

Americans Are Relatively Shorter

Paul Krugman writes in the *New York Times* that Americans were generally the tallest people in the world until the middle of the last century, but they are now the shortest when compared to others in advanced industrial countries. He also notes that there is a strong association between the per capita income of a country and the mean height of the country's people, so Americans should be taller than Europeans, but they no longer are. One possible explanation for this discrepancy is that Americans mistreat children by feeding them too much fast food and not giving them enough healthy food and exercise. Krugman writes that "Whatever the full explanation for America's stature deficit, our relative shortness, like our low life expectancy, suggests that something is amiss with our way of life."



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 unusual? (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, \dots, 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