Practical-1

Aim: To find control limits for $\bar{x}$ chart and R chart and comment on state of control.

Problem: A machine is set to deliver the packets of a given weight. Ten samples of size five were examined and the following results were obtained:

Sample No. :	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

Calculate the values for the central line and the control limits for the mean chart and range chart. comment on the state of control. (Given for $n=5$, $d_2 = 2.326$, $d_3 = 0.864$)

Theory and Formula

For the given data, we have to calculate $\bar{x}$ and R chart 3σ control limits.

Then 3σ control limits are given by :

$$CL_{\bar{x}} = \bar{\bar{x}} \qquad CL_R = \bar{R}$$

$$UCL_{\bar{x}} = \bar{\bar{x}} + A_2\bar{R} \qquad UCL_R = D_4\bar{R}$$

$$LCL_{\bar{x}} = \bar{\bar{x}} - A_2\bar{R} \qquad LCL_R = D_3\bar{R}$$

where $A_2 = \dfrac{3}{d_2\sqrt{n}}$, $D_4 = 1 + \dfrac{3d_3}{d_2}$, $D_3 = 1 - \dfrac{3d_3}{d_2}$

A_2, D_3 and D_4 are constants and their value can be taken from the table on the basis of sample size.

Calculations

~~The 3σ control limits are~~

~~For $\bar{x}$ chart~~

$$\bar{\bar{x}} = \frac{1}{k}\sum_{i=1}^{10} \bar{x}_i = 44.2 \qquad \left\{ \begin{matrix} k=10 \\ n=5 \end{matrix} \right\}$$

$$\bar{R} = \frac{1}{k}\sum_{i=1}^{10} R = 5.8$$

The 3σ control limits are given by :

<u>$\bar{x}$ chart</u> : $CL_{\bar{x}} = \bar{\bar{x}} = 44.2$ (central line)

$$UCL_{\bar{x}} = \bar{\bar{x}} + \frac{3\bar{R}}{d_2\sqrt{n}} = 44.2 + 3.346 = 47.546$$

$$LCL_{\bar{x}} = \bar{\bar{x}} - \frac{3\bar{R}}{d_2\sqrt{n}} = 44.2 - 3.346 = 40.854$$

Upper and Lower control limits

For R Chart

$$CL_R = \bar{R} = 5.8$$

$$UCL_R = D_4\bar{R} = 5.8\left(1 + \frac{3(0.864)}{2.326}\right) = 12.263$$

$$LCL_R = D_3\bar{R} = 5.8\left(1 - \frac{3(0.864)}{2.326}\right) = 0$$

Result

$\bar{X}$-Chart : Since the sample means corresponding to the sample numbers 2, 3, 6 and 7 are outside the control limits, the process average is out of control. This suggests the presence of assignable causes of variation which should be traced and corrected.

R-Chart : Since none of the sample ranges lie beyond the control limits of the R chart, the process variability is in control.

Aim: To construct a $\bar{X}$ and R control chart and interpret them

Problem: Construct a control chart for mean and range for the following data on the basis of fuses, samples of 5 being taken every hour (each set of 5 has been arranged in ascending order of magnitude). Comment on whether the production seems to be under control, assuming that these are the first data:

42	42	19	36	42	51	60	18	15	69	64	61
65	45	24	54	51	74	60	20	30	109	90	78
75	68	80	69	57	75	72	27	39	113	93	94
78	72	81	77	59	78	95	42	62	118	109	109
87	90	81	84	78	132	138	60	84	153	112	136

Theory and Formula:

$$\bar{\bar{X}} = \frac{1}{k}\sum_{i=1}^{k}\bar{X}_i \qquad \bar{R} = \frac{1}{k}\sum_{i=1}^{k}R_i$$

$\bar{X}$ Chart	R Chart
$CL_{(\bar{X})} = \bar{\bar{X}}$	$CL_{(R)} = \bar{R}$
$UCL_{(\bar{X})} = \bar{\bar{X}} + A_2\bar{R}$	$UCL_{(R)} = D_4\bar{R}$
$LCL_{(\bar{X})} = \bar{\bar{X}} - A_2\bar{R}$	$LCL_{(R)} = D_3\bar{R}$

