UNIT-5

STATISTICAL QUALITY CONTROL

01) Given below are sample mean values ($\bar{x}$) and sample range (R) for 10 samples. Draw appropriate mean and range charts and comment on state of control of process

SOLN::

Sample	1	2	3	4	5	6	7	8	9	10
Mean	43	49	37	44	45	37	51	46	43	47
Range	5	6	5	7	7	4	8	6	4	6

Construction of $\bar{x}$ chart

i) Mean of each sample ($\bar{x}$)

ii) Mean of sample means

$$\bar{\bar{x}} = \frac{\Sigma \bar{x}}{N} = 44.2 \ (\bar{\bar{x}}) \ (CL)$$

$\bar{R}$ = Range value = $\frac{\Sigma R}{N}$ = 5.8 (CL)

$A_2 = 0.577$ for $n = 5$

upper control line (UCL) = $\bar{\bar{x}} + A_2\bar{R}$

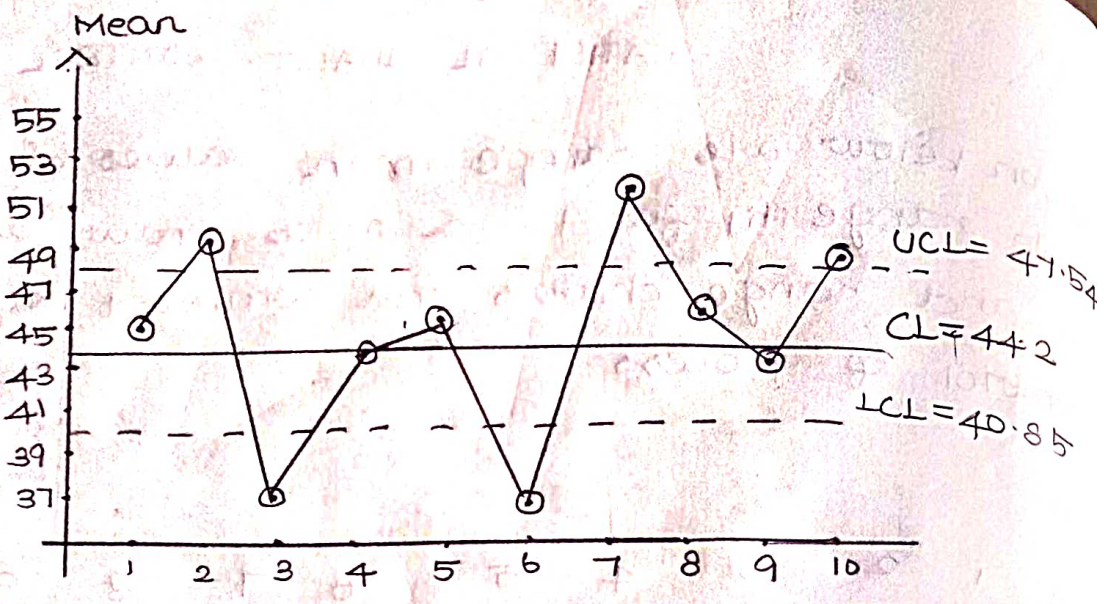
$= 42.5 + (0.577)(5.8)$

$= 47.54$

Lower control line (LCL) = $\bar{\bar{x}} - A_2\bar{R}$

$= 44.2 - 3.346$

$= 40.85$



CONCLUSION:

