TOD - assignment - 4

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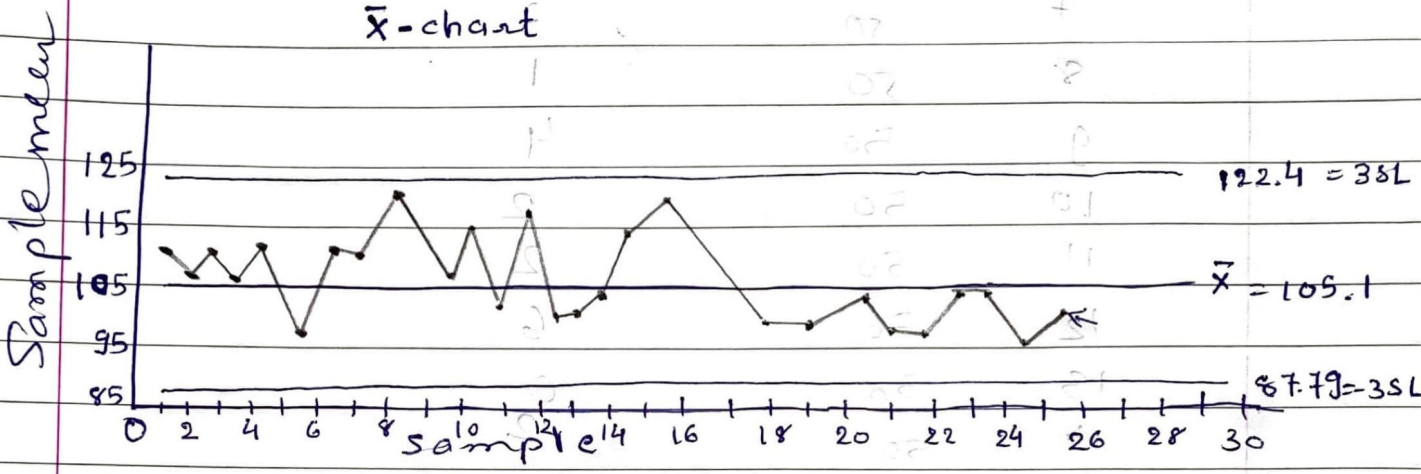
Question-1

Study the following chart and determine whether it indicates problem in processes



Answer 1

Any unusal or apparent pattern of points is a signed for speeial cause.

1. Nine consecutive points in row below the central line

So the process is out-of-control.

Question-2

A company produces board paper and at regular samples of 50 sheets of paper are inspected. Suppose 20 random samples of 50 sheets of paper each are taken during a certain period of time, with the following numbers of sheets in noncompliane per sample. Construct an app. control chart from these data

samplesize (n) = 50
subgroupsize (k) = 20
Characteristic : noncompliance [no. of defectives]

Type : attribute
chart → np-chart

Samples	n	Out of compliance (np)
1	50	4
2	50	3
3	50	1
4	50	0
5	50	5
6	50	2
7	50	3
8	50	1
9	50	4
10	50	2
11	50	2
12	50	6
13	50	0
14	50	2
15	50	1
16	50	6
17	50	2
18	50	3
19	50	1
20	50	5

$\Sigma np = 53$

$$\overline{np} = \frac{\Sigma np}{k} = \frac{53}{20} = 2.65$$

$CL = 2.65$

$$UCL = \overline{np} + 3\sqrt{\overline{np} \times \left(1 - \frac{\overline{np}}{n}\right)}$$

