chapter = 03

Control chart for Attibutes

* It is 3 types :

a) c - chart
b) p - chart
c) np - chart / D-chart

1) c chart = [c. chart for no. of deffect]

* 1 of the imp c.chart for attributes is c - chart
* It is designed to control the no. of deffects per units.
* There are many situations in industry where the data are obtained by counting & are of discrete types.
* eg → No. of ideale machines, no. of air bubbles in glasses, no. of rust spots in steel sheets, no. of deffects in body alignment of air crafts & buses, are the egs where c-chart is usually of 1 unit

→ procedure for construction of c-chart =

Let c denote the no. of deffects counted in 1 units of cloth of paper/ any material.

find the mean $\bar{c} = \frac{c_1 + c_2 + \cdots + c_n}{n}$

where $c_1, c_2 \ldots c_n$ are deffects counted in several such units.

The expected standard / central line is $\bar{c}$. In a poisson distri~ the v(x) = V. (i.e), $\sigma^2 = \bar{c}$ or $\sigma = \sqrt{\bar{c}}$.

Based on this 3σ limits for the UCL & LCL are obtained.

$UCL = \bar{c} + 3\sigma = \bar{c} + 3\sqrt{\bar{c}}$

$LCL = \bar{c} - 3\sigma = \bar{c} - 3\sqrt{\bar{c}}$

Q 1) 10 pieces of cloth out of diffrnt rdes of equal length contained the follo~ no. of deffects → 1, 3, 5, 0, 6, 0, 9, 4, 4, 3

Draw a control chart for the no. of deffects & state whether the process is in a state of statistical control?

A) 1, 3, 5, 0, 6, 0, 9, 4, 4, 3 → c_i

n = 10

$\bar{c} = \frac{\sum c_i}{n} = \underline{3.5}$

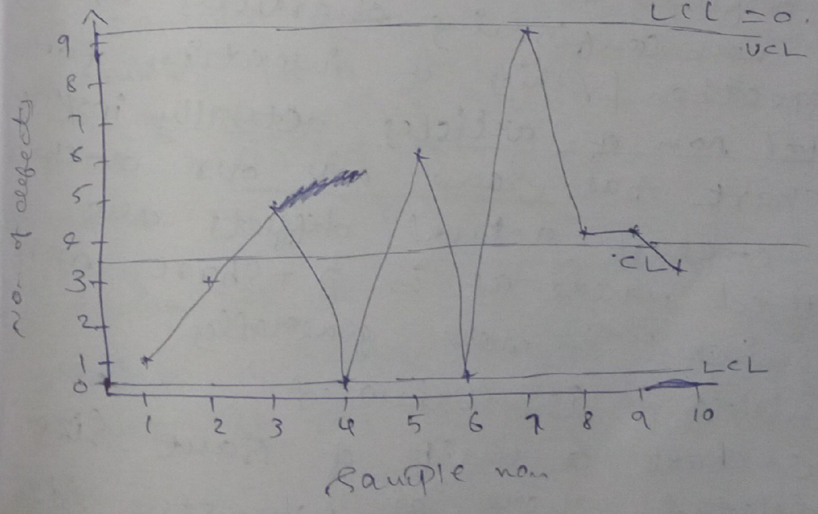
$C.L = \bar{c} = 3.5$

$UCL = \bar{c} + 3\sqrt{\bar{c}} = 3.5 + 3 \times \sqrt{3.5} = \underline{9.112}$

$LCL = \bar{c} - 3\sqrt{\bar{c}} = \underline{-2.11}$

as LCL/UCL is -ve it is considered as 0

LCL = 0.



