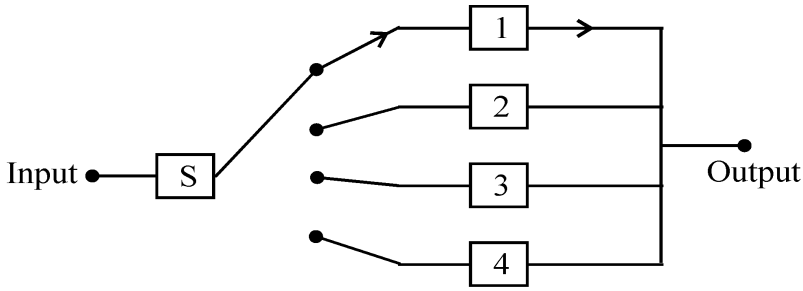
March	16
April	17
May	15
June	18
July	20
Aug.	22
Sep.	23
Oct.	21
Nov.	24
Dec.	26

(i) Compute 3 monthly moving average.

(ii) Forecast the demand for all months axing exponential and mouthing technique for $\alpha = 0.2$.

(iii) Plot the demand obtained in (i). 3+5+2

6. (a) A standby component has four components which are connected as shown in the figure given below :



Where component 1 is normally operating and components, 2, 3 and 4 are standby. The reliability of component 1 is 0.80. The reliability of component 2 given that component 1 has failed is 0.90. The reliability of component 3 given that components 1 and 2 have failed is 0.70 and that of component 4 given that components 1, 2 and 3 have failed is 0.60. Evaluate the reliability of the system by considering the switch is perfect. 4

(b) Consider the time series model :

$y_t = 2 + \in_t + 0.8 \in_{t-1}$ where $\in_t \sim N(0,1)$

(i) Identify the model. 2

(ii) Is this a moving average model ? If yes, check whether it is invertible. 2

(iii) What are the mean and variance of the time series ? 2