$$= 2.65 + 3\sqrt{2.65 \times (1 - 2.65/50)}$$

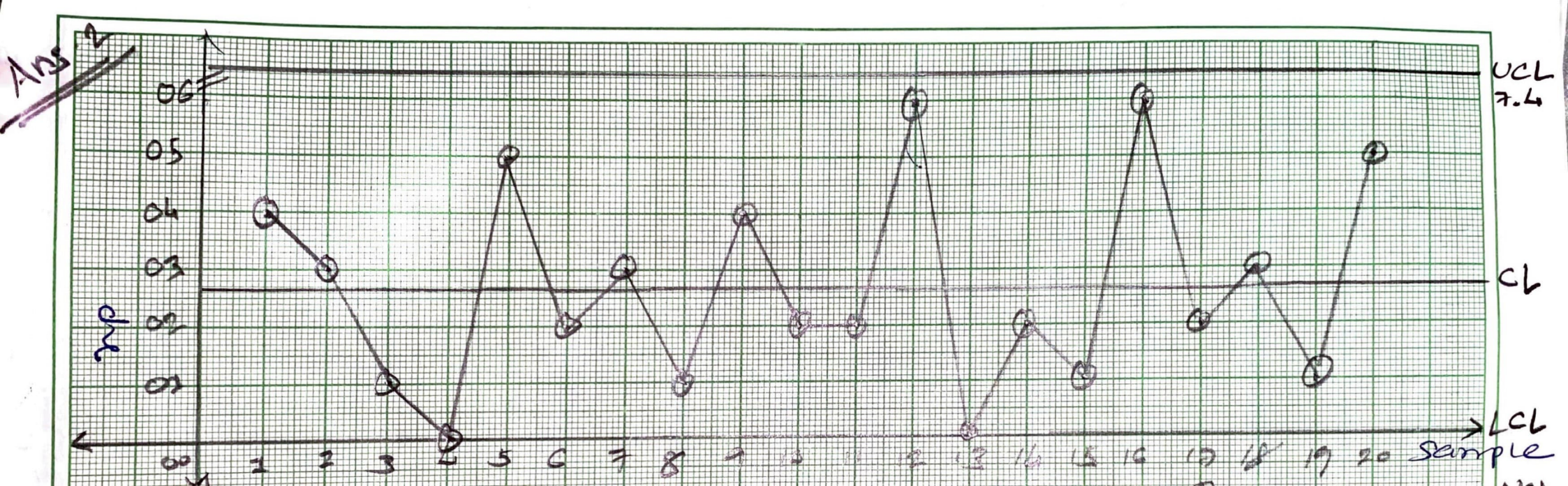
$$= 2.65 + 4.7524$$

$UCL = 7.4024$

$$LCL = \overline{np} - 3\sqrt{\overline{np} \times (1 - \overline{np}/n)}$$

$$= 2.65 - 4.7524$$

$= -2.1024 \longrightarrow 0$


Ans 2
UCL
7.4
CL
LCL
Sample
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20

This chart is showing the process is in statistical control. There are two things on chart which indicate stability

i) All the sample points are within control limits

ii) All sample points appear randomly distributed. There is no unusual or apparent pattern of points

→ process is statistically in control.

Question-3

fifteen successive heats of a steel alloy are tested for hardness. The results are shown in defa Table

→ Answer

Sample size(n) = 1

data size (k) = 15

Type: Variable

characteristic: successive heats of steel alloy

chart → Individual & Moving Ranged chart

Sample		MR
1	52	—
2	51	1
3	54	3
4	55	1

Question 8

Sample No.	X	MR
5	50	5
6	52	2
7	50	2
8	51	1
9	58	7
10	51	7
11	54	3
12	59	5
13	53	6
14	54	1
15	55	1
	$\Sigma x = 799$	$\Sigma MR = 45$