All the points lie within the CL hence the process is in statistical control

= 2) **p-chart** (chart for fraction deffective)

* The most versatile & widely used c-chart for attributes.
* This chart is for the fraction rejected as non conforming to specification.
* This is also → chart for fraction deffective
* This chart is applied quality characteristics that are considered as attributes.
* If the result of an inspection is the classification of an individual articles as accepted / rejected, then p-chart is applied to 1 quality charatristics / grp / %.
* Fraction deffective / fraction rejected p is defined as the ratio of the non of non confirming ~~ch~~articles in any inspection / series of inspection to the total no of articles actually inspected.
* p chart has some adv over c-chart
a) In c-chart actual deffects are plotted where as in p-chart more meaningful & more generally variable p is evaluated.
b) In c-chart a unit of same size is selected where as when the size of sample size varies from sample to sample the p-chart permits a more meaningful & straight forward & scattered presentation.

Procedure →

a) compute fraction deffective for each sample

$$p = \frac{\text{no of defective unit in sample}}{\text{sample size / total no of unit inspected in the sample.}}$$

b) obtain the avg deffective p from all the gvn samples,

$$\bar{p} = \frac{\text{Total no of defectives in all the samples combined}}{\text{total no of items inspected in all the sample combined.}}$$

c) expected standard / central line, $CL = \bar{p}$

d) LCL & UCL gvn by

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

$$LCL_p = \bar{p} - 3\sigma_p = \bar{p} - 3\sqrt{\frac{\bar{p}(1-\bar{p})}{n}}$$

1) 12 samples of 200 bulb where each examined in a fortnight production, no of deffective bulb in each sample was recorded below,

sample no :	1	2	3	4	5	6	7	8	9	10	11	12
no of deffective :	23	32	40	30	43	27	28	24	10	12	9	10

a) Draw c-chart for fraction deffective
b) what do you find out from chart.

d) ① p ?

fraction defective (p)	23/200	32/200	40/200	30/200	43/200	27/200	28/200	24/200	10/200	12/200	9/200	10/200
⇒	.115	.16	.2	.15	.215	.135	.14	.12	.05	.06	.045	.05

② $\bar{p}$?

$n = 12$

$$CL = \boxed{\bar{p} = \frac{\Sigma p_i}{n}} = \frac{1.44}{12} = \underline{\underline{0.12}}$$

③ UCL, LCL ?

$n = 200$

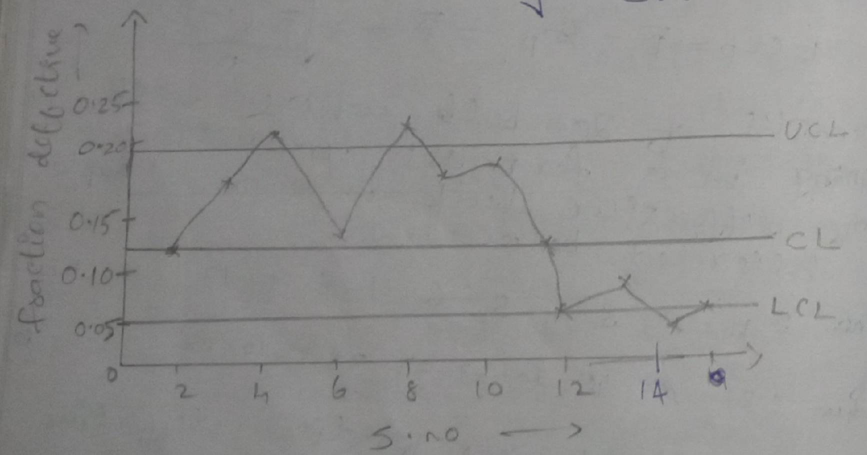
$$UCL_p = \bar{p} + 3\sqrt{\frac{\bar{p}(1-\bar{p})}{n}}$$

$$= 0.12 + 3\sqrt{\frac{0.12\,(1-0.12)}{200}}$$

$$= 0.12 + 3\cdot\sqrt{\frac{0.12 \times 0.88}{200}} = \underline{\underline{0.188}}$$

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

$$= 0.12 - 3\sqrt{\frac{0.12 \times 0.88}{200}} = \underline{\underline{0.051}}$$



④ points are found to lie outside the CL
∴ production process of bulb is not under statistical control.