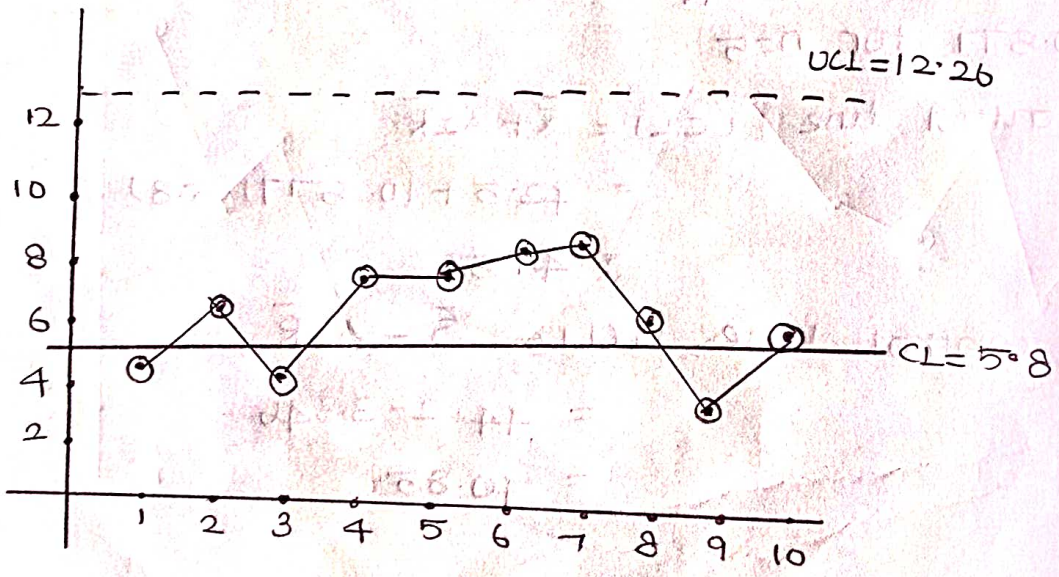
In the mean chart, some points lie outside the control line, hence process are not under control.

$$LCL = D_3 \bar{R} = 0$$

$$UCL = D_4 \bar{R} = 2.115\ (5.8)$$

$$= 12.26$$

RANGTE CHART:



CONCLUSION:-

All the pe within control line. Hence process are under control.

22) 15 samples of 4 boxes are drawn randomly. The weights of the sampled boxes are shown as Follows. Draw the control charts for sample mean and sample range & determine whether the process is in state of control

Sample Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	43.9	43.6	46.0	44.2	45.9	43.8	44.1	47.8	49.6	45.6	43.5	43.0	47.0	49.1	46.3
ΣX	11	10.9	11.5	11.1	11.7	11.0	11.0	12.0	12.4	11.4	11.9	11.8	11.8	12.3	11.6
$\bar{X}$	2.4	1.4	1.7	0.7	0.8	0.7	1.1	2.0	2.1	1.4	1.2	0.7	1.0	1.2	1.5
Ri.															

construction of $\bar{x}$ chart

i) Mean of each sample ($\bar{x}$)

ii) Mean of samples ($\bar{\bar{x}}$) (CL)