$$\bar{x} = \frac{\Sigma x}{k} = \frac{799}{15} = 53.2667$$

$$\overline{MR} = \frac{\Sigma MR}{k-1} = \frac{45}{14} = 3.2143$$

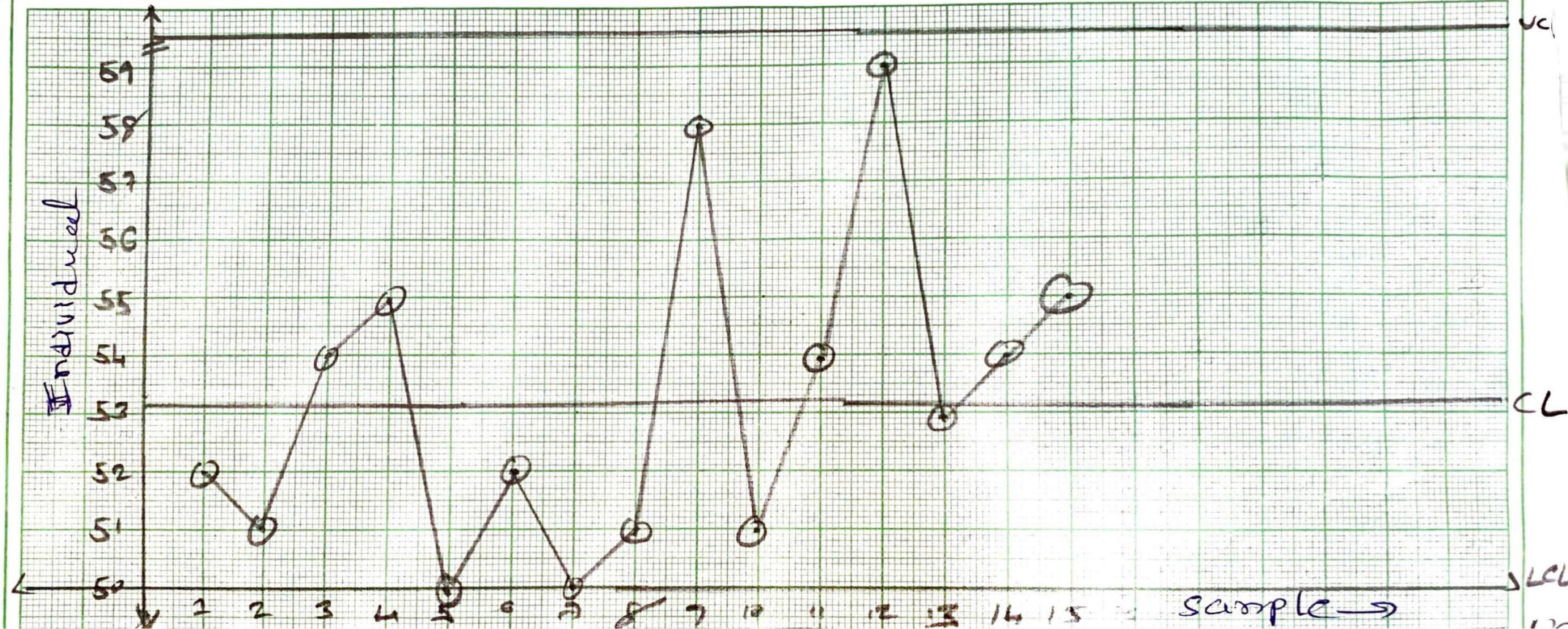
I-chart:

$$CL = \bar{x} = 53.2667$$

$$UCL = \bar{x} + (2.66 \times \overline{MR})$$
$$= 53.2667 + (2.66 \times 3.2143)$$
$$= 61.8167$$

$$LCL = \bar{x} - (2.66 \times \overline{MR})$$
$$= 53.2667 - 8.55$$
$$= 44.7167$$

Ans:-3


Individual
59
58
57
56
55
54
53
52
51
50
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
sample →
UCL
CL
LCL

this chart is showing the process is in statical control. There are two things on chart which indicate stability

i) All the sample points are within control limits.

ii) All sample points appear randomly distributed. there is no unusual or apparent pattern of points.

→ process is statically in control

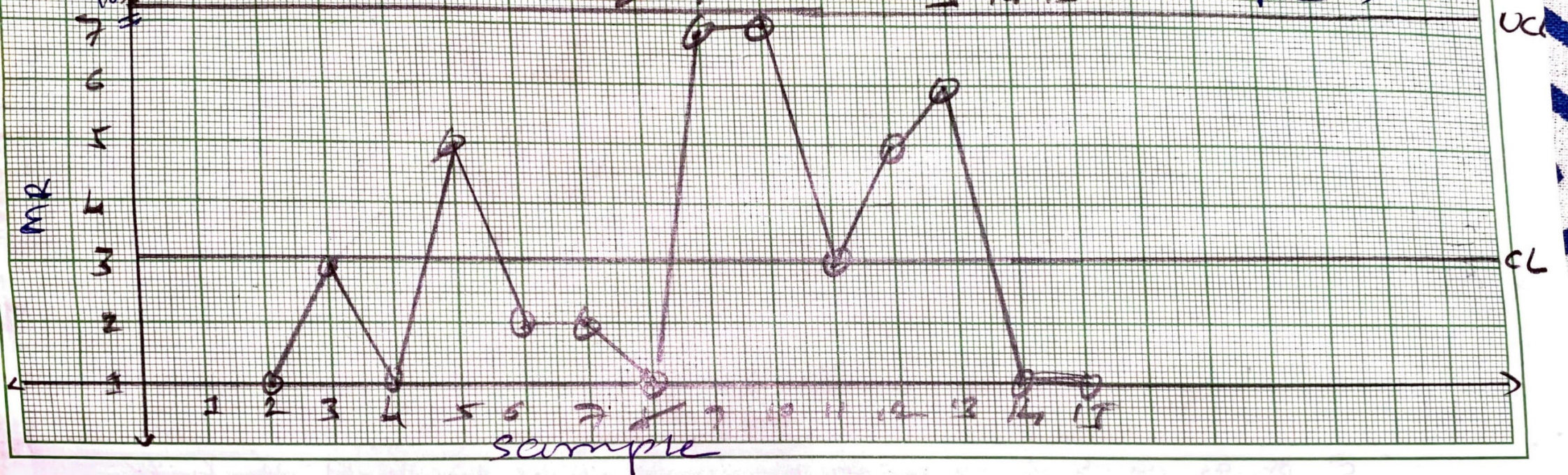
Moving Range chart.

