5.4.

What is meant by a process that is in a state of statistical control?

The statement that a process is in a state of statistical control means that assignable or special causes of variation have been removed; characteristic parameters like the mean, standard deviation, and probability distribution are constant; and process behavior is predictable. One implication is that any improvement in process capability (i.e., in terms of non-conforming product) will require a change in material, equipment, method, etc.

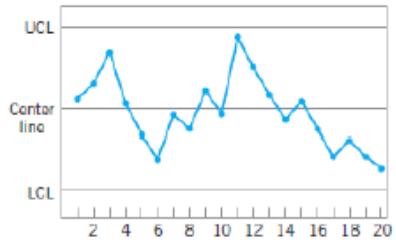
5.5.

If a process is in a state of statistical control, does it necessarily follow that all or nearly all of the units of product produced will be within the specification limits?

No. The fact that a process operates in a state of statistical control does not mean that nearly all product meets specifications. It simply means that process behavior (mean and variation) is statistically predictable. We may very well predict that, say, 50% of the product will not meet specification limits! *Capability* is the term, which refers to the ability to meet product specifications, and a process must be in control in order to calculate capability.

5.17.

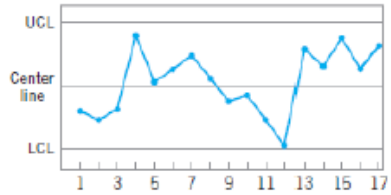
Consider the control chart shown here. Does the pattern appear random?



Evidence of runs, trends or cycles? NO. There are no runs of 5 points or cycles. So, we can say that the plot point pattern appears to be random.

5.18.

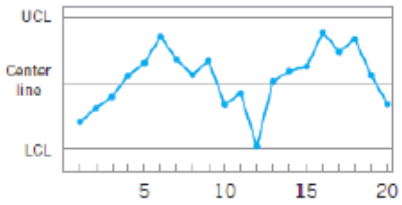
Consider the control chart shown here. Does the pattern appear random?



Evidence of runs, trends or cycles? YES, there is one "low - high - low - high" pattern (Samples 13 – 17), which might be part of a cycle. So, we can say that the pattern does not appear random.

5.19.

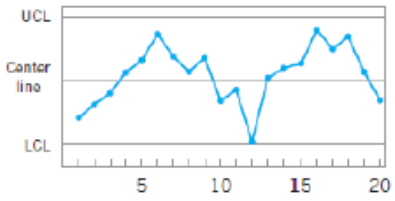
Consider the control chart shown here. Does the pattern appear random?



Evidence of runs, trends or cycles? YES, there is a "low - high - low - high - low" wave (all samples), which might be a cycle. So, we can say that the pattern does not appear random.

5.23.

Apply the Western Electric rules to the control chart presented in Exercise 5.19. Would these rules result in any out-of-control signals?



Check:

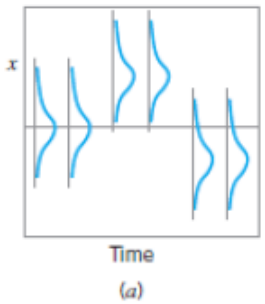
- Any point outside the 3-sigma control limits? NO. (Point #12 is within the lower 3-sigma control limit.)
- 2 of 3 beyond 2 sigma of centerline? YES, points #16, 17, and 18.
- 4 of 5 at 1 sigma or beyond of centerline? YES, points #5, 6, 7, 8, and 9.
- 8 consecutive points on one side of centerline? NO.

Two out-of-control criteria are satisfied.

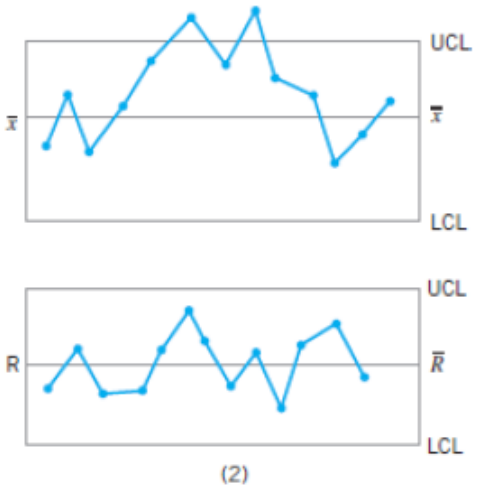
5.24.

Consider the time-varying process behavior shown below and on the next page. Match each of these several patterns of process performance to the corresponding and R charts shown in figures (a) to (e) below.

The pattern in Figure (a) matches the control chart in Figure (2).



