Numericals related $\bar{X}$, R, c & p-charts

1) calculate the upper and lower control limits for the p-chart given the following data, when $n = 100$

(20, 10, 15, 18, 19, 20, 17, 16, 14, 29, 16, 17)

Solution

For p-chart
upper and lower control limits are

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

i.e upper control limits $= \bar{p} + 3\sqrt{\frac{\bar{p}(1-\bar{p})}{n}}$

& Lower control limit $= \bar{p} - 3\sqrt{\frac{\bar{p}(1-\bar{p})}{n}}$

$$\bar{p} = \sum_{1}^{K} \frac{\hat{p}_i}{K} = \frac{(20+10+15+18+19+20+17+16+14+29+16+17)/100}{12}$$

$$\bar{p} = \frac{211/100}{12} = \frac{2.11}{12}$$

$$\bar{p} = 0.1758$$

$$\therefore \bar{p} \pm 3\sqrt{\frac{\bar{p}(1-\bar{p})}{n}}$$

$$= 0.1758 \pm 3\sqrt{\frac{0.1758(1-0.1758)}{100}}$$

$$= 0.1758 \pm 0.1142$$

So upper control limit = 0.1758 + 0.1142
(UCL) = 0.2900

Lower control limit = 0.1758 − 0.1142
(LCL) = 0.0616

* Numerical problem based on control chart $\bar{X}$ & R

The following data was obtained (Table, no. 1) for diameter of a component from shop floor: construct $\bar{X}$ & R charts. Find control limits for sample size '5' take $A_2 = 0.577$, $D_4 = 2.114$, $D_3 = 0$

Sample No	$\bar{X}$	R
1	50.04	0.07
2	5.24	0.08
3	50.14	0.03
4	50.08	0.05
5	50.28	0.04
6	60.16	0.08
7	50.30	0.04
8	50.10	0.03
9	50.16	0.06
10	50.10	0.07