$CL = \overline{MR} = 3.243$

$UCL = 3.27 \times \overline{MR}$

$= 10.5708$

LCL → None


UCL
CL
ΣR
7
6
5
4
3
2
1
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
sample

This chart is showing the process is in stastical control. there are two things on chart which indicate stability.

i) All sample points appear randomley distributed. There is no unsul on cepperent pattern

ii) All sample points are within control limits

→ process is in stastical control

Question-4

A process that produces titanium forgings for automobile turbocharger wheels is to be controlled through use of rejects one sample of size 150 is taken each day for 20 days. and results shown in Table, Establish control charts

Answer

sample size(n) = 150, data size(k) = 20
Type: attribute (no. of defectives)
Chart → NP-chart
chart: defetive wheels

Sample no.	defetive units (NP)
1	5
2	3
3	2
4	4
5	6
6	1

7	4
8	1
9	5
10	0
11	3
12	6
13	4
14	5
15	7
16	0
17	10
18	8
19	4
20	3

$$\Sigma np = 81$$

$$\overline{np} = \frac{\Sigma np}{K}$$

$$= \frac{81}{20} = 4.05$$

$$CL = 4.05$$

$$UCL = \overline{np} + 3\sqrt{\overline{np} \times \left(1 - \frac{\overline{np}}{n}\right)}$$

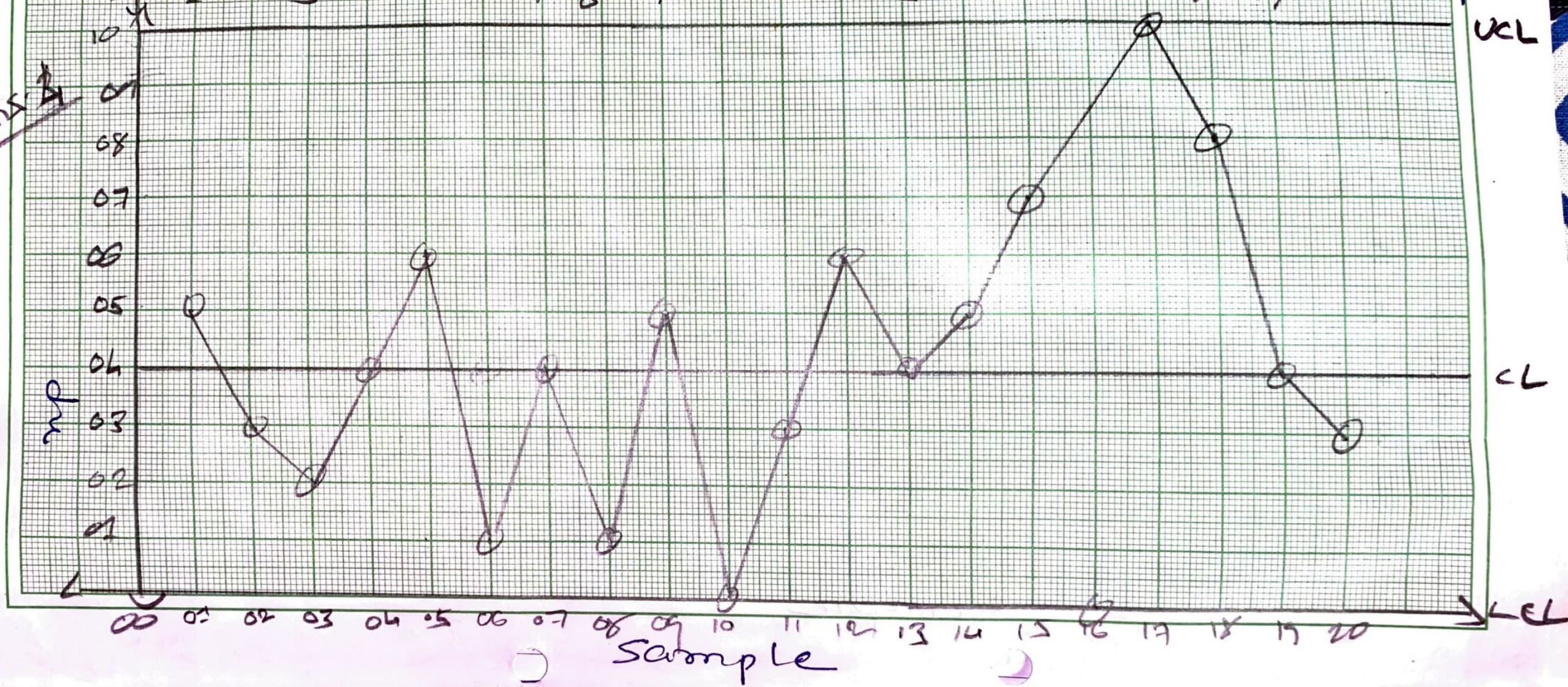
$$= 4.05 + 3\sqrt{4.05 \times \left(1 - \frac{4.05}{150}\right)}$$