Calculations

Sample No.	Sample Observations	Total	$\bar{X}$	R
1	42 65 75 78 87	347	69.4	45
2	42 45 68 72 90	317	63.4	48
3	19 24 80 81 81	285	64.0	62
4	86 54 69 77 84	320	57.4	48
5	42 51 57 59 78	287	82	36
6	51 74 75 78 132	410	85	81
7	60 60 72 95 138	425	83.4	78
8	18 20 27 42 60	167	46	42
9	15 30 39 62 84	230	10.4	69
10	69 109 113 118 153	562	93.6	84
11	64 90 93 109 112	468	95.6	48
12	61 78 94 109 136	478	95.6	75

$\bar{\bar{X}} = 71.6$

$\bar{R} = 59.67$

Remaining calculations done in excel sheet

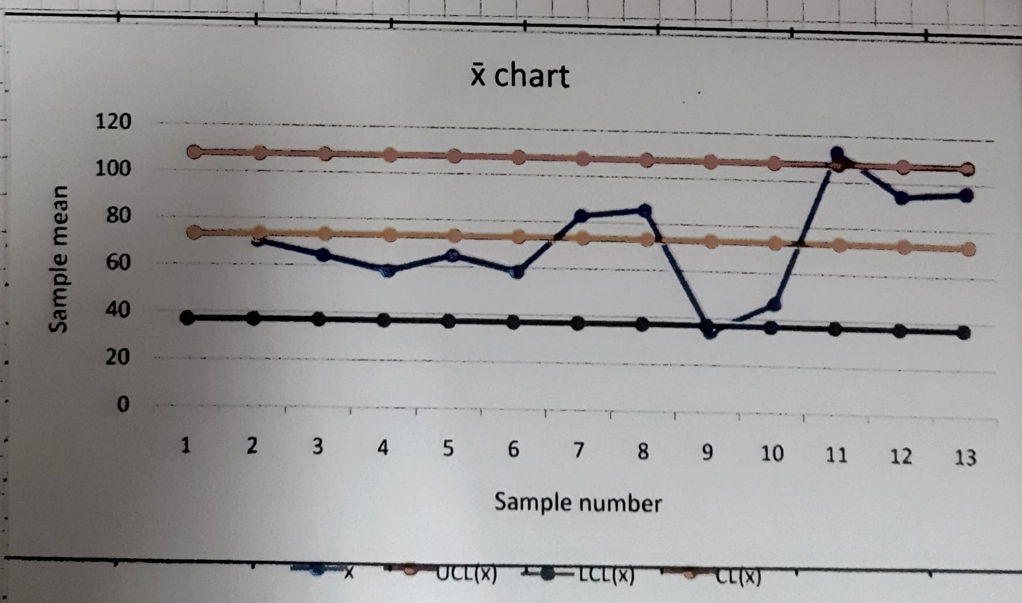
sample no	Sample observations					Total	x̄	R
1	42	65	75	78	87	347	69.4	45
2	42	45	68	72	90	317	63.4	48
3	19	24	80	81	81	285	57	62
4	36	54	69	77	84	320	64	48
5	42	51	57	59	78	287	57.4	36
6	51	74	75	78	132	410	82	81
7	60	60	72	95	138	425	85	78
8	18	20	27	42	60	167	33.4	42
9	15	30	39	62	84	230	46	69
10	69	109	113	118	153	562	112.4	84
11	64	90	93	109	112	468	93.6	48
12	61	78	94	109	136	478	95.6	75