3) **np chart** = [c.chart for no. of defective]

* Here, if n is taken as 100, then it represent the % deffective chart / 100 p-chart
* The central line / expected standard is,

$$CL = n\bar{p} = \frac{\text{Total no. of defective of all samples}}{\text{no. of samples inspected}}$$

$$UCL = n\bar{p} + 3\sqrt{n\bar{p}(1-\bar{p})}$$

$$LCL = n\bar{p} - 3\sqrt{n\bar{p}(1-\bar{p})}$$

* Also ⟶ D chart.
* we hue to plot the values of no. of deffectives, d = np in chart & find the nature of process.
* Here d will never be -ve. Hence whever LCL is < than 0, it is taken 0.

Note →

* To obtain the CL for np chart, multiply CL of p chart by n.

) A sample of 100 items was examined each hr from a production process. The no. of deffectives found in a day are reproduced below.

16	18	12	4	10	15	13	6	7	12	10	10
2	3	13	4	1	6	5	8	4	2	5	6

Draw CL for no. of deffectives & Comment on the state of control of process.

4) $n\bar{p} = \bar{d} = \frac{\Sigma d_i}{n} = \frac{192}{24} = 8$

$\bar{p} = \frac{\bar{d}}{n} = \frac{8}{100} = 0.08$

$CL = n\bar{p} = 100 \times 0.08 = 8$

$UCL = n\bar{p} + 3\sqrt{n\bar{p}(1-\bar{p})}$

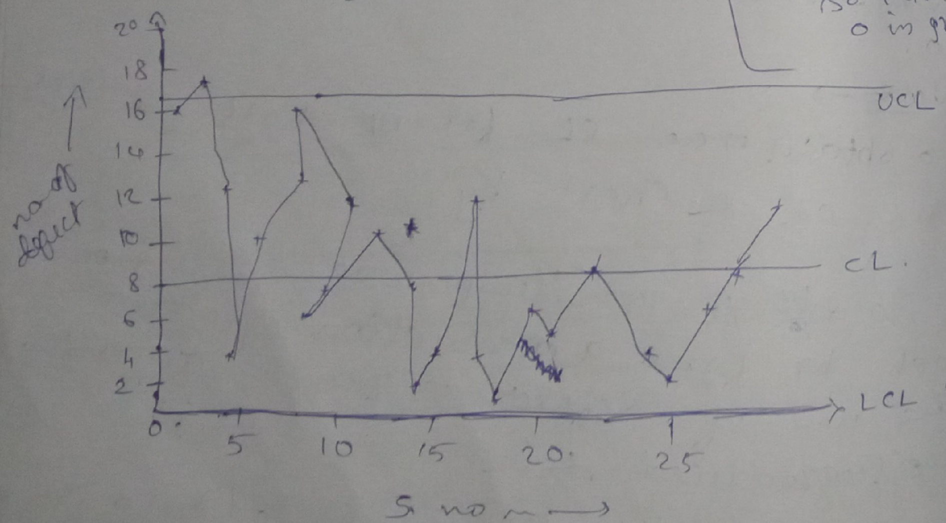
$= 8 + 3\sqrt{8(1-0.08)} = 16.13$

$LCL = n\bar{p} - 3\sqrt{n\bar{p}(1-\bar{p})}$

$= 8 - 3\sqrt{8(1-0.08)}$

$= -0.13 \Rightarrow 0$

[LCL is -ve no so taken as 0 in graph]



2nd point lies outside the CL. Hence the production process is not under statistical control.

→ Uses of statistical quality control (SQC):-

* An objective check is maintained on the quality of the product through statistical quality control. (SQC)
* Through SQC, we can know that whether the manufacturing process is under control / not.
* If it is not under control remedial measures can be taken
* SQC has healthy influence on workers.
* SQC enhances the goodwill of the product i.e it he is adopting an efficient strict SQC system.
* Quality of the product can be guarented before any govermental agency on the basis of SQC records.