$$= 10.00$$

$$LCL = \overline{np} - 3\sqrt{\overline{np} \times \left(1 - \frac{\overline{np}}{n}\right)}$$

$$= -0.68 \longrightarrow 0$$

Ans 3.


UCL
CL
LCL
$\bar{x}$
10
09
08
07
06
05
04
03
02
01
00
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20
Sample

- This chart is showing the process is in Statistical control. There are two things on chart which indicate stability.

i) All sample points are within control limits.

ii) All sample points appear randomly distributed. There is no unusal or apperet pattern of points

→ process is statistically in control

Question-5

→ Altoona Tire company sells its ATC-50 tires with 50,000 -mile tread-life warranty Lorie Ueberman, a quality control engineer with the company, runs simulated road tests to monitor the life of output from ATC-50 production process. From each of last 12 batches of 1000 tires. She has tested 5 tires and recorded following results. R & $\bar{x}$

Answer → sample size (n) = 5
date size (K) = 12
Type: variable
characteristic: tires
Chart → mean and Range chart

Batch	mean	Ranges
1	50.4	1.3
2	49.6	1.5

	$\bar{X}$	R
3	50.3	1.7
4	50.4	0.5
5	50.9	0.9
6	50.1	2.5
7	49.8	0.5
8	51.3	0.8
9	50.7	2.5
10	50.5	1.5
11	50.9	2.2
12	50.5	2.5
	$\Sigma\bar{X} = 605.4$	$\Sigma R = 18.4$