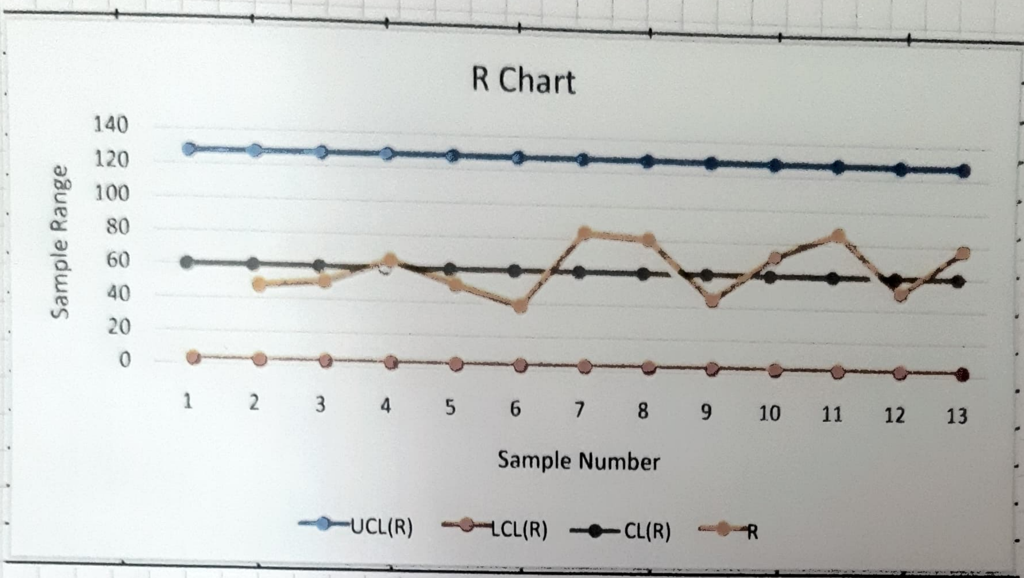
A2	0.58
D3	0
D4	2.11

Total	859.2	716
X(Dbar)	71.6	
R(bar)	59.66667	

UCL(x̄)	LCL(x̄)	CL(x̄)
106.2067	36.99333	71.6

UCL(R)	LCL(R)	CL(R)
125.8967	0	59.66667





Result

$\bar{x}$-chart - The process average is out of control since the sample mean (points) corresponding to 8th and 10th samples lie outside the control limits.

R chart - Since, all sample points (range) fall within the control limits, the process variability is in control.

Therefore the process cant said to be in statistical control since $\bar{x}$ chart shows lack of control.

Aim: To ~~control~~ find control limits for $\bar{x}$ and R chart

Problem: The following are the $\bar{x}$ and R values for 20 subgroups of 5 readings. The specification for this product characteristic are 0.4037 ± 0.0010. The value given are the last two figures of dimension reading i.e 31.6 should 0.40316.

Subgroup	$\bar{x}$	R	Subgroup	$\bar{x}$	R
1	34.0	4	11	35.8	4
2	31.8	4	12	38.4	4
3	30.6	2	13	34.0	19
4	33.0	3	14	35.0	4
5	35.0	5	15	33.8	7
6	32.3	2	16	31.6	5
7	33.6	5	17	33.0	5
8	32.0	13	18	28.2	3
9	33.8	19	19	31.8	9
10	37.8	6	20	35.6	6

i) Determine the control limits for $\bar{x}$ and R charts future use, eliminating all out of control points

ii) Will the process be able to meet the specifications.

iii) Will you recommend shifting of process centering?

Calculations

$$\bar{\bar{x}} = \frac{\Sigma \bar{x}}{20} = \frac{671}{20} = 33.6$$

$$\bar{R} = \frac{\Sigma R}{20} = \frac{124}{20} = 6.2$$

Control limits on $\bar{x}$ and R charts

$\bar{x}$ Chart

$UCL_{\bar{x}} = \bar{\bar{x}} + A_2 \bar{R} = 37.20$

$LCL_{\bar{x}} = \bar{\bar{x}} - A_2 \bar{R} = 30$

$CL_{\bar{x}} = \bar{\bar{x}} = 33.6$

R Chart

$UCL_R = D_4 \bar{R} = 13.08$

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

$CL_R = \bar{R} = 6.2$

For $\bar{x}$ chart, we observe that the sample points corresponding to 10th and 12th subgroups fall above $UCL_{\bar{x}}$ and 18th falls below $LCL_{\bar{x}}$ and hence process is out of control.

These points suggest presence of assignable causes of variation. Eliminating these points, we have

$$\bar{\bar{x}}_{Revised} = \frac{671 - (37.8 + 38.4 + 28.2)}{20-3} = \frac{566.6}{17} = 33.3$$

For R chart, the sample ranges of subgroups 9 and 13 fall above UCL_R and hence process is out of control.

