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**3 (Sem-4/CBCS) STA HC 3**

**2022**

**STATISTICS**

(Honours)

Paper : STA-HC-4036

**(Statistical Quality Control)**

Full Marks : 60

Time : Three hours

***The figures in the margin indicate full marks for the questions.***

1. Answer the following as directed : **(any seven)**  $1 \times 7 = 7$

(a) Main tool of statistical equality control is

(i) W. A. Shewhart chart

(ii) Acceptance sampling plan

(iii) Both (i) and (ii)

(iv) None of the above

*(Choose the incorrect option)*

Contd.



(b) Which one of the following is not a control chart for variable ?

(i)  $\bar{X}$  - chart

(ii)  $\sigma$  - chart

(iii)  $R$  - chart

(iv)  $C$  - chart

*(Choose the correct option)*

(c) In control chart for standard deviation an estimate of the population standard deviation is  $\hat{\sigma} = \frac{\bar{s}}{c_2}$ .

*(State True or False)*

(d) If the lower control limit is found negative in case of control charts for attributes, then it is taken to be \_\_\_\_\_.  
*(Fill in the blank)*

(e) The control chart for fraction defective is called  $np$ -chart.

*(State True or False)*

(f) The probability of accepting a lot with fraction defective  $P_t$  is known as

(i) consumer's risk

(ii) producer's risk

(iii) type-I error

(iv) None of the above

*(Choose the correct option)*

(g) In the construction of a control chart the extreme control limits are fixed at a distance of

(i)  $\sigma$

(ii)  $2\sigma$

(iii)  $3\sigma$

(iv)  $2.58\sigma$

*(Choose the correct option)*

(h) A curve showing the probability of accepting a lot  $P_a(p)$  for variation in the incoming lot of quality  $p$  is known as

(i) O. C. curve

(ii) A. S. N. curve

(iii) A. O. Q curve

(iv) None of the above

*(Choose the correct option)*



(i) If the lot is accepted on the basis of the sample inspection plan, then

(i)  $ATI = ASN$

(ii)  $ATI > ASN$

(iii)  $ATI < ASN$

(iv) None of the above

(Choose the correct option)

(j) In a control chart the upper control limit can be

(i) negative

(ii) never negative

(iii) zero

(iv) either negative or positive

(Choose the correct option)

2. Answer **any four** of the following questions :  
 $2 \times 4 = 8$

(a) What is meant by process control in industrial statistics ?

(b) Distinguish between chance causes and assignable causes in SQC.

(c) Explain the term 'natural tolerance limits'.

(d) When is S-chart used in place of R-chart ?

(e) Write down the control limits in p-chart if 50 blades are found defective in a consignment of 200 blades.

(f) What are the limitations of the control charts for variables ?

(g) What do you understand by acceptance quality level (A.Q.L) ?

(h) What is meant by control limits ?

3. Answer **any three** of the following questions :  
 $5 \times 3 = 15$

(a) Discuss the construction of p-chart when all samples are of same size. How is the procedure modified for variable sample size ?

(b) Compare the charts of variable and charts of attributes.

(c) Explain acceptance sampling plan.



- (d) Describe the control chart for S. What are the advantages of S-chart over the R-chart ?
- (e) Discuss the relative merits and demerits of single and double sampling plans.
- (f) Write briefly a note on historical perspective of quality control.
- (g) Write briefly the overview of six-sigma limit.
- (h) A machine is set to deliver packets of a given weight. Weights for six samples of size 5 each were recorded. Mean and range of each sample are given below :

Sample no :	1	2	3	4	5	6
Mean :	14	18	16	15	17	16
Range :	7	6	6	4	8	5

Find the control limits for mean and range charts. (Given that for  $n=5$ ,  $A_2=0.577$ ,  $D_4=2.115$ ,  $D_3=0$  and for  $n=6$ ,  $A_2=0.483$ ,  $D_3=0$ ,  $D_4=2.004$ )

4. Answer **any three** of the following questions : 10×3=30

- (a) What are the advantages of statistical quality control ? Also explain the justification for using three sigma ( $3\sigma$ ) limits in the control charts.
- (b) Explain in detail  $\bar{X}$  and R-charts. What purpose do they serve ? What are their advantages over the p-chart ?
- (c) What is C-chart ? How are the control limits for C-chart obtained ? Justify the use of Poisson distribution.
- (d) Describe the single sampling plan for acceptance sampling deriving expressions for the producer's and consumer's risks and show that

$$ATI = n + (N - n) \left[ 1 - \sum_{x=0}^c \left\{ \frac{e^{-n\bar{P}} (n\bar{P})^x}{x!} \right\} \right]$$

- (e) Describe the method of double sampling plan and derive its OC curve.
- (f) Describe seven tools of statistical process control (SPC).



(g) What do you mean by quality ?  
Describe different dimensions of quality.

(h) Explain the terms :  $4+4+2=10$

(i) Average outgoing quality limit

(ii) Specification limits

(iii) Why are ASN and ATI calculated ?