$$= \frac{\Sigma \bar{X}}{N} = 11.56$$

$$\bar{R} = \frac{\Sigma R}{N} = 1.227 \text{ (CL)}$$

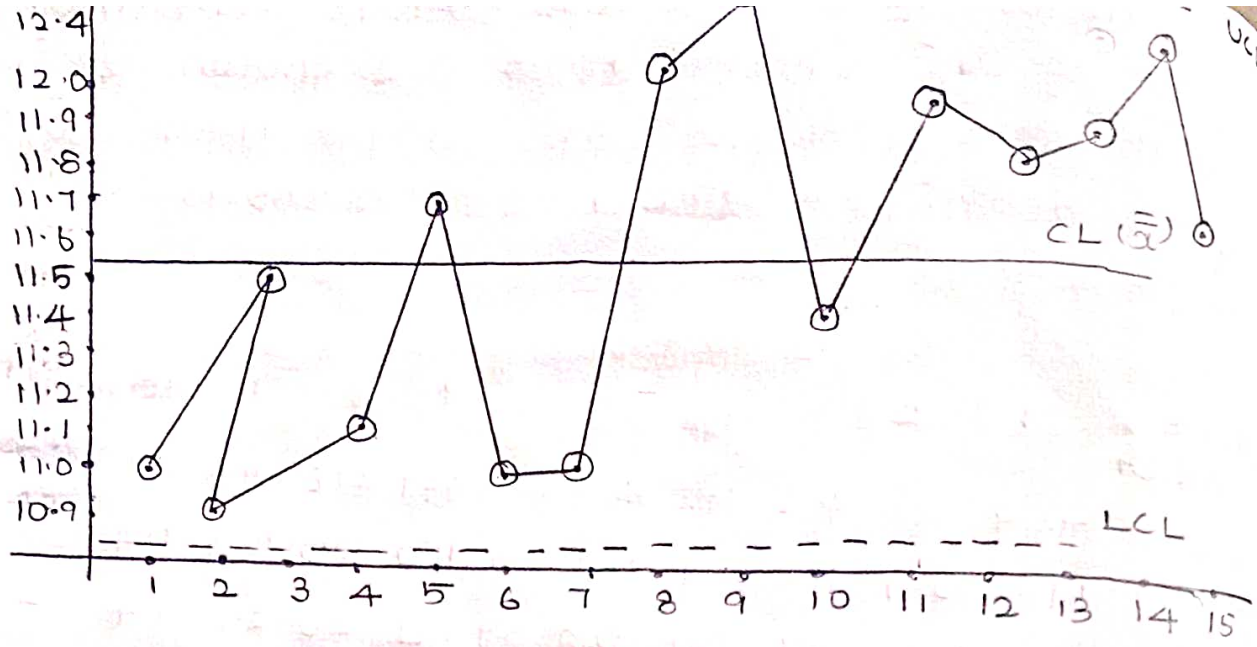
$A_2 = 0.729$ for $n = 4$

$$UCL = \bar{\bar{x}} + A_2(\bar{R})$$

$$= 11.56 + 0.729 \times 1.227 = 12.45$$

$$LCL = \bar{\bar{x}} - A_2(\bar{R})$$

$$= 10.667$$



CONCLUSION:-

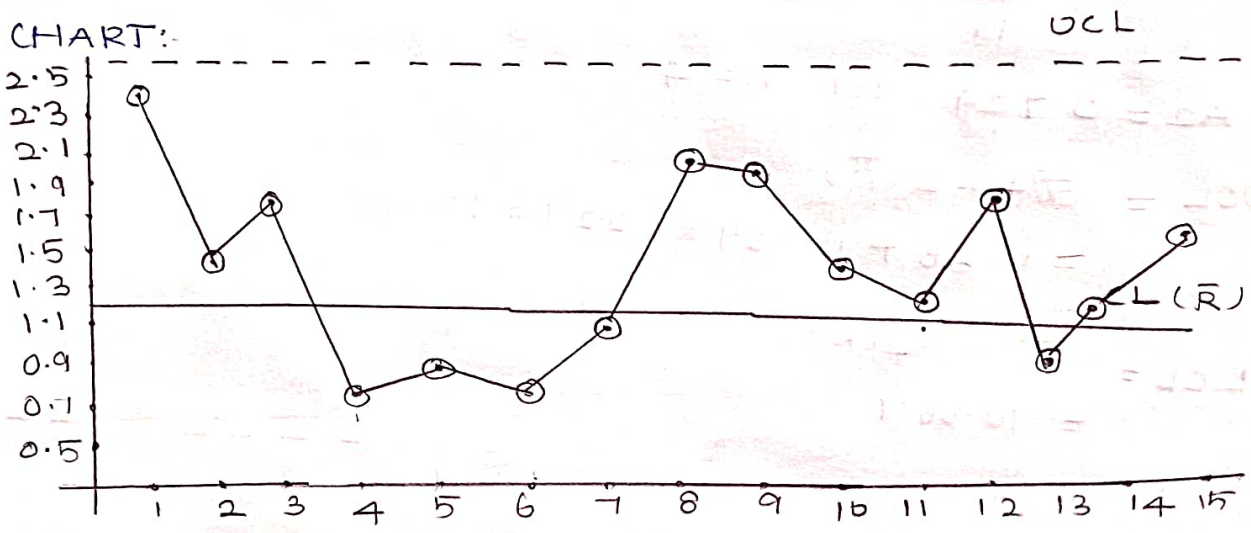
All the points are within control line. So all the process are under control