Eliminating these points,

$$\bar{R}_{Revised} = \frac{124 - (19+14)}{20-2} = \frac{91}{18} = 5.06$$

i) Revised control limits for future use

$\bar{x}$ chart

$$UCL_{\bar{x}} = \bar{\bar{x}}_{Rev} + A_2 \bar{R}_{Rev} = 33.3 + (5.06)(0.58) = 36.23$$

$$LCL_{\bar{x}} = \bar{\bar{x}}_{Rev} - A_2 \bar{R}_{Rev} = 33.3 - (5.06)(0.58) = 30.37$$

R chart

$$UCL_R = D_4 \bar{R}_{Rev} = 10.67$$

$$LCL_R = D_3 \bar{R}_{Rev} = 0$$

ii) $$\hat{\sigma} = \frac{\bar{R}_{Rev}}{d_2} = \frac{5.06}{2.32} = 2.175$$

Upper natural specification limit $= \bar{\bar{x}}_{Rev} + 3\hat{\sigma} = 39.825$

Lower natural specification limit $= \bar{\bar{x}}_{Rev} - 3\hat{\sigma} = 26.775$

In terms of actual data, the natural specification will be 0.40268 and 0.40398 i.e, 0.4027 and 0.4040. Since, 0.4037 ± 0.0010. i.e, the specification limits are 0.4027 and 0.4047, it is evident that process will be able to meet specifications.

iii) Since, process is able to meet specifications, it is not advisable to shift the process provided the process remain in control at above level ($\bar{\bar{x}}_{REV}$ = 8.4033).

Result

i) $UCL_{\bar{x}} = 36.23$ $\quad$ $UCL_R = 10.67$

$LCL_{\bar{x}} = 30.37$ $\quad$ $LCL_R = 0$

ii) $\hat{\sigma} = \dfrac{\bar{R}_{REV}}{d_2} = 2.175$

- The process will meet the specifications.

iii) It is not advisable to shift the process.

Practical no - 4

Aim : To draw $\bar{x}$ and R chart

Problem : Construct a control chart for mean and range for the following data on the basis of fuses, sample of 4 being taken every hour.

Sample No	Observations	Sample No.	Observations
1	27 23 36 24	14	28 30 17 23
2	30 17 27 32	15	44 32 22 41
3	21 44 22 28	16	26 42 35 28
4	40 21 29 24	17	38 40 51 32
5	51 34 17 10	18	26 28 34 39
6	33 30 28 22	19	42 38 52 36
7	30 22 18 12	20	30 32 39 45
8	35 48 20 47	21	23 44 48 33
9	20 34 15 42	22	28 34 39 44
10	22 50 45 41	23	25 29 40 33
11	34 22 36 44	24	30 38 44 22
12	32 22 36 33	25	38 27 39 22
13	34 48 32 44		

Theory and Formula :

$$\bar{\bar{x}} = \frac{1}{k} \sum_{i=1}^{k} \bar{x}_i$$

$$\bar{R} = \frac{1}{k} \sum_{i=1}^{k} R_i$$

3σ control limits for $\bar{x}$ and R chart are given by

$\bar{x}$ chart

$UCL_{\bar{x}} = \bar{\bar{x}} + A_2 \bar{R}$

$LCL_{\bar{x}} = \bar{\bar{x}} - A_2 \bar{R}$

$CL_{\bar{x}} = \bar{\bar{x}}$

R chart

$UCL_R = D_4 \bar{R}$

$LCL_R = D_3 \bar{R}$

$CL_R = \bar{R}$

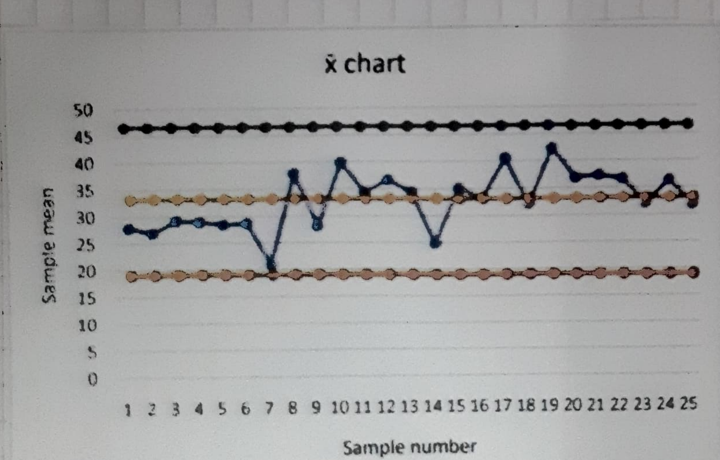
Since A_2, D_3, D_4 are constants and these values can be taken from the table on basis of sample size.

