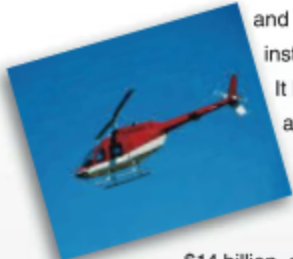


## Six Sigma at Textron

Textron is a large conglomerate with products that include Cessna jets, Bell helicopters, golf carts,

and test instruments. It has annual revenues greater than

\$14 billion, and has 37,000 employees in 29 countries. Textron recently trained 10,000 employees in Six Sigma methods. The actual reference to Six Sigma suggests 6 standard deviations away from the center of a normal distribution, but the assumption of a perfectly stable process is replaced with the assumption of a process that drifts slightly, so the defect rate is so low that there are no more than three or four defects per million. Implementation of Six Sigma methods started around 1985, and their use has enabled companies to save billions of dollars.



The last three columns of Table 14-1 list the mean, standard deviation, and range for the five coins selected on each day of production. We will analyze the data in Table 14-1 as we would analyze any process, such as the filling of cans of Coke, repairs of defective iPods, and processing flight passengers through security checkpoints.

## 14-1 Review and Preview

In Section 2-1 we noted that an important characteristic of data is a changing pattern over time. Some populations change over time so that values of parameters change. The main objective of this chapter is to learn how to construct and interpret *control charts* that can be used to monitor changing characteristics of data over time. That knowledge will better prepare us for work with businesses trying to maintain or improve the quality of their goods and services.

Minitab, StatCrunch, XLSTAT, and other software packages include programs for automatically generating charts of the type discussed in this chapter, and we will include examples of such displays. Control charts are good examples of visual tools that allow us to *see* and *understand* some properties of data that would be difficult or impossible to understand without graphs. The world needs more people who can construct and interpret graphs, such as the control charts described in this chapter.

## 14-2 Control Charts for Variation and Mean

**Key Concept** In this section we introduce run charts,  $R$  charts, and  $\bar{x}$  charts as tools that enable us to monitor characteristics of data over time. We can use such charts to determine whether a process is statistically stable (or within statistical control).

The following definition formally describes the type of data that will be considered in this chapter.

**DEFINITION** **Process data** are data arranged according to some time sequence. They are measurements of a characteristic of goods or services that result from some combination of equipment, people, materials, methods, and conditions.

### Example 1 Weights of Quarters as Process Data

Table 14-1 includes process data consisting of the weights of manufactured quarters. Because the values in Table 14-1 are arranged according to the time at which they were selected, they are process data.

It is important to know that companies have gone bankrupt because they unknowingly allowed manufacturing processes to deteriorate without constant monitoring. They suffered from a failure to monitor process data. This section introduces three