$$LCL = D_3\bar{R} = 0$$

$$UCL = D_4\bar{R} = 2.28 \times 1.227$$

$$= 2.797$$

RANGTE CHART:-



CONCLUSION:-

All the process are under control

np-chart
↓
no. of defectives

a) In a Factory producing the no. of defectives found in the inspection of 15 lots of 100 each is given below draw the control chart for the no of defectives and comment on the state of control.

sample NO	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
NO. of defectives	5	10	12	8	6	4	6	3	4	5	4	7	9	5	4

N = 15

$$CL = n\bar{p} = \frac{np_1 + np_2 + \dots + np_{15}}{N} = \frac{\Sigma n\bar{p}}{N} = 6$$

$$\bar{p} = \frac{n\bar{p}}{n} = \frac{6}{100} = 0.06$$

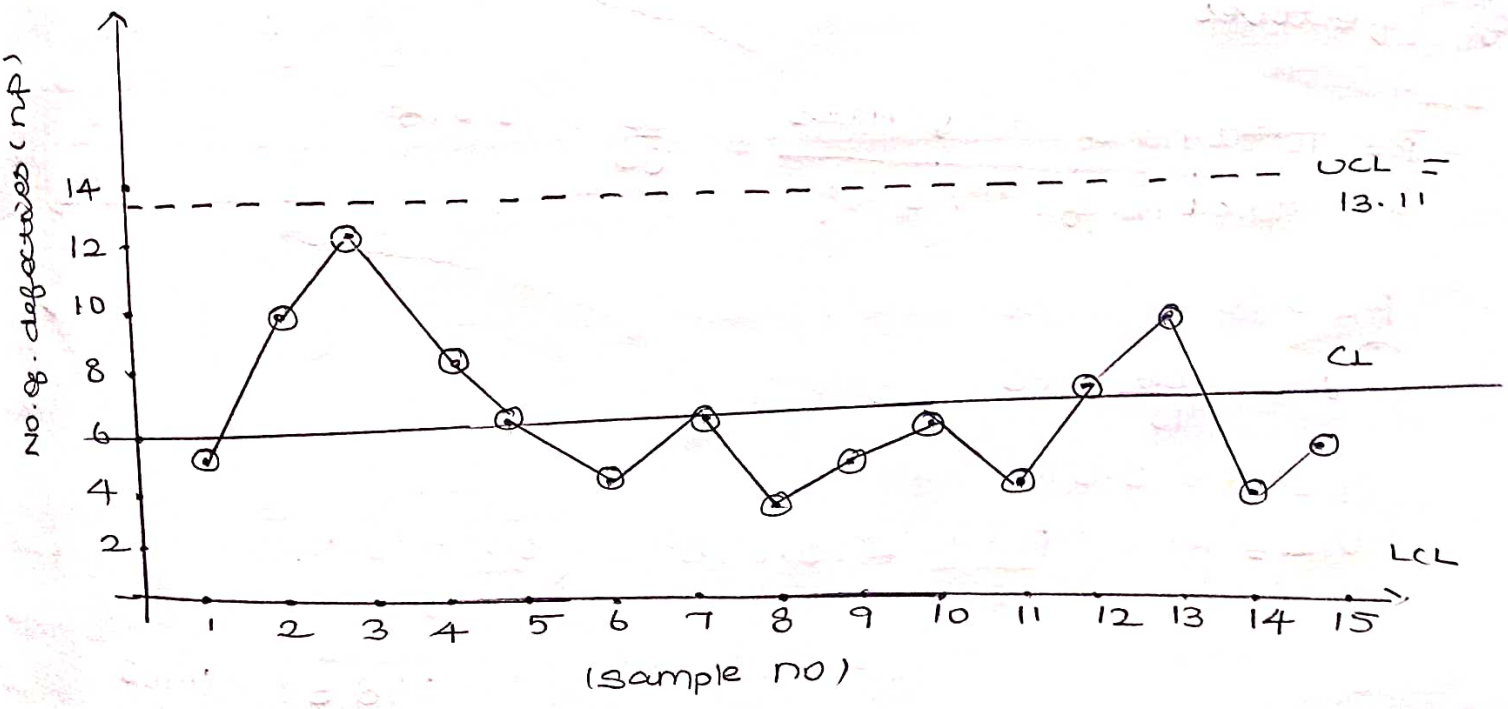
$$UCL = n\bar{p} + 3\sqrt{n\bar{p}(1-\bar{p})} = 6 + 3\sqrt{6(1-0.06)} = 6 + 3\sqrt{6 \times 0.94}$$