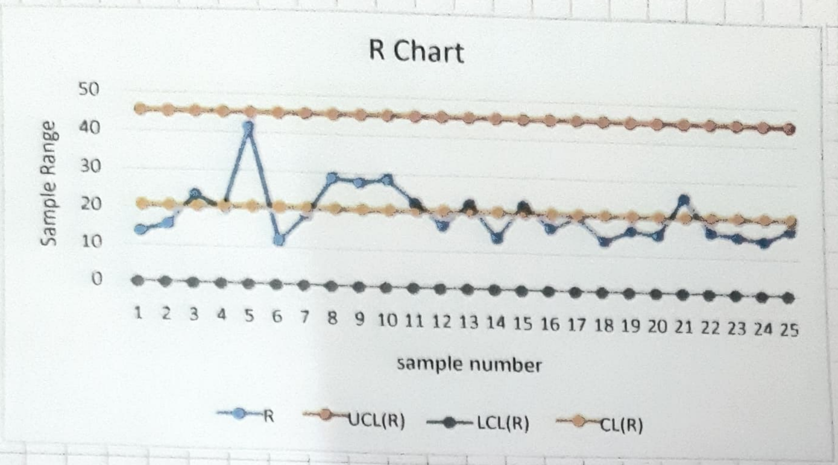
calculations :

sample no					Total	x̄	R
1	27	23	36	24	110	27.5	13
2	30	17	27	32	106	26.5	15
3	21	44	22	28	115	28.75	23
4	40	21	29	24	114	28.5	19
5	51	34	17	10	112	28	41
6	33	30	28	22	113	28.25	11
7	30	22	18	12	82	20.5	18
8	35	48	20	47	150	37.5	28
9	20	34	15	42	111	27.75	27
10	22	50	45	41	158	39.5	28
11	34	22	36	44	136	34	22
12	32	48	32	33	145	36.25	16
13	34	22	36	44	136	34	22
14	28	30	17	23	98	24.5	13
15	44	32	22	41	139	34.75	22
16	26	42	35	28	131	32.75	16
17	38	40	51	32	161	40.25	19
18	26	28	34	39	127	31.75	13
19	42	38	52	36	168	42	16
20	30	32	39	45	146	36.5	15
21	23	44	48	33	148	37	25
22	28	34	39	44	145	36.25	16
23	25	29	40	33	127	31.75	15
24	30	38	44	32	144	36	14
25	38	27	39	22	126	31.5	17
	A2	0.729			Total	812	484
	D3	0			X(Dbar)	32.48	
	D4	2.282			R(bar)	19.36	

LCL(x̄)	UCL(x̄)	CL(x̄)
18.36656	46.59344	32.48

UCL(R)	LCL(R)	CL(R)
44.17952	0	19.36





Result

We observe from $\bar{x}$ and R charts that both the ~~[illegible] mean~~ process average and process variability are in control hence we can say that the process is in control.

Practical - 5

AIM : To find control limits for $\bar{x}$ and R chart.

Problem : The following data shows the value of sample mean $\bar{x}$ and R for ten samples of size 5 each. Calculate the values for central line and control limits for mean chart and range chart and determine whether the process is in control.