for $n = 5$, $A_2 = 0.577$, $D_3 = 0$, $D_4 = 2.114$

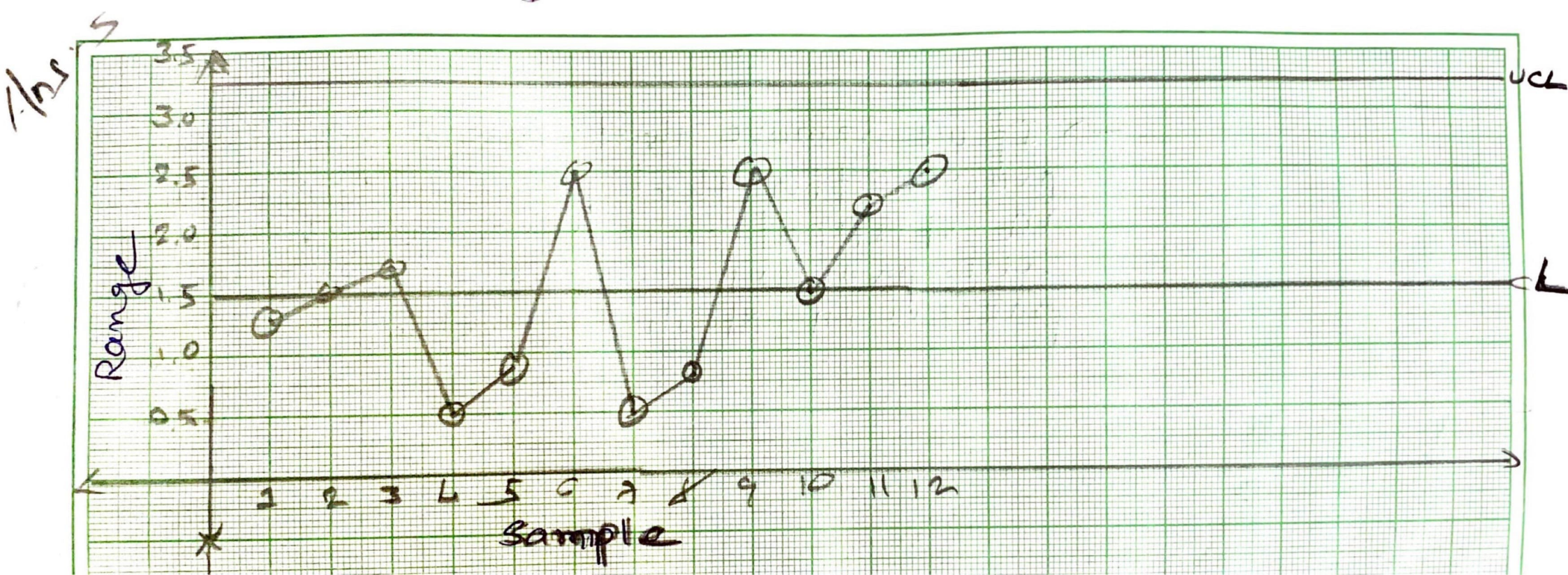
Range chart

$$\bar{R} = \frac{\Sigma R}{K} = \frac{18.4}{12} = 1.533$$

$$CL = \bar{R} = 1.5333$$

$$UCL = D_4 \times \bar{R}$$
$$= 2.114 \times 1.533$$
$$= 3.2414$$

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


Ans. 5
3.5
3.0
2.5
2.0
1.5
1.0
0.5
Range
UCL
L
1 2 3 4 5 6 7 8 9 10 11 12
Sample

This chart is showing the process is in stastical control. There are two things on chart which indicate stability.

i) All sample points are within control limits

ii) All sample points appear randomly distributed. There is no unusual or apparent pattern of points.