$$= 6 + 3 \times 0.48 \quad 2.37$$

$$= 13.11$$

$$LCL = n\bar{p} - 3\sqrt{n\bar{p}(1-\bar{p})} = 6 - 3 \times 2.37$$

$$= -1.124 \text{ (cannot be (-)ve) so } LCL = 0$$



NOTE: np chart is used when $np \geq 4$.

2) All the samples are of same size

P chart

1) p chart is used when $\bar{p} \geq 0.05$

2) $0.75\bar{n} \leq n_i \leq 1.25\bar{n}$ $\forall i$ & $\bar{n} = \frac{\sum n_i}{N}$

3) samples are different size

same sample → np & p | diff → p

P-chart

1) construct a control chart for defectives

sample no	1	2	3	4	5	6	7	8	9	10
No Inspected	90	65	85	70	80	80	70	95	90	75
No. of defectives	9	7	3	2	9	5	3	9	6	7
Proportion (Fraction) of defectives	$\frac{9}{90}$	$\frac{7}{65}$	$\frac{3}{85}$	$\frac{2}{70}$	$\frac{9}{80}$	$\frac{5}{80}$	$\frac{3}{70}$	$\frac{9}{95}$	$\frac{6}{90}$	$\frac{7}{75}$

$$\bar{p} = \frac{\text{Total no. of defectives}}{\text{total no. of items insp}} = \frac{60}{800} = 0.075$$

$\bar{p} \geq 0.05$

⊗ $n = \frac{800}{10} = 80$

$CL = \bar{p} = 0.075$

$$UCL = \bar{p} + 3\sqrt{\frac{\bar{p}(1-\bar{p})}{n}} = 0.075 + 3\sqrt{\frac{0.075(0.925)}{80}}$$