Sample No. -	1	2	3	4	5	6	7	8	9	10
Mean ($\bar{x}$) -	11.2	11.8	10.8	11.6	11.0	9.6	10.4	9.6	10.6	10.0
Range (R) -	7	4	8	5	7	4	8	4	7	9

Given, for $n=5$

$A_2 = 0.577$

$D_3 = 0$

$D_4 = 2.115$

Theory and Formula

$$\bar{\bar{x}} = \frac{1}{k}\sum_{i=1}^{k}\bar{x}_i$$

$$\bar{R} = \frac{1}{k}\sum_{i=1}^{k}R_i$$

3σ control limits for $\bar{x}$ and R charts are

$UCL(\bar{x}) = \bar{\bar{x}} + A_2\bar{R}$ $\quad$ $UCL(R) = D_4\bar{R}$

$LCL(\bar{x}) = \bar{\bar{x}} - A_2\bar{R}$ $\quad$ $LCL(R) = D_3\bar{R}$

$CL(\bar{x}) = \bar{\bar{x}}$ $\quad$ $CL(R) = \bar{R}$

where D_4, D_3 and A_2 are constants depending on sample size

Calculation

$$\bar{\bar{x}} = \frac{1}{10}\sum_{i=1}^{10}\bar{x}_i = 10.66$$

$$\bar{R} = \frac{1}{10}\sum_{i=1}^{10}R_i = \frac{63}{10} = 6.3$$

Therefore 3σ control limits for $\bar{X}$ and R charts are -

$\bar{X}$ Chart

$UCL(\bar{X}) = \bar{\bar{X}} + A_2\bar{R} = 14.2951$

$LCL(\bar{X}) = \bar{\bar{X}} - A_2\bar{R} = 7.0249$

$CL(\bar{X}) = \bar{\bar{X}} = 10.56$

R Chart

$UCL(R) = D_4\bar{R} = 13.3245$

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

$CL(R) = 6.3$

<u>Result</u>

<u>$\bar{X}$ Chart</u> - All the sample mean lie between $UCL(\bar{X})$ and $LCL(\bar{X})$, therefore process average is in control.

<u>R chart</u> - All the sample ranges lie between $UCL(R)$ and $LCL(R)$, thus the process variability is in control.

Practical No - 6

Aim - To determine control limits for $\bar{X}$ and R chart

Problem - The following data gives the value of mean and range of five observations.

Sample No	Mean	Range	Sample No	Mean	Range
1	4.17	0.14	11	4.35	[illegible]
2	4.15	0.30	12	4.44	[illegible]
3	4.08	0.20	13	4.21	0.23
4	4.26	0.26	14	[illegible]	[illegible]
5	4.13	0.10	15	4.5	[illegible]
6	4.22	0.24	16	[illegible]	[illegible]
7	4.33	0.65	17	4.33	[illegible]
8	4.25	0.11	18	4.6	[illegible]
9	4.54	0.53	19	[illegible]	0.25
10	4.54	0.22	20	[illegible]	[illegible]

i) Find an estimate of σ from above data

ii) What are control limits for $\bar{X}$ and R chart ? What do you conclude about the process.

Theory and Formula

$$\bar{\bar{X}} = \frac{1}{k}\sum_{i=1}^{k} \bar{X}_i$$

$$\bar{R} = \frac{1}{k}\sum_{i=1}^{k} R_i$$

3σ control limits for $\bar{X}$ and R chart are

$UCL(\bar{X}) = \bar{\bar{X}} + A_2\bar{R}$ $UCL(R) = D_4\bar{R}$

$LCL(\bar{X}) = \bar{\bar{X}} - A_2\bar{R}$ $LCL(R) = D_3\bar{R}$

$CL(\bar{X}) = \bar{\bar{X}}$ $CL(R) = \bar{R}$

where A_2, D_3 and D_4 are constants depending on sample size.

Calculations

$$\bar{\bar{X}} = \frac{1}{20}\sum_{i=1}^{20} \bar{X}_i = \frac{1}{20}(96.55) = 4.3275$$

$$\bar{R} = \frac{1}{20}\sum_{i=1}^{20} R_i = \frac{1}{20}(5.59) = 0.2795$$

i) $E(R) = \sigma d_2$

$$\hat{\sigma} = \frac{E(R)}{d_2} = \frac{\bar{R}}{d_2} = 0.1202$$

ii) $\bar{X}$ Chart

$UCL(\bar{x}) = \bar{\bar{x}} + A_2\bar{R} = 5.184$

$LCL(\bar{x}) = \bar{\bar{x}} - A_2\bar{R} = 3.471$

$CL(\bar{x}) = \bar{\bar{x}} = 4.3275$

R Chart

$UCL(R) = D_4\bar{R} = 0.5911$

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

$CL(R) = \bar{R} = 0.2795$

<u>Result</u>

$\bar{x}$ chart - All the sample mean lies between $UCL(\bar{x})$ and $LCL(\bar{x})$ so the process average is in control.