→ process is stastically control

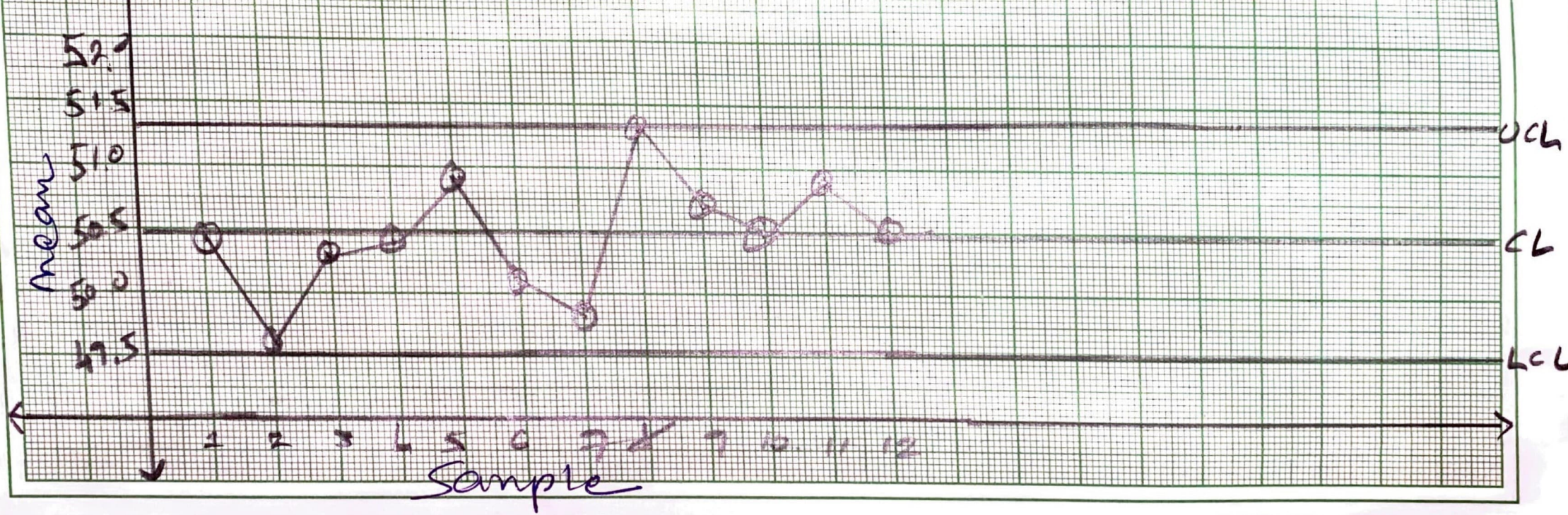
Mean-chart

$$\bar{\bar{x}} = \frac{\Sigma \bar{x}}{k} = \frac{605.4}{12} = 50.45$$

$$CL = 50.45$$

$$LCL = \bar{\bar{x}} - (A_2 \times \bar{R})$$
$$= 50.45 - (0.577 \times 1.533)$$
$$= 50.45 - 0.88454$$
$$= 49.5655$$

$$UCL = \bar{\bar{x}} + (A_2 \times \bar{R})$$
$$= 50.45 + (0.577 \times 1.533)$$
$$= 50.45 + 0.88454$$
$$= 51.3345$$


52.5
51.5
51.0
50.5
50.0
49.5
Mean
UCL
CL
LCL
1
2
3
4
5
6
7
8
9
10
11
12
Sample

this chart is showing the process is in stastical control. There are two things on chart which indicate stability

i) All sample points are within control limits.

ii) All sample points appear randomly distributed There is no unusual or apperent pattern of points

→ process is stastically in control.

Question-6

→ In large-scale factory, produced units are inspected for occurance of defects. The data on fifteen runs are shown in table

Answer

→ sample size (n) = 40
data size (k) = 15
type : attribute (no. of defects)
chart → c-chart

Run (sample)	Unit size (n)	Defects (c)
1	40	16
2	40	32
3	40	10
4	40	14
5	40	37
6	40	29
7	40	11
8	40	38

Sample No.	n	c
9	40	83
10	40	12
11	40	46
12	40	54
13	40	21
14	40	15
15	40	45
~~16~~	~~40~~	$\Sigma c = 457$
~~17~~	~~40~~	
~~18~~	~~40~~	
~~19~~	~~40~~	

$$\bar{c} = \frac{\Sigma c}{k} = \frac{457}{15} = 30.4667$$

$CL = 30.4667$

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

$= 30.4667 + 16.559$

$= 47.0257$

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

$= 30.4667 - 16.559$

$= 13.9077$

decision :

six samples [1st, 3rd, 7th, 10th, 9th, 2nd] are not within control limits

1st, 3rd, 7th, 10th are below Lower CL and 9th, 2nd are above Upper CL.

