12. Smart Phone Batteries The SmartBatt company manufactures batteries for smart phones. Listed below are numbers of defects in batches of 200 randomly selected in each of 15 consecutive days of production. What action should be taken?

12 11 14 15 9 10 12 16 8 9 15 7 17 5 18

14-3 Beyond the Basics

13. *np* Chart A variation of the control chart for p is the ***np* chart** in which the *actual numbers* of defects are plotted instead of the *proportions* of defects. The np chart has a centerline value of $n\bar{p}$, and the control limits have values of $n\bar{p} + 3\sqrt{n\bar{p}\,\bar{q}}$ and $n\bar{p} - 3\sqrt{n\bar{p}\,\bar{q}}$. The p chart and the np chart differ only in the scale of values used for the vertical axis. Construct the np chart for Example 1 in this section. Compare the np chart to the control chart for p given in this section.

Chapter 14 Review

In Chapter 2 we noted that important characteristics of data include center, variation, distribution, outliers, and changing pattern of data over time. The focus of this chapter is the changing pattern of data over time, and we can monitor such changes using run charts and control charts. Control charts have a centerline, an upper control limit, and a lower control limit. A process is statistically stable (or within statistical control) if it has only natural variation, with no patterns, cycles, or unusual points. Decisions about statistical stability are based on how a process is actually behaving, not on how we might like it to behave because of such factors as manufacturer specifications. The following graphs were described:

- *Run chart:* a sequential plot of *individual* data values over time
- *R chart:* a control chart that uses ranges in an attempt to monitor the *variation* in a process
- $\bar{x}$ *chart:* a control chart used to determine whether the process *mean* is within statistical control
- *p chart:* a control chart used to monitor the proportion of some process *attribute*, such as whether items are defective

Chapter Quick Quiz

1. What are *process* data?

2. What is the difference between *random variation* and *assignable variation*?

3. Identify three specific criteria for determining when a process is out of statistical control.

4. What is the difference between an R chart and an $\bar{x}$ chart?