R Chart - Sample range corresponding to 11th sample is above $UCL(R)$ so the process variability is not in control.

$\hat{\sigma} = 0.1202$

Practical No - 7

Aim: To construct p chart and find its control limits

Problem: The following are the figures of defectives in 22 lots each containing 2000 rubber belts:

425, 430, 216, 341, 225, 322, 280, 306, 337, 305, 356, 402, 216, 264, 126, 409, 193, 326, 280, 389, 451, 430.

Draw control chart for fraction defective and comment on the state of control of process.

Theory and Formula

For the given data, we have to ~~contr~~ calculate 3σ control limits for p chart.

$$\bar{p} = \frac{\sum p_i}{k}, \quad \bar{q} = 1-\bar{p}, \quad n = \text{sample size}$$

$$UCL(p) = \bar{p} + 3\sqrt{\frac{\bar{p}\bar{q}}{n}} \quad \text{(Upper control limit)}$$

$$LCL(p) = \bar{p} - 3\sqrt{\frac{\bar{p}\bar{q}}{n}} \quad \text{(Lower control limit)}$$

$$CL(p) = \bar{p} \quad \text{(Central line)}$$

$\left.\right\}$ 3σ control limits for p chart

Calculations

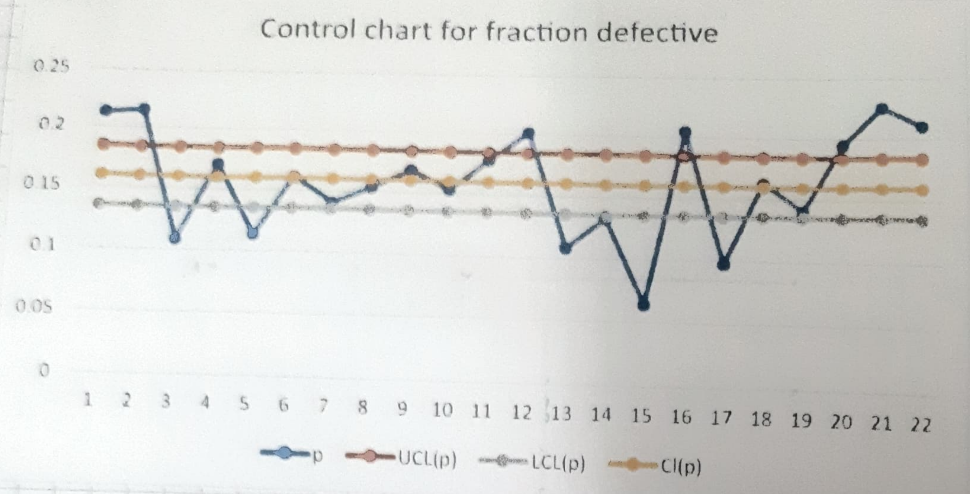
Here we have a fixed sample size n = 2000 for each lot. If p_i and d_i are respectively the number of defectives and the sample fraction defective for i^{th} lot, then

$$p_i = \frac{d_i}{2000}, \quad (i = 1, 2, \ldots, 22)$$

$\bar{p}$	0.159523
$\bar{q}$	0.840477

UCL(p)	LCL(p)	Cl(p)
0.184086	0.134959777	0.159523

S No	d	p
1	425	0.2125
2	430	0.215
3	216	0.108
4	341	0.1705
5	225	0.1125
6	322	0.161
7	280	0.14
8	306	0.153
9	337	0.1685
10	305	0.1525
11	356	0.178
12	402	0.201
13	216	0.108
14	264	0.132
15	126	0.063
16	409	0.2045
17	193	0.0965
18	326	0.163
19	280	0.14
20	389	0.1945
21	451	0.2255
22	420	0.21



Result

From the p chart, we find that the sample points (fraction defectives) corresponding to sample numbers 1, 2, 3, 5, 12, 13, 14, 15, 16, 17, 20, 21 and 22 fall outside the control limits.

