UNIT-6

Statistical Quality Control

- Statistical Quality Control :- It is the application of statistical techniques to determine how far the product conferm to the standard of Quality and to what entend quality is below the standard quality. The purpose of statistical Quality Control is to discover and correct only those forces which are responsible for variation outside the stable pattern.

- Objective of Quality Control :-

1- To locate an identify the process fault, in order to control the defective waste.

2- To make necessary corrective measure to mentain the quality of the product.

3- To ensure that sub-standard products do not read to the costumer.

4- To achieve better utilization of raw material and equipment.

PAGE NO. // //
DATE // //

★ Advantages of statistical quality control -

1- To ensure control, mentenance and improvement in the quality standard.
2- To provide better quality assuarance at lower inspection cost.
3- It reduces the wastage of time and material to the minimum at it reduces the inspection and manufacturing cost and inhance profit.
4- It provided a bases for resolving the difference among the various interest in the organisation.

★ Techniques of SQC :-

Technique
- Process control
  - Variable
    - → $\bar{x}$ chart
    - → Range chart
    - → σ chart
  - Attribute
    - → P chart
    - → np chart
    - → C chart
- Product control
  - Variable
  - Attribute

1- Process control :- It is concern with controlling the quality of the product during the production process. It ensure that a product of only standard is produce and make use of control charts.

2- Product control :- It is concern with controlling the quality of the product by critical examination at stategic point. It is concern with inspection of goods already produce to a certain whom whether they are fit to be dispatched or not. It make use of sampling inspection to achieve the objective.

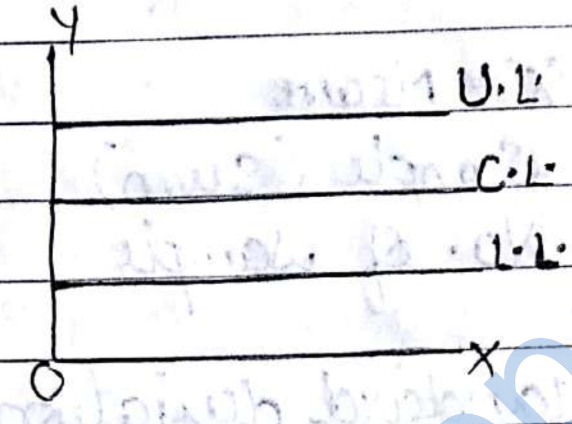
- Control charts-

Control chart is the most important quality control technique. It show three lines on the chart.

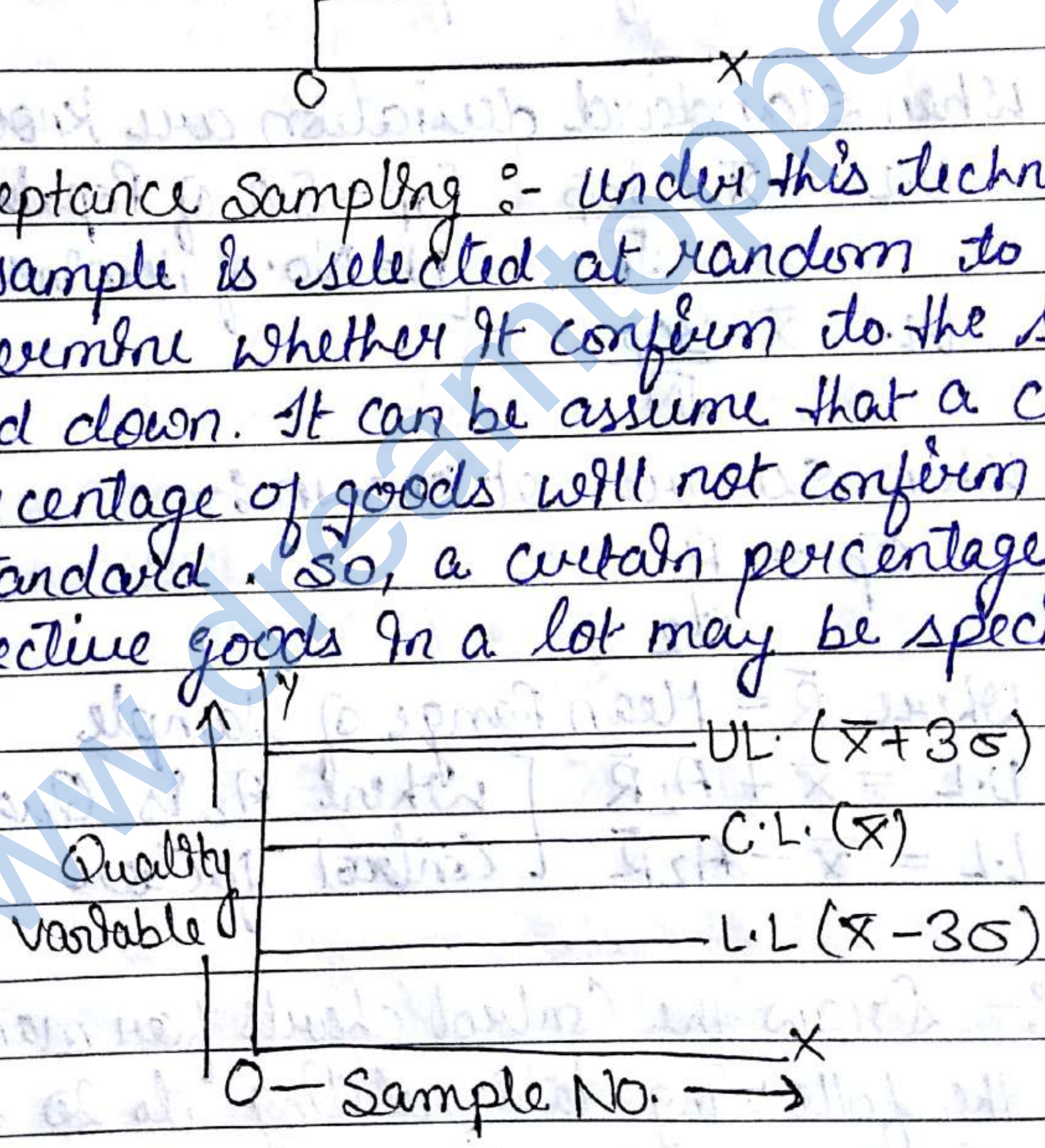
One line is the control line showing the average, Second line is below the first line indicates the limit of tolerances, Third line is above the

