regular Coke in cans. We now consider a comparison of two *individual* data values with this question: Which of the following two data values is more extreme?

- The Chips Ahoy (regular) cookie with 30 chocolate chips (among 40 cookies with a mean of 24.0 chocolate chips and a standard deviation of 2.6 chocolate chips)
- The can of regular Coke with a weight of 0.8295 lb (among 36 cans of regular Coke with a mean weight of 0.81682 lb and a standard deviation of 0.00751 lb)

Both of the above data values are the largest values in their respective data sets, but which of them is more extreme relative to the data sets from which they came?

Solution

The two given data values are measured on different scales with different units of measurement, but we can standardize the data values by converting them to z scores. Note that in the following calculations, the individual scores are substituted for the variable x.

Chips Ahoy cookie with 30 chocolate chips:

$$z = \frac{x - \bar{x}}{s} = \frac{30 \text{ chocolate chips} - 24.0 \text{ chocolate chips}}{2.6 \text{ chocolate chips}} = 2.31$$

can of Coke with weight of 0.8295 lb:

$$z = \frac{x - \bar{x}}{s} = \frac{0.8295 \text{ lb} - 0.81682 \text{ lb}}{0.00751 \text{ lb}} = 1.69$$

Interpretation

The results show that the cookie is 2.31 standard deviations above the mean, and the can of Coke is 1.69 standard deviations above the mean. Because the cookie is more standard deviations above the mean, it is the more extreme value. A cookie with 30 chocolate chips is more extreme than a can of Coke weighing 0.8295 lb.

Using z Scores to Identify Unusual Values In Section 3-3 we used the range rule of thumb to conclude that a value is “unusual” if it is more than 2 standard deviations away from the mean. It follows that unusual values have z scores less than -2 or greater than $+2$, as illustrated in Figure 3-4. Using this criterion with the two individual values used in Example 1 above, we see that the cookie with 30 chocolate chips is unusual (because its z score is 2.31, which is greater than 2), but the can of Coke weighing 0.8295 lb is not unusual (because its z score is 1.69, which is between -2 and $+2$).

Usual values: $-2 \le z \text{ score} \le 2$

Unusual values: $z \text{ score} < -2$ *or* $z \text{ score} > 2$

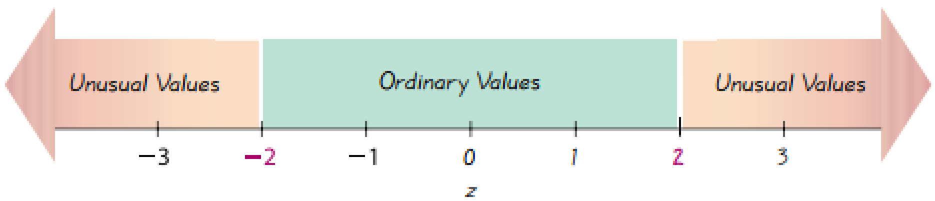

Figure 3-4

Interpreting z Scores

Unusual values are those with z scores less than −2.00 or greater than 2.00.

Changing Populations

Included among the five important data set characteristics listed in Chapter 2 is the changing pattern of data over time. Some populations change, and their important statistics change as well. Car seat belt standards haven't changed in 40 years, even though the weights of Americans have increased considerably since then. In 1960, 12.8% of adult Americans were considered obese, compared to 22.6% in 1994.

According to the National Highway Traffic Safety Administration, seat belts must fit a standard crash dummy (designed according to 1960 data) placed in the most forward position, with 4 in. to spare. In theory, 95% of men and 99% of women should fit into seat belts, but those percentages are now lower because of the increases in weight over the last half-century. Some car companies provide seat belt extenders, but some do not.