AE Additional Exercises

1. Edwards Electrical Company produces voltage regulators designed to maintain 220 volts. Samples of 10 units are taken from production to monitor the process and the voltage regulators are found to maintain 220 volts as designed. The mean of the sample ranges is found to be 4 volts.

a. Determine the UCL, LCL, and centerline for an $\bar{x}$ chart.

b. Determine the UCL, LCL, and centerline for an R chart.

2. A steel products manufacturer makes 20-foot lengths of pipe that are later cut into smaller lengths in the production process. To monitor the production and to make sure the pipe is acceptable for the cutting state, a sample of 20 pipes is taken each hour of the day. Along with the pipe length, the range of pipe length is recorded for each sample. Determine the upper and lower control limits for an R chart and indicate which samples, if any, are out of control.

Pipe Length Ranges

Sample Number	Sample Range	Sample Number	Sample Range	Sample Number	Sample Range
1	0.03	9	0.08	17	0.05
2	0.07	10	0.06	18	0.06
3	0.07	11	0.05	19	0.07
4	0.03	12	0.06	20	0.05
5	0.02	13	0.06	21	0.05
6	0.08	14	0.03	22	0.06
7	0.07	15	0.03	23	0.04
8	0.03	16	0.02	24	0.04

3. The league director decides to sample 200 matches each season to study forfeits in league games. The numbers of forfeits for the last eight seasons are shown in the following table. Find the upper and lower control limits and construct a p chart. Indicate which seasons, if any, are out of control.

Game Forfeits

Season Number	Number Forfeited	Season Number	Number Forfeited
1	8	5	7
2	10	6	5
3	9	7	12
4	8	8	16

4. A tire manufacturer randomly samples 20 tires at the end of each shift to determine if the tires are defective. The numbers of defectives in 12 shifts are given in the following table. Construct an appropriate control chart to determine if the tire manufacturing process is in control. Identify any shifts that are out of control.

Defective Tires

Shift	Number of Defectives
1	4
2	2
3	0
4	5
5	2
6	3
7	14
8	2
9	3
10	4
11	12
12	3

5. The vice president of audit at a Fortune 500 firm customarily checks the financial statements for errors in 15 departments. The following table contains information about mistakes made on financial statements. Construct an appropriate control chart to determine if the VP should be concerned about the number of mistakes being made on the financial statements.

Mistakes on Financial Statements

Sample Size	Number of Mistakes	Sample Size	Number of Mistakes
15	0	15	0
15	0	15	3
15	3	15	8
15	2	15	7
15	6	15	0
15	3	15	1
15	4	15	5
15	8	15	4
15	2		

6. 15 samples of five items each were taken to monitor the amount of fill for a 12-ounce bottle of soda. As each bottle is selected from the line, it is measured. The data from the process is given in the following table. Create an $\bar{x}$ chart and an R chart to determine if the process is in control.

Fill Amounts for 12-Ounce Bottles

	Observations				
Sample	1	2	3	4	5
1	13.11	11.17	11.35	13.71	13.00
2	13.19	13.50	13.63	12.36	11.98
3	12.83	12.12	12.65	12.22	11.43
4	11.62	13.72	13.73	11.36	13.93
5	13.65	12.44	13.15	12.42	11.21
6	12.60	11.07	11.17	12.88	12.33
7	11.07	13.22	11.41	13.21	13.14
8	11.56	12.16	12.47	13.41	13.13
9	13.23	12.05	11.25	12.55	13.00
10	12.30	12.18	12.00	13.59	12.18
11	14.00	12.33	11.52	13.29	13.51
12	12.05	11.52	12.80	12.21	12.67
13	13.29	11.91	11.11	11.32	13.85
14	11.21	11.89	13.07	11.22	13.09
15	13.37	13.25	11.48	13.46	11.26

7. A company packages salt pellets for in-ground well water softeners in bags with a 40-pound label weight. During a typical day's operation of the filling process, 10 samples of five bag fills are selected and measured. Using the data in the following table, create an $\bar{x}$ and an R chart to determine if the process is in control.

Bag Weights (Pounds)

	Observations				
Sample	1	2	3	4	5
1	41.41	40.63	38.83	40.57	39.94
2	40.31	40.20	41.28	40.13	42.53
3	41.64	41.02	39.49	41.64	39.14
4	40.34	39.23	41.96	42.26	40.97
5	40.77	42.73	41.83	42.59	40.43
6	42.54	42.87	40.04	40.00	40.84
7	39.84	42.65	42.86	41.75	39.68
8	42.25	40.96	39.11	41.66	39.69
9	42.94	38.52	41.50	39.13	40.57
10	39.42	39.98	38.90	41.17	41.03