> **DEFINITION** A process is **statistically stable** (or **within statistical control**) if it has only natural variation, with no patterns, cycles, or unusual points.

Interpreting Run Charts A run chart with no obvious pattern suggests that the data are from a process that is *statistically stable,* and the data can be treated as if they came from a population with a constant mean, standard deviation, distribution, and other characteristics. Figure 14-1 shows a pattern of increasing variation, and that is one of several criteria for determining that a process is not statistically stable.

- **Increasing Variation:** As the run chart proceeds from left to right, the vertical variation of the points is increasing, so the corresponding data values are experiencing an increase in variation. (See Figure 14-1.) This is a common problem in quality control. The net effect is that products vary more and more until almost all of them are worthless.

- **Upward Trend:** The points are rising from left to right, so the corresponding values are increasing over time.

- **Downward Trend:** The points are falling from left to right, so the corresponding values are decreasing over time.

- **Upward Shift:** The points near the beginning are noticeably lower than those near the end, so the corresponding values have shifted upward.

- **Downward Shift:** The points near the beginning are noticeably higher than those near the end, so the corresponding values have shifted downward.

- **Exceptional Value:** There is a single point that is exceptionally high or low.

- **Cyclical Pattern:** There is a *cyclical pattern* (or repeating cycle).

Many different methods of quality control attempt to *reduce variation* in the product or service. Variation in a process can result from two types of causes.

> **DEFINITIONS**
>
> **Random variation** is due to chance; it is the type of variation inherent in any process that is not capable of producing every good or service exactly the same way every time.
>
> **Assignable variation** results from causes that can be identified (such as defective machinery or untrained employees).

Later in the chapter we will consider ways to distinguish between assignable variation and random variation.

The run chart is one tool for monitoring the stability of a process. We will now consider *control charts,* which are also useful for monitoring the stability of a process.

Control Chart for Monitoring Variation: The *R* Chart

Because control charts were first introduced by Walter Shewhart in 1924, they are sometimes called Shewhart charts. We begin with a basic definition.