1. The variable x is a numerical random variable and its values (0, 1, 2) are associated with probabilities, as determined by the given formula.
2. $\Sigma P(x) = P(0) + P(1) + P(2) = \frac{0}{3} + \frac{1}{3} + \frac{2}{3} = 1$
3. Each value of $P(x)$ is between 0 and 1 inclusive.

Because the three requirements are satisfied, we conclude that the given formula does describe a probability distribution.

Parameters of a Probability Distribution: Mean, Variance, and Standard Deviation

Remember that with a probability distribution, we have a description of a *population* instead of a sample, so the values of the mean, standard deviation, and variance are *parameters* instead of statistics. The mean is the central or "average" value of the random variable. The variance and standard deviation measure the variation of the random variable. These parameters can be found with the following formulas:

Formula 5-1 $\mu = \Sigma[x \cdot P(x)]$

Mean for a probability distribution

Formula 5-2 $\sigma^2 = \Sigma[(x - \mu)^2 \cdot P(x)]$

Variance for a probability distribution (This format is easier to understand.)

Formula 5-3 $\sigma^2 = \Sigma[x^2 \cdot P(x)] - \mu^2$

Variance for a probability distribution (This format is easier for manual computations.)

Formula 5-4 $\sigma = \sqrt{\Sigma[x^2 \cdot P(x)] - \mu^2}$

Standard deviation for a probability distribution

When applying Formulas 5-1 through 5-4, use the following rule for rounding results.

Round-off Rule for μ, σ, and σ^2 from a Probability Distribution

Round results by carrying one more decimal place than the number of decimal places used for the random variable x. If the values of x are integers, round μ, σ, and σ^2 to one decimal place.

It is sometimes necessary to use a different rounding rule because of special circumstances, such as results that require more decimal places to be meaningful. For example, with four-engine jets the mean number of jet engines working successfully throughout a flight is 3.999714286, which becomes 4.0 when rounded to one more decimal place than the original data. Here, 4.0 would be misleading because

Life Data Analysis

Life data analysis deals with the longevity and failure rates of manufactured products. In one application, it is known that Dell computers have an "infant mortality" rate, whereby the failure rate is highest immediately after the computers are produced. Dell therefore tests or "burns-in" the computers before they are shipped. Dell can optimize profits by using an optimal burn-in time that identifies failures without wasting valuable testing time. Other products, such as cars, have failure rates that increase over time as parts wear out. If General Motors or Dell or any other company were to ignore the use of statistics and life data analysis, it would run the serious risk of going out of business because of factors such as excessive warranty repair costs or the loss of customers who experience unacceptable failure rates.

The *Weibull distribution* is a probability distribution commonly used in life data analysis applications. That distribution is beyond the scope of this book.