$$= 0.075 + 3\sqrt{0.000867} = 0.163$$

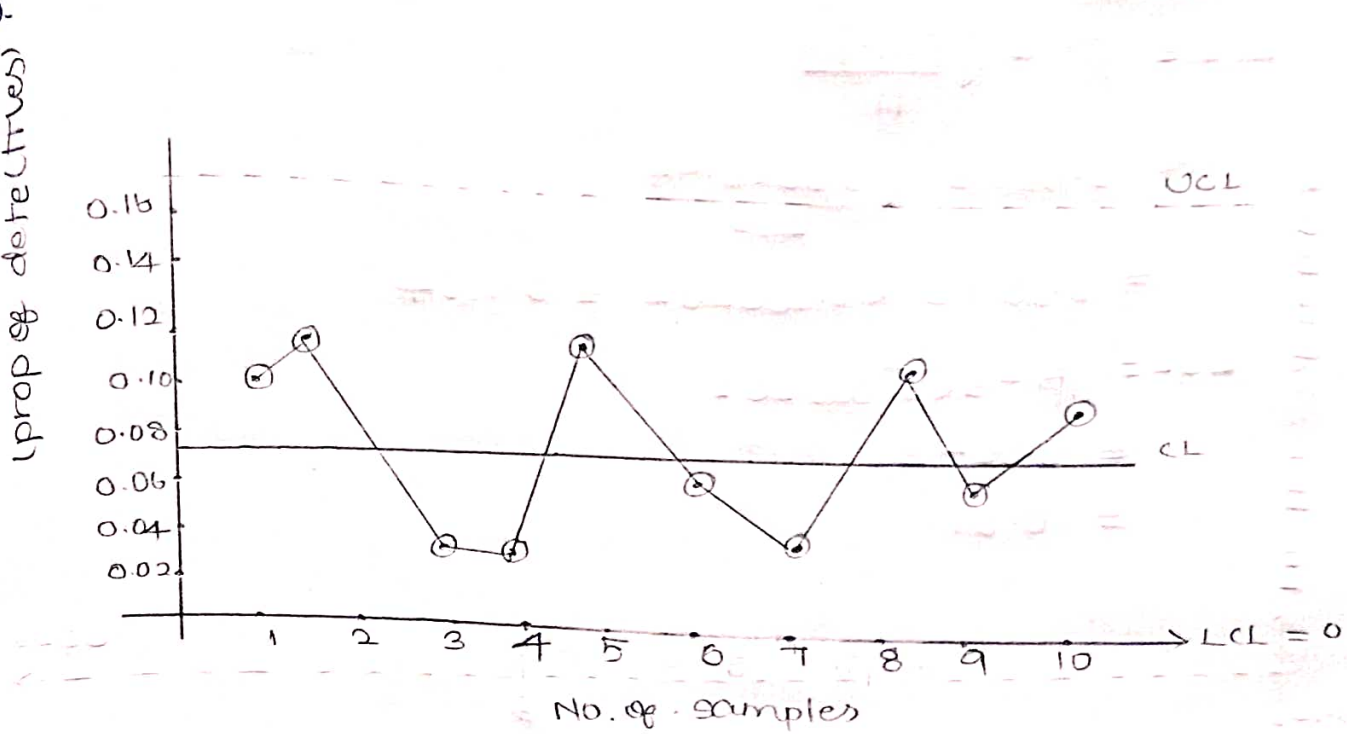
$$LCL = \bar{p} - 3\sqrt{\frac{\bar{p}(1-\bar{p})}{n}}$$

$$= 0.075 - 3\sqrt{\frac{0.075\ 10.925}{80}}$$

$LCL = -0.013$

(cannot have -ve LCL)

$LCL = 0$



CONCLUSION:

All the process are under control.

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2) 15 samples of 200 items each were drawn from the output of a process the no. of defective items of the sample are given below. prepare a control chart for the Fraction defectives (even though sample size is diff we can draw p-chart)

S.N	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
No. of defec (np)	12	15	10	8	19	15	17	11	13	20	10	8	9	5	8
Fraction defectives	$\frac{12}{200}$	$\frac{15}{200}$	$\frac{10}{200}$	$\frac{8}{200}$	$\frac{19}{200}$	$\frac{15}{200}$	$\frac{17}{200}$	$\frac{11}{200}$	$\frac{13}{200}$	$\frac{20}{200}$	$\frac{10}{200}$	$\frac{8}{200}$	$\frac{9}{200}$	$\frac{5}{200}$	
	0.06	0.075	0.05	0.04	0.095	0.075	0.085	0.055	0.065	0.1	0.05	0.04	0.045	0.025	0.075

