np = defectives 1 1 1 3 4 2 3 2 1 3 3 1 2 1 2 1 2 2 1 1

2. In a biscuit manufacturing company, 200 samples were drawn at random. The number of defectives is given below. Plot a *p* chart and a *np* chart for the biscuit manufacturing process.

np = defectives 11 1 10 11 4 8 3 9 1 10 3 7 2 6 2 5 7 2 9 1

3. A tile manufacturer inspected each operator's output and noted the number of defectives and sample size. The data is given below. Plot a *p* chart.

No. of defectives	2	1	5	1	4	5	2	3	1	0	0	2	5	4	1	3	2	1	5	0
Sample size	120	56	278	311	123	254	17	35	45	67	56	92	235	123	70	45	58	62	278	75

4. A glassware production gave the following defectives on sample size indicated therein. Plot a *p* chart.

No. of defectives	2	1	5	1	4	5	2	3	1	0	0	2	5	4	1	3	2	1	5	0
Sample size	17	21	31	11	25	35	17	34	45	25	22	23	33	34	34	25	21	21	45	10

5. A TV receiver manufacturer measured the number of defects in each TV receiver on final inspection. Plot a *c* chart and a *u* chart for the assembly line.

No. of defects 12 11 7 6 5 4 3 2 1 5 4 6 7 8 9 5 7 8 6 7

6. A carpet manufacturer inspected and counted the number of defects in each carpet that was manufactured. The number of defectives and the sample size are listed below. Plot a *p* chart.

No. of defectives	2	1	5	1	4	5	2	3	1	1	1	2	5	4	1	3	2	1	5	2
Sample size	25	25	25	18	18	18	18	14	14	14	12	12	20	20	20	20	18	18	18	18

7. In a smithy the defects in axes made were counted and are indicated below along with the sample size. Plot a *u* chart.

No. of defective	12	9	5	7	8	8	8	7	8	8	9	10	5	4	1	8	7	9	8	5
Sample size	25	25	25	18	18	18	18	14	14	14	12	12	20	20	20	20	18	18	18	18

8. The specification for the width of table was 100 cms. The actual width measured on the samples is given below. Plot a *X* and *MR* chart.

99 101 100 102 98 101 100 99 101 100 103 102 99 100 101 98 102 98 101 99 98 100 101 99

9. A company manufacturing speedometers, picked up 4 samples each 25 times in a shift. For a setting of 10 Kmph, the values indicated by the speedometer samples are given below. Plot *X* bar and *R* chart. Draw the Action and Warning lines as well as the control limits.

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
10.1	9.8	10.2	10	9.8	10	9.8	10.1	10.3	9.8	9.8	9	10
9.9	10	10.1	9.8	9.9	9.9	9.8	9.9	10	10	10.1	10.2	9.6
10	10	10	10.2	10.2	10.1	10.1	10	9.9	10	10	10	10
10	10.1	10	10	10	9.9	9.9	9.9	10	10.1	10.1	10	10.1

14	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
10.2	9.9	10.3	9.9	10.6	10.2	9.8	10.1	10.3	10.1	9.8	10.1
9.8	10	10.1	9.8	9	9.9	9.8	9.9	10.1	9.9	10.1	10.2
10	10	10	10	10	10	10	10	10	10	10	10
10	10.1	10	10.1	9.8	9.9	9.9	10.1	10	10.1	10.1	10

10. 4 samples each of stopwatches were picked up at random from the assembly line. 25 times the samples were picked up. The indication of the speedometer for a true value of 300 seconds were checked and noted. The values indicated by the various samples are given below. Plot X bar and R chart. Draw the Action and Warning lines as well as control limits.

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
301	299	302	300	306	300	300	301	303	301	295	301	300	302	299
288	300	301	298	268	299	298	299	300	300	301	302	296	298	300
299	299	299	302	302	301	301	299	295	310	300	300	302	297	300
300	301	300	302	307	300	301	302	300	302	300	301	304	304	301

16	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
303	299	306	302	298	301	303	301	302	301
301	298	298	299	298	299	301	299	303	301
298	302	302	301	301	299	299	300	302	301
301	301	304	304	302	302	301	301	302	302

11. In Problems 1 and 2, if the data the corresponds to the number of defects, calculate a c chart.

Table A: Proportional under the Tail of the Normal Distribution

$Z = \frac{(x-\mu)}{\sigma}$	*.00*	*.01*	*.02*	*.03*	*.04*	*.05*	*.06*	*.07*	*.08*	*.09*
0.0	.5000	.4960	.4920	.4880	.4840	.4801	.4761	.4721	.4681	.4641
0.1	.4602	.4562	.4522	.4483	.4443	.4404	.4364	.4325	.4286	.4247
0.2	.4207	.4168	.4129	.4090	.4052	.4013	.3974	.3936	.3897	.3859
0.3	.3821	.3783	.3745	.3707	.3669	.3632	.3594	.3557	.3520	.3483
0.4	.3446	.3409	.3372	.3336	.3300	.3264	.3228	.3192	.3156	.3121
0.5	.3085	.3050	.3015	.2981	.2946	.2912	.2877	.2843	.2810	.2776
0.6	.2743	.2709	.2676	.2643	.2611	.2578	.2546	.2514	.2483	.2451
0.7	.2420	.2389	.2358	.2327	.2296	.2266	.2236	.2206	.2177	.2148
0.8	.2119	.2090	.2061	.2033	.2005	.1977	.1949	.1922	.1894	.1867
0.9	.1841	.1814	.1788	.1762	.1736	.1711	.1685	.1660	.1635	.1611
1.0	.1587	.1562	.1539	.1515	.1492	.1469	.1446	.1423	.1401	.1379
1.1	.1357	.1335	.1314	.1292	.1271	.1251	.1230	.1210	.1190	.1170
1.2	.1151	.1131	.1112	.1093	.1075	.1056	.1038	.1020	.1003	.0985
1.3	.0968	.0951	.0934	.0918	.0901	.0885	.0869	.0853	.0838	.0823
1.4	.0808	.0793	.0778	.0764	.0749	.0735	.0721	.0708	.0694	.0681
1.5	.0668	.0655	.0643	.0630	.0618	.0606	.0594	.0582	.0571	.0559
1.6	.0548	.0537	.0526	.0516	.0505	.0495	.0485	.0475	.0465	.0455
1.7	.0446	.0436	.0427	.0418	.0409	.0401	.0392	.0384	.0375	.0367
1.8	.0359	.0351	.0344	.0336	.0329	.0322	.0314	.0307	.0301	.0294
1.9	.0287	.0281	.0274	.0268	.0262	.0256	.0250	.0244	.0239	.0233
2.0	.0228	.0222	.0216	.0211	.0206	.0201	.0197	.0192	.0187	.0183
2.1	.0179	.0174	.0170	.0165	.0161	.0157	.0153	.0150	.0146	.0142

(*Contd.*)