Scanned with CamScanner

Solution: calculate $\bar{\bar{X}}$ & $\bar{R}$

Grand average $\bar{\bar{X}} = \frac{\Sigma \bar{X}}{N}$

$$= \frac{(50.04+50.24+50.14+50.08+50.28+50.16+50.30+50.10+50.16+50.10)}{10}$$

$$\therefore \bar{\bar{X}} = 50.16$$

Range average $\bar{R} = \frac{\Sigma R}{N}$

$$= \frac{(0.07+0.08+0.03+0.05+0.04+0.08+0.04+0.03+0.06+0.07)}{10}$$

$$\therefore \bar{R} = 0.055$$

Now the control limits for $\bar{X}$ chart

upper control limits (UCL) $\bar{X} = \bar{\bar{X}} + A_2 \bar{R}$

$$\therefore UCL\,\bar{X} = \bar{\bar{X}} + A_2\bar{R}$$

$$= 50.16 + (0.577 \times 0.055)$$

$$\boxed{\therefore UCL\,\bar{X} = 50.19}$$

Scanned with CamScanner

Lower control limit ~~x~~ (LCL) $\bar{\bar{X}} = \bar{\bar{X}} - A_2\bar{R}$

$= 50.16 - (0.577 \times 0.055)$

$\therefore \boxed{LCL\ \bar{X} = 50.12}$

Now control limits of for R chart

upper control limit (UCL) $R = D_4\bar{R}$

Lower control limit (LCL) $R = D_3\bar{R}$

$UCL\,R = D_4\bar{R}$

$= 2.114 \times 0.055$

$\therefore \boxed{UCL\,R = 0.1162}$

$LCL\,R = D_3\bar{R}$

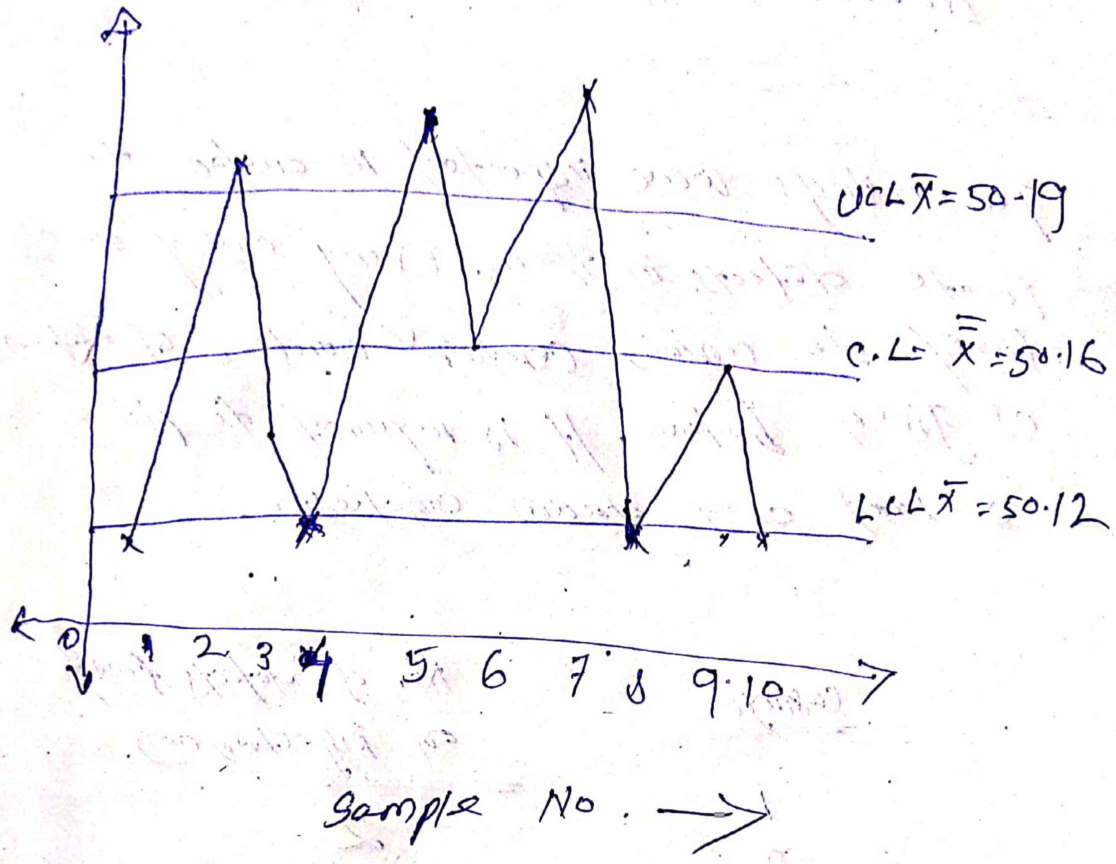
$= 0 \times 0.055$

$\therefore$ ~~LCR~~

$\therefore \boxed{LCL\,R = 0}$

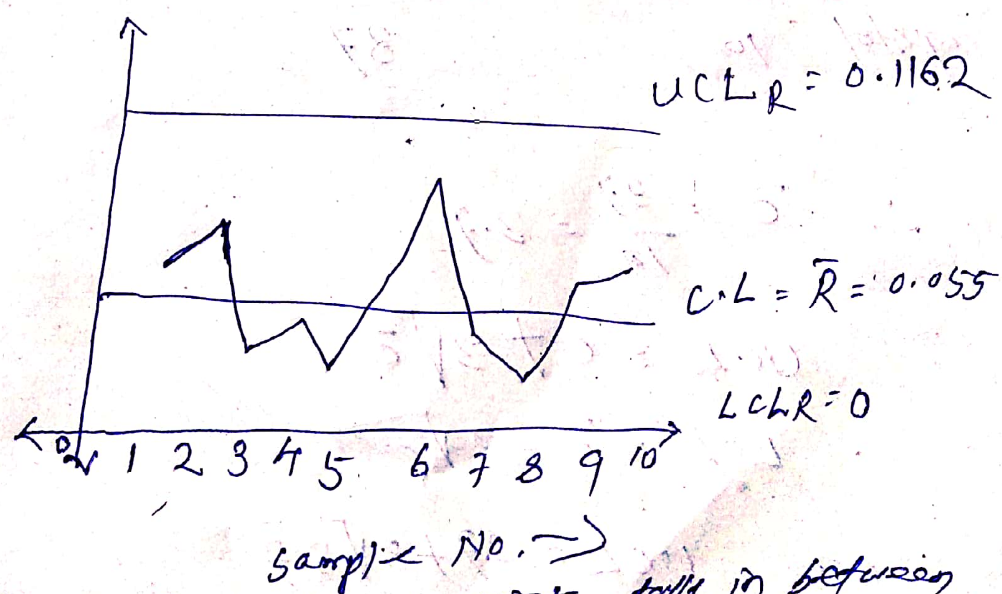
Now we will ~~control~~ construct $\bar{\bar{X}}$ chart

$\bar{X}$ chart



As some points like Sample No 1, 4, 8 & 10 falls below Lower control limits and sample No. 2, 5, and 7 lying above upper control limit, so process is not in control.