$$n\bar{p} = \frac{\Sigma np}{N} = \frac{180}{15} = 12$$

$$\bar{p} = \frac{n\bar{p}}{n} = \frac{12}{200}$$

$$= 0.06$$

$CL = 0.06$

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

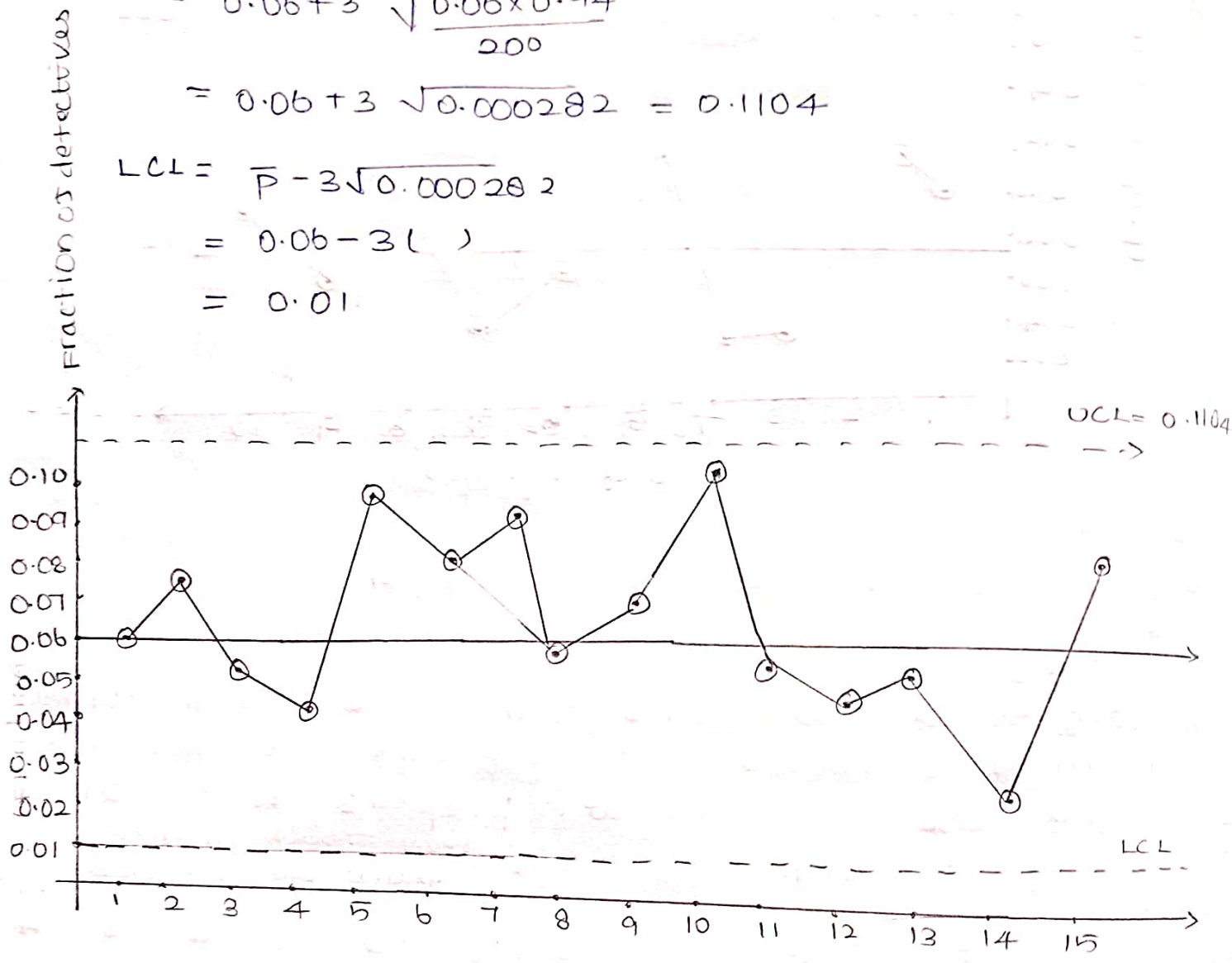
$$= 0.06 + 3\sqrt{\frac{0.06 \times 0.94}{200}}$$

$$= 0.06 + 3\sqrt{0.000282} = 0.1104$$

$$LCL = \bar{p} - 3\sqrt{0.000282}$$

$$= 0.06 - 3(\ )$$

$$= 0.01$$



All the points are within control lines. Therefore all the process are under control.

