Example 2   Is a Pulse Rate of 48 Unusual?

As the author was creating this example, he measured his pulse rate to be 48 beats per minute. (The author has too much time on his hands.) Is that pulse rate un-usual? (Based on the pulse rates of males from Data Set 1 in Appendix B, assume that a large sample of adult males has pulse rates with a mean of 67.3 beats per minute and a standard deviation of 10.3 beats per minute.)

Solution

The author's pulse rate of 48 beats per minute is converted to a z score as shown below:

Pulse rate of 48:

$$z = \frac{x - \bar{x}}{s} = \frac{48 \text{ beats per minute} - 67.3 \text{ beats per minute}}{10.3 \text{ beats per minute}} = -1.87$$

Interpretation

The result shows that the author's pulse rate of 48 beats per minute is converted to the z score of -1.87. Refer to Figure 3-4 to see that $z = -1.87$ is between -2 and $+2$, so it is not unusual.

In Example 2, the pulse rate of 48 beats per minute resulted in a *negative z* score because that pulse rate is *less than* the mean of 67.3 beats per minute. Also, the units of "beats per minute" all canceled out, and the resulting z score has no units associated with it. These observations are included in the following summary describing z scores.

Properties of z Scores

1. A z score is the number of standard deviations that a given value x is above or below the mean.

2. z scores are expressed as numbers with no units of measurement.

3. A data value is unusual if its z score is less than -2 or greater than $+2$.

4. If an individual data value is less than the mean, its z score is a negative number.

A z score is a measure of position, in the sense that it describes the location of a value (in terms of standard deviations) relative to the mean. Quartiles and percentiles are other measures of position useful for comparing values within the same data set or between different sets of data.

Percentiles

Percentiles are one type of *quantiles*—or *fractiles*—which partition data into groups with roughly the same number of values in each group.

> **DEFINITION Percentiles** are measures of location, denoted $P_1, P_2, \ldots, P_{99}$, which divide a set of data into 100 groups with about 1% of the values in each group.

For example, the 50th percentile, denoted P_{50}, has about 50% of the data values below it and about 50% of the data values above it. So the 50th percentile is the same as