PAGE NO. // //
DATE // //

first line which show the limit of higher tolerance.



★. Acceptance Sampling :- under this technique a sample is selected at random to determine whether it confirm to the standard laid down. It can be assume that a certain percentage of goods will not confirm to the standard. So, a certain percentage of defective goods in a lot may be specifying.



★ Control charts for mean :- ($\bar{x}$ chart) :-

Central line $(\bar{x}) = \frac{\Sigma X}{K}$

Where $\bar{X}$ = Mean
ΣX = Sample (sum).
K = No. of sample

- When standard deviation are known :-

$U.L = \bar{X} + \frac{3\sigma_p}{\sqrt{N}}$ [σ_p = S.D. of Population
N = No. of item in sample]

$L.L. = \bar{X} - \frac{3\sigma_p}{\sqrt{N}}$

- When S.D. are not known :-

$\sigma_p = \frac{\bar{R}}{d_2}$

Where $\bar{R}$ = Mean Range of sample

$U.L = \bar{x} + A_2\bar{R}$ [Where A_2 is Quality
$L.L = \bar{x} - A_2\bar{R}$ Control factor]

Ques :- Draw the Control charts for man from the following data relating to 20 sample. Each of size 5.

Sample No.	Mean	Range	Sample no.	Mean	Range.
1	38.2	15	11	32.6	31
2	33.8	1	12	22.8	12
3	24.4	22	13	21.6	29
4	36.6	24	14	20.8	22
5	27.4	18	15	24.4	16
6	30.6	33	16	30.4	19
7	31.2	21	17	25.4	20
8	27	29	18	25.4	34
9	24	29	19	37.8	19
10	29.4	18	20	31.4	17.

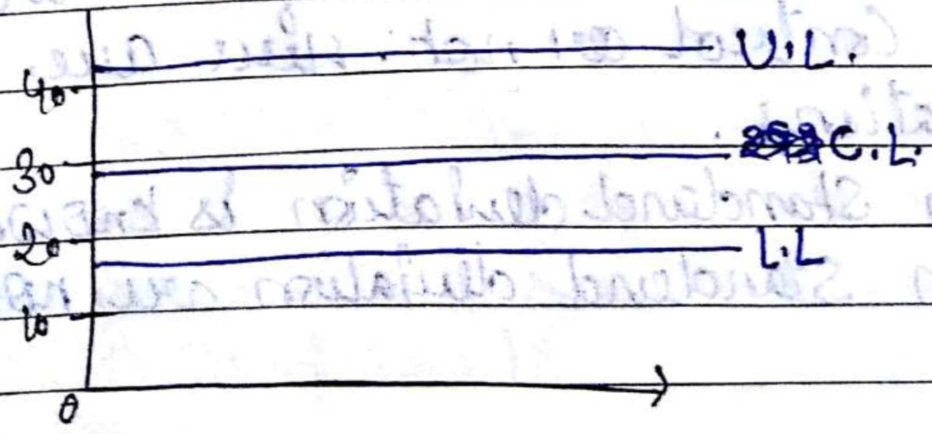
$D_2 = 2.326.$

$D_3 = 0.864.$

Solution :- C Line $(\bar{X}) = \frac{\Sigma X}{K} = \frac{583.1}{20} = 29.155$

$$U.L. = \bar{X} + \frac{3\sigma_p}{\sqrt{N}} = 29.16 + \frac{2.326}{\sqrt{5}} = 41.44.$$

$$L.L. = \bar{X} - \frac{3\sigma_p}{\sqrt{N}} = 29.16 - \frac{2.326}{\sqrt{5}} = 17.26.$$