c-chart :-

@) 15 taperecorders were examined for quality control test. The no of defects in the each taperecorder is recorded below. Draw the appropriate control chart and comment on the state of control

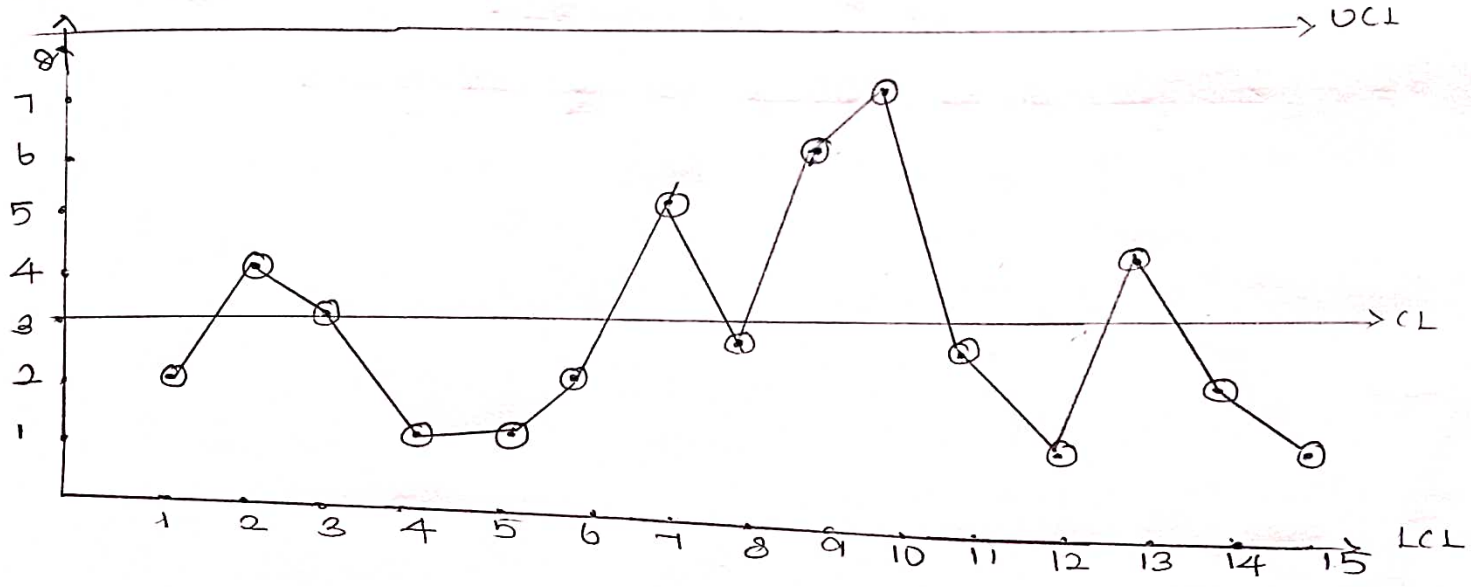
Unit no	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
No. of defects	2	4	3	1	1	2	5	3	6	7	3	1	4	2	1.

(c)

$$\bar{c} = \frac{\Sigma c_i}{N} = 3$$

$UCL = \bar{c} + 3\sqrt{\bar{c}} = 3 + 3\sqrt{3} = 8.196$

$LCL = \bar{c} - 3\sqrt{\bar{c}} = -2.196$ (LCL cannot be -ve)



CONCLUSION:-

Since all the points are within control lines. Therefore all the process are under control.