R chart



As in R charts all points falls in between two limits i.e UCL and L.C.L, so for Range value the process ~~is~~ is ~~in control~~ under control

Numerical on c-chart :

Ten castings were inspected in order to locate defects in them. Every casting was found to contain certain number of defects as given below. It is required to plot a c-chart and draw conclusion.

Castings	No. of defects found on inspection (c)
1	2
2	4
3	1
4	5
5	5
6	6
7	3
8	4
9	0
10	7
Total 10	37

$$\therefore \bar{c} = \frac{37}{10} = 3.7$$

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

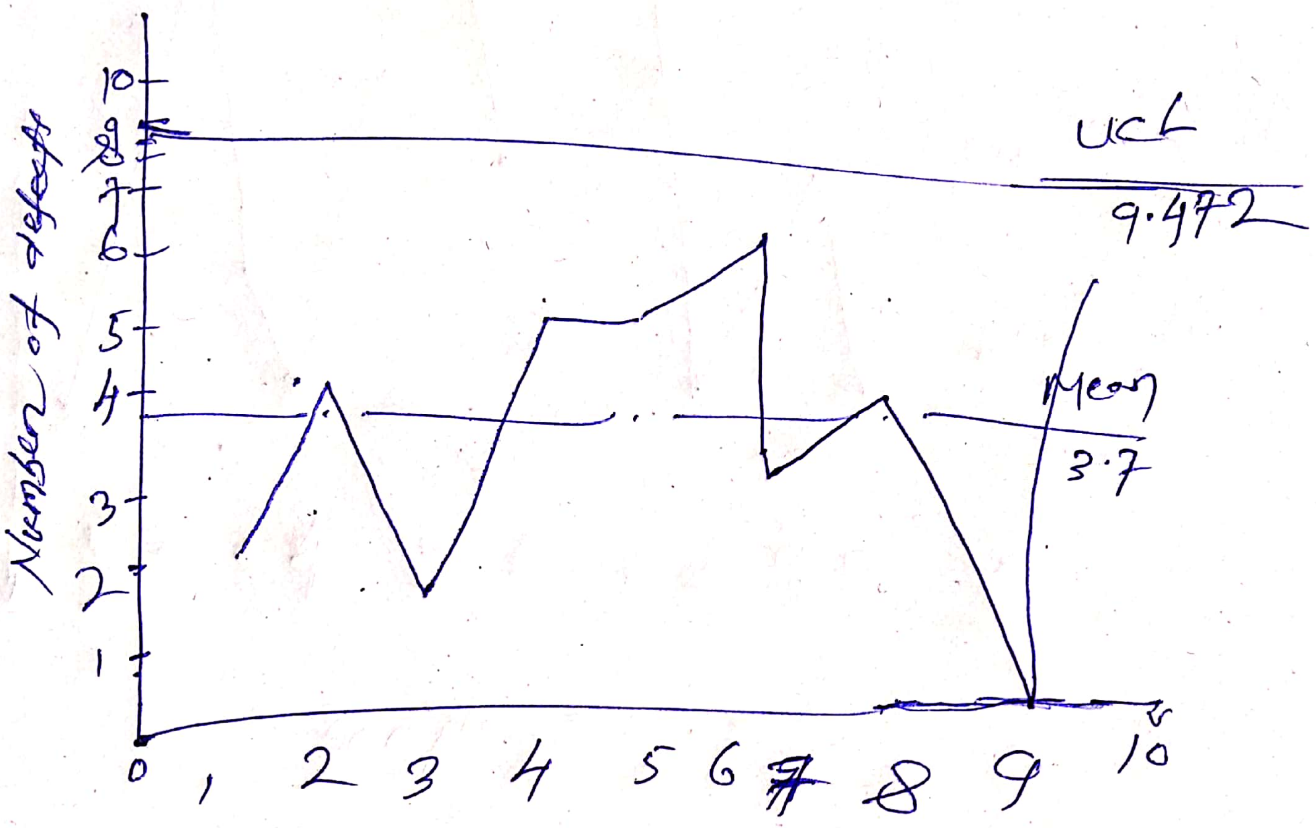
$$LCL = \bar{c} - 3\sqrt{\bar{c}}$$

or $$UCL = 3.7 + 3\sqrt{3.7}$$
$$= 9.472$$

$$LCL = 3.7 - 3\sqrt{3.7}$$

$= -2.072 = $ zero As LCL is -ve so it has been taken as being zero.

C-chart



It is concluded that since all the values of C i.e within the control limits, the process is under control.