$\bar{R} = \frac{\Sigma R}{K} = \frac{420}{20} = 21$

$UCL = \bar{R} + 3\sigma_R$

$= 21 + 3 \times 7.8 \qquad (\sigma_R = 7.8)$

$= 21 + 22.4$

$= 43.4$

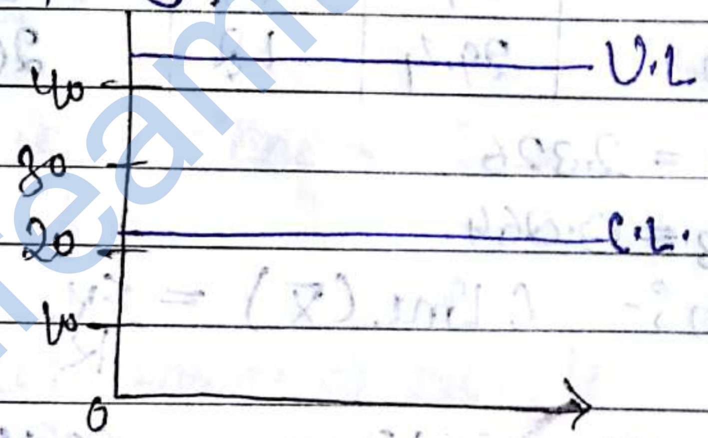
$LCL = \bar{R} - 3\sigma_R$

$= 21 - 3 \times 7.8$

$= 21 - 22.4$

$= -1.4 = 0$

R-chart :-



★ Control chart for Range (R chart) :-
The Range chart is use to see whether the standard deviation of the characteristics is in control or not. Here are two situations.

1- When standard deviation is known.
2- when standard deviation are not known.

PAGE NO. // //
DATE // //

- When S.D. are known:-

Range = highest − lowest.

Mean of Range = $\frac{\Sigma R}{K}$ [K = total no. of sample]

Central line ⇒ $(\bar{R}) = d_2 \sigma_p$

$UL = d_2 \sigma_p + 3\sigma_p \times d_3$

$LL = d_2 \sigma_p - 3\sigma_p \times d_3$

- When S.D. are not known:-

Control limit = $\frac{\Sigma R}{K}$

$UL = D_4 \bar{R}$

$LL = D_3 \bar{R}$

☆ Control charts attribute:-

<u>P chart</u>-

Central line = $\frac{\Sigma P}{n \times K}$

$UL = \bar{p} + 3\sqrt{\frac{\bar{P}(1-\bar{P})}{n}}$

$LL = \bar{p} - 3\sqrt{\frac{\bar{P}(1-\bar{P})}{n}}$

(n is sample size, K is total no. sample, p = central line).

nP chart :-

$$\text{Central Limit} = \frac{\Sigma P}{K}$$

$$\text{U. Control limit} = n\bar{P} + 3\sqrt{np(1-\bar{p})}$$

$$\text{U. " " } = n\bar{p} - 3\sqrt{np(1-\bar{p})}$$

C-chart :-

$$\text{Central line} = \frac{\text{Total defect}}{\text{Total no. of item inspected}}$$

$$UCL = \bar{C} + 3\sqrt{C}$$

$$L.CL = \bar{C} - 3\sqrt{C}$$

If lower limit is negative it is taken to be equal to 0.

R-chart :-

$$\bar{R} = \frac{\Sigma R}{K}$$

$$UCL = \bar{R} + 3\sigma R$$

$$LCL = \bar{R} - 3\sigma R.$$

Ques :- The following table give the result of inspection of 20 sample of 100 items each taken in 20 working day. Draw P-chart.

Sample No.	No. of defective	Sample no.	No. of defective.
1	6	11	10
2	2	12	4
3	4	13	6
4	1	14	11
5	20	15	22
6	6	16	8
7	10	17	0
8	19	18	3
9	4	19	23
10	21	20	10

Total no. of Item Inspected = No. of Sample × unit Inspected each day

$= 100 \times 20$

$= 2000$

average fraction = $\dfrac{\text{Total no. of dectective}}{\text{Total no. of Items Inspected}}$

$= \dfrac{200}{2000} = \dfrac{1}{10}$

$CL = 0.10$

$UL = \bar{P} + 3\sqrt{\dfrac{\bar{P}(1-\bar{P})}{n}}$

$= 0.10 + 3\sqrt{\dfrac{0.10(1-0.10)}{100}}$

$= 0.19.$

$LL = .10 - 3\sqrt{\frac{0.10(1-0.10)}{100}} = .01$