Hence, the process cannot be regarded in statistical control.

Practical No-8

Aim : To find control limits for p chart

Problem : From the following inspection results, construct 3-σ control limits for p chart.

Date Sept	No. of Defectives	Date Sept.	No. of Defectives	Date Sept.	No. of Defectives
1	22	11	70	21	66
2	40	12	80	22	50
3	36	13	44	23	46
4	32	14	22	24	32
5	42	15	32	25	42
6	40	16	42	26	46
7	30	17	20	27	30
8	44	18	46	28	32
9	42	19	28	29	40
10	38	20	36	30	24

The subgroups from which the defectives were taken out, were of the same size, i.e, 1000 items each.

Without constructing the control charts, comment on the state of control of the process, if the process is out of control, then suggest revised control limits for future use.

Theory and Formula

3σ control limits for p chart are given by

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

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

$$CL(p) = \bar{p}$$

$$\left\{ \begin{array}{l} \bar{p} = \frac{\sum p_i}{k} \\ \bar{q} = 1-\bar{p} \\ n = \text{sample size} \end{array} \right\}$$

Calculations

Here, we have a fixed sample size for each lot. If d_i and p_i are respectively the number of defectives and the sample fraction defective for the ith lot then

$$p_i = \frac{d_i}{1000}, \quad (i = 1, 2, \ldots, 30)$$

Date sept.	No. of defectives (d_i)	Fraction defectives ($p_i = \frac{d_i}{1000}$)
1	22	0.022
2	40	0.040
3	36	0.036
4	32	0.032
5	42	0.042
6	40	0.040
7	30	0.030
8	44	0.044
9	42	0.042
10	38	0.038
11	70	0.070
12	80	0.080
13	44	0.044
14	22	0.022
15	32	0.032
16	42	0.042
17	20	0.020
18	46	0.046
19	28	0.028
20	36	0.036
21	66	0.066
22	50	0.05
23	46	0.46
24	32	0.32
25	42	0.42
26	46	0.46
27	30	0.3
28	38	0.38
29	40	0.4
30	24	0.24

$\Sigma p_i = 1.2$, $n = 1000$

$\bar{p} = \frac{\Sigma p_i}{k} = \frac{1.2}{30} = 0.04$ $(k=30)$

$\bar{q} = \cancel{0.04}\ 0.96$

$UCL(p) = \bar{p} + 3\sqrt{\frac{\bar{p}\bar{q}}{n}} = 0.04 + 3(0.0062) = 0.0586$

$LCL(p) = \bar{p} - 3\sqrt{\frac{\bar{p}\bar{q}}{n}} = 0.04 - 3(0.0062) = 0.0214$

$CL(p) = \bar{p} = 0.04$

We observe that the sample points (fraction defectives) on 11th, 12th, 17th and 21st September were 0.07, 0.08, 0.02 and 0.066 respectively and these fall outside the control limits.

Hence, the process is not in a state of statistical control.

Revised Control Limits

The revised control limits are obtained on the eliminating these four samples and considering the remaining (30-4) = 26 samples.

Based on the remaining 26 samples, we get

$$CL(p) = \bar{p}' = \frac{\Sigma p - 0.07 - 0.08 - 0.02 - 0.066}{26} = \frac{1.2 - 0.236}{26} = \frac{0.964}{26} = 0.0371$$

$$UCL(p) = \bar{p}' + 3\sqrt{\frac{\bar{p}'\bar{q}'}{n}} = 0.0371 + 3(0.06) = 0.0551$$

$$LCL(p) = \bar{p} - 3\sqrt{\frac{\bar{p}'\bar{q}'}{n}} = 0.0371 - 0.018 = 0.0191$$

Since, none of the remaining 26 sample points lie outside the revised control limits, these maybe regarded as the control limits for p chart for future production from this process.

Results

- The process is not in state of control
- Revised Control Limits are $UCL(p) = 0.0551$
  $LCL(p) = 0.0191$
  $CL(p) = 0.0371$