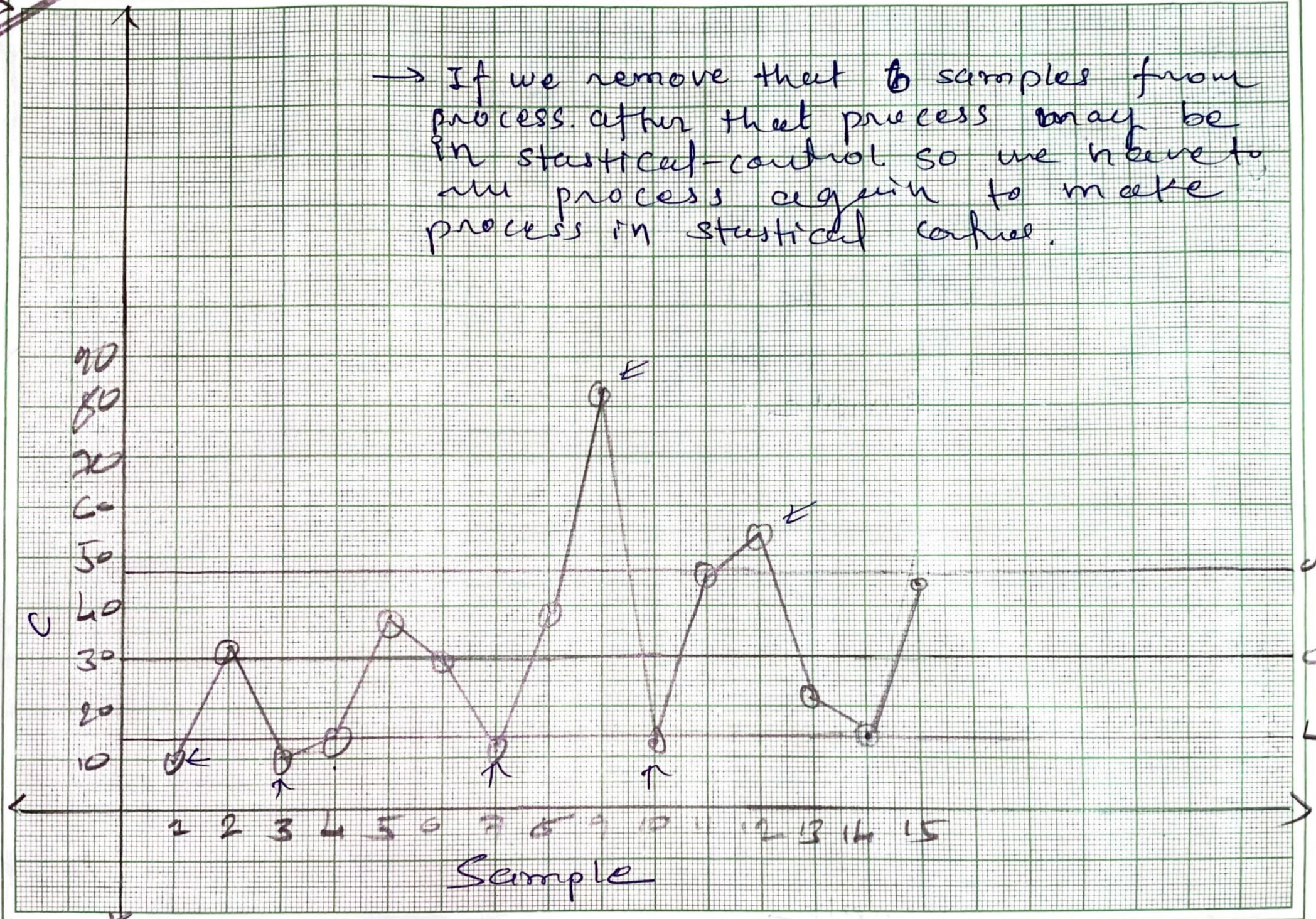
→ there is presence of assignable variation

→ process not in control.

process is out-of-control.

Ans-6

→ If we remove that 6 samples from process. after that process may be in stastical-control so we have to run process again to make process in stastical control.



Answer-7

Brief description on importance of stastical process control in real life

→ Stastical process control (SPC) has been around for a long time. While everyone's heard about it, not many people are doing much with it. The short definition of SPC is that it's the application of stastical methods to control manufacturing processes

→ Real-time SPC, can help you avoid failures. By using SPC you can tell when a process is about to go out of control. And, if you know it's about to go out of control, you can do something about it before it goes out of control. That helps you significantly reduce quality issues and helps you reduce downgrades and rework. It helps you identify problems, before they are problems and then eliminate or at least minimize the failures

→ SPC helps you improve product consistency. With this you can look at the process a lot more closely so you can start ferreting out the causes of product variability. You'll find processes that you thought were very stable are not feet as stable as you thought. SPC lets you identify those processes, determine the degree that they're stable or unstable, and then take the actions to improve the process. SPC gives you the information to figure out if steps you're taking to improve the process actually work. Helps you identify

problems, particularly SPC helps you analyze where you need improvements and helps you pinpoint specifically what types of improvement in process need to make. As you make those improvements. SPC helps you verify that improvements are actually working and things are actually getting better just as you hope.

→ In 21st century, more data are collected about our daily life than ever before. As computers become more powerful, we can easily analyze and interpret ever larger datasets. Statistical analysis is becoming increasingly important in many research fields, allowing us to fully understand & disseminate ideas not just to our peers, but to wider population.

→ The most basic component of SPC is the data. You have to have data and you have to get it from somewhere. It can exist almost any-where but most commonly it resides in a database, a historian or both. How it got there isn't really important but data is truthworthy. You can get in there automatically or manually but you just have to get the data and get it in historian or database so you can do something with SPC. The most fundamental aspect of SPC is real-time data visiblity. All data in real-time as it's being collected. So even before you start to apply all SPC rules, with real-time data visiblity you can see the data, just seeing data gives you and operators a lot of important information.

Set up specification limits and set up alarms and notifications based on specific limits.