Example 5 Range Rule of Thumb for Estimating s

Use the range rule of thumb to estimate the standard deviation of the sample of 40 chocolate chip counts for the Chips Ahoy (regular) cookies as listed in Table 3-1. Those 40 values have a minimum of 19 and a maximum of 30.

Solution

The range rule of thumb indicates that we can estimate the standard deviation by finding the range and dividing it by 4. With a minimum of 19 and a maximum of 30, the range rule of thumb can be used to estimate the standard deviation s as follows:

$$s \approx \frac{\text{range}}{4} = \frac{30 - 19}{4} = 2.75 \text{ chips}$$

Interpretation

The actual value of the standard deviation is $s = 2.6$ chips, so the estimate of 2.75 chips is quite close. Because this estimate is based on only the minimum and maximum values, it is generally a rough estimate that might be off by a considerable amount.

Standard Deviation of a Population

The definition of standard deviation and Formulas 3-4 and 3-5 apply to the standard deviation of *sample* data. A slightly different formula is used to calculate the standard deviation σ (lowercase sigma) of a *population:* Instead of dividing by $n - 1$, we divide by the population size N, as shown here:

$$\text{population standard deviation} \quad \sigma = \sqrt{\frac{\Sigma(x - \mu)^2}{N}}$$

Because we generally deal with sample data, we will usually use Formula 3-4, in which we divide by $n - 1$. Many calculators give both the sample standard deviation and the population standard deviation, but they use a variety of different notations.

CAUTION When using a calculator to find standard deviation, identify the notation used by your particular calculator so that you get the *sample* standard deviation, not the population standard deviation.

Variance of a Sample and a Population

So far, we have used the term *variation* as a general description of the amount that values vary among themselves. (The terms *dispersion* and *spread* are sometimes used instead of *variation*.) The term *variance* has a specific meaning.

DEFINITIONS

The **variance** of a set of values is a measure of variation equal to the square of the standard deviation.

Sample variance: s^2 = square of the standard deviation s.

Population variance: σ^2 = square of the population standard deviation σ.

More Stocks, Less Risk

In their book *Investments*, authors Zvi Bodie, Alex Kane, and Alan Marcus state that "the average standard deviation for returns of portfolios composed of only one stock was 0.554. The average portfolio risk fell rapidly as the number of stocks included in the portfolio increased." They note that with 32 stocks, the standard deviation is 0.325, indicating much less variation and risk. They make the point that with only a few stocks, a portfolio has a high degree of "firm-specific" risk, meaning that the risk is attributable to the few stocks involved. With more than 30 stocks, there is very little firm-specific risk; instead, almost all of the risk is "market risk," attributable to the stock market as a whole. They note that these principles are "just an application of the well-known law of averages."