QUESTIONS

1. The following data relate to the life(in hours) of 15 samples of 6 electric bulbs each, drawn at intervals of one hour from a production process. Draw the $\overline{x}$ and R charts and comment.

Sample No.	Life-time (in hours)					
1	620	687	666	769	839	686
2	501	585	524	585	655	668
3	673	701	636	567	622	660
4	646	626	572	628	632	743
5	494	984	659	643	660	640
6	634	755	625	582	685	555
7	619	710	664	693	773	534
8	631	723	614	535	551	570
9	482	791	533	612	497	499
10	706	524	626	503	662	754
11	530	432	379	690	724	536
12	485	497	608	393	648	729
13	585	535	762	588	625	737
14	462	490	635	587	554	673
15	722	608	665	587	531	705

2. A machine is set to deliver the packets of a given weight. Ten samples of size five each 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.

3. Construct a control chart for mean and the 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 contorl, 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

4. The fill volume of soft-drink beverage bottles is an important quality characteristic. The volume is measured (approximately) by placing a gauge over the crown and comparing the height of the liquid in the neck of the bottle against a coded scale. On this scale, a reading of zero corresponds to the correct fill height. Fifteen samples of size n = 10 have been analyzed, and the fill heights are shown in following table :

Sample Number	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}
1	2.5	0.5	2.0	-1.0	1.0	-1.0	0.5	1.5	0.5	-1.5
2	0.0	0.0	0.5	1.0	1.5	1.0	-1.0	1.0	1.5	-1.0
3	1.5	1.0	1.0	-1.0	0.0	-1.5	-1.0	-1.0	1.0	-1.0
4	0.0	0.5	-2.0	0.0	-1.0	1.5	-1.5	0.0	-2.0	-1.5
5	0.0	0.0	0.0	-0.5	0.5	1.0	-0.5	-0.5	0.0	0.0
6	1.0	-0.5	0.0	0.0	0.0	0.5	-1.0	1.0	-2.0	1.0
7	1.0	-1.0	-1.0	-1.0	0.0	1.5	0.0	1.0	0.0	0.0
8	0.0	-1.5	-0.5	1.5	0.0	0.0	0.0	-1.0	0.5	-0.5
9	-2.0	-1.5	1.5	1.5	0.0	0.0	0.5	1.0	0.0	1.0
10	-0.5	3.5	0.0	-1.0	-1.5	-1.5	-1.0	-1.0	1.0	0.5
11	0.0	1.5	0.0	0.0	2.0	-1.5	0.5	-0.5	2.0	-1.0
12	0.0	-2.0	-0.5	0.0	-0.5	2.0	1.5	0.0	0.5	-1.0
13	-1.0	-0.5	-0.5	-1.0	0.0	0.5	0.5	-1.5	-1.0	-1.0
14	0.5	1.0	-1.0	-0.5	-2.0	-1.0	-1.5	0.0	1.5	1.5
15	1.0	0.0	1.5	1.5	1.0	-1.0	0.0	1.0	-2.0	-1.5

Set up $\overline{x}$-chart and s-chart on this process and comment on the state of control.

5. A high-voltage power supply should have a nominal output voltage of 350 V. A sample of four units is selected each day and tested for process-control purposes. The data shown the following table give the difference between the observed reading on each unit and the nominal voltage times ten; that is $x_i = (\text{observed voltage on unit } i - 350)10$.

Sample Number	x_1	x_2	x_3	x_4
1	6	9	10	15
2	10	4	6	11
3	7	8	10	5
4	8	9	6	13
5	9	10	7	13
6	12	11	10	10
7	16	10	8	9
8	7	5	10	4
9	9	7	8	12
10	15	16	10	13
11	8	12	14	16
12	6	13	9	11
13	16	9	13	15
14	7	13	10	12
15	11	7	10	16
16	15	10	11	14
17	9	8	12	10
18	15	7	10	11
19	8	6	9	12
20	13	14	11	15

Set up $\overline{x}$-chart and R-chart on this process. Is the process in statistical control ?

6. Following are the figures for the number 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, 420.

Drawing the control chart for fraction defective, plot the points on it. Comment on the state of control of the process.

Also calculate the control limits of the control chart for percent defective.

7. The data in the following table give the number of nonconforming bearing and seal assemblies in samples of size 100. Construct a fraction nonconforming control chart for these data. If any points plot out of control, assume that assignable causes can be found and determine the revised control limits.

Sample Number	Number of Nonconforming Assemblies	Sample Number	Number of Nonconforming Assemblies
1	7	11	6
2	4	12	15
3	1	13	0
4	3	14	9
5	6	15	5
6	8	16	1
7	10	17	4
8	5	18	5
9	2	19	7
10	7	20	12

8. The following data give the number of defectives in 10 independent samples of varying sizes from a production process :

Sample Number	1	2	3	4	5	6	7	8	9	10
Sample size	2000	1500	1400	1350	1250	1760	1875	1955	3125	1575
No. of defectives	425	430	216	341	225	322	280	306	337	305

Construct the control chart for fraction defective with varying control limits and comment on it.

9. 20 samples each of size 10 were inspected. The number of defectives detected in each of them is given below :

Sample Number	1	2	3	4	5	6	7	8	9	10
No. of defectives	0	1	0	3	9	2	0	7	0	1
Sample Number	11	12	13	14	15	16	17	18	19	20
No. of defectives	1	0	0	3	1	0	0	2	1	0

Construct the *number of defectives* chart and establish quality standard for the future.

10. In welding of seams, there are defects included pinholes, cracks, cold taps, etc. A record was made of the number of defects found in one seam each hour and is given below.

1.12.2005	8 A.M.	2
	9 A.M.	4
	10 A.M.	7
	11 A.M.	3
	12 P.M.	1
	1 P.M.	4
	2 P.M.	8
	3 P.M.	9
2.12.2005	8 A.M.	5
	9 A.M.	3
	10 A.M.	7
	11 A.M.	11
	12 P.M.	6
	1 P.M.	4
	2 P.M.	9
	3 P.M.	9
3.12.2005	8 A.M.	6
	9 A.M.	4
	10 A.M.	3
	11 A.M.	9
	12 P.M.	7
	1 P.M.	4
	2 P.M.	7
	3 P.M.	12

Construct the control chart for number of defects and give your comments.

11. The number of workmanship nonconformities observed in the final inspection of disk-drive assemblies has been tabulated as shown in the following table. Does the process appear to be in control?

Day	Number of Assemblies Inspected	Total Number of Imperfections
1	2	10
2	4	30
3	2	18
4	1	10
5	3	20
6	4	24
7	2	15
8	4	26
9	3	21
10	1	8