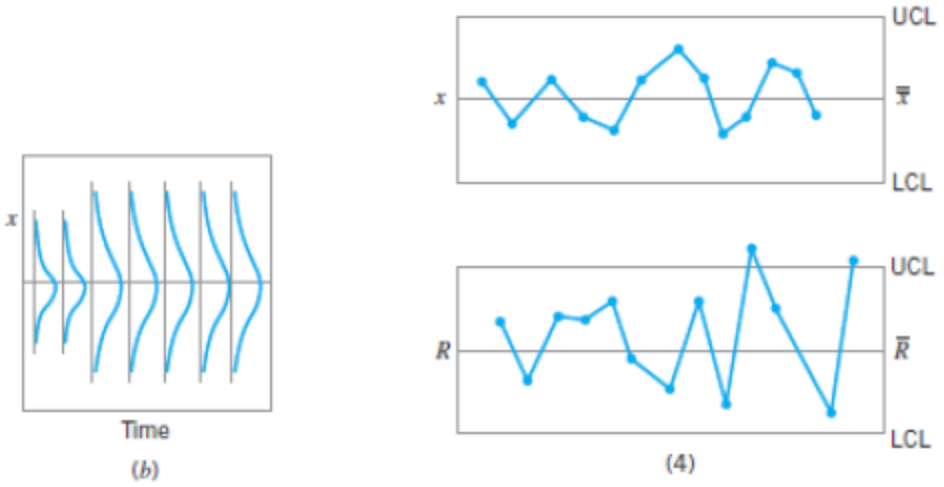
(a)



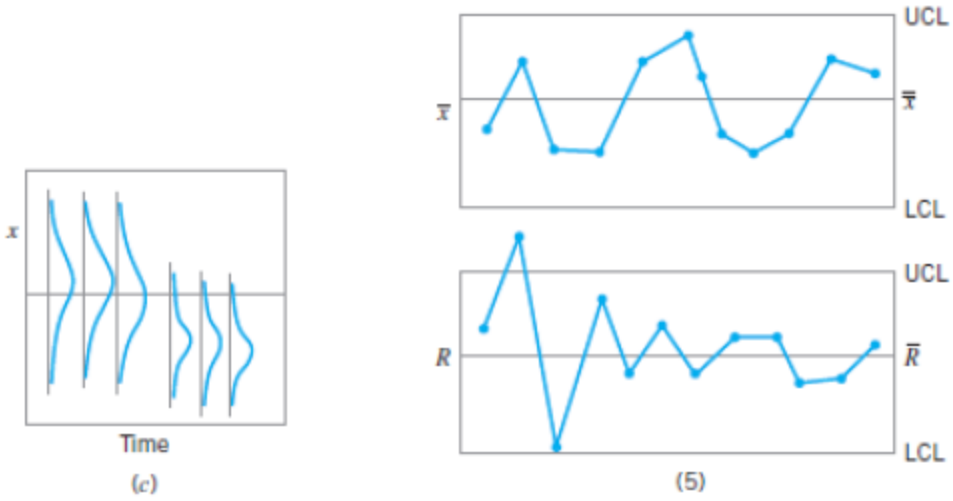
(2)

5.24. continued

The pattern in Figure (b) matches the control chart in Figure (4).

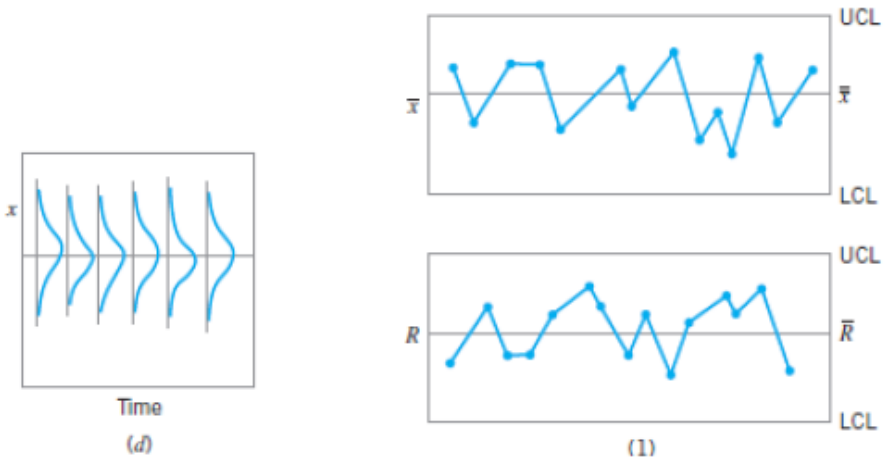


The pattern in Figure (c) matches the control chart in Figure (5).



5.24. continued

The pattern in Figure (d) matches the control chart in Figure (1).



The pattern in Figure (e) matches the control chart in Figure (3).