Your author does not cover skewness, but we'll make up for it here. Skewness compares the dispersion on the left side of the distribution, i.e., below the mean, to that of the right side. A distribution that is more dispersed to the left is said to be negatively dispersed; more to the right, positively dispersed; and one that is evenly dispersed, symmetrical.

The calculation involves this somewhat fearsome-looking formula:

\[
population\ S_k = \frac{1}{N} \sum_{i=1}^{n} \left( \frac{x_i - \mu}{\sigma} \right)^3 \quad \text{or} \quad S_k = \frac{\sum_{i=1}^{n} \left( \frac{x_i - \mu}{\sigma} \right)^3}{N}
\]

\[
sample\ S_k = \frac{n}{(n-1)(n-2)} \sum_{i=1}^{n} \left( \frac{x_i - \bar{x}}{s} \right)^3
\]

Both versions share the term \([(x - \text{mean})/\text{standard deviation}]^3\), which we'll soon call the cubed z-score. The sample version includes a degrees-of-freedom adjustment.

The usual range of \(S_k\) is from –3 to +3, with values at or beyond those extremes pretty rare. The sign tells you whether the distribution is negatively or positively skewed; the absolute value tells you how great the skewness is. If \(S_k = 0\), then the distribution is symmetrical, i.e., it is not skewed at all. Generally, mean < median < mode implies a negatively skewed distribution; mean > median > mode, positively skewed; and all three equal, a symmetrical distribution.

### Example

Referring to data set \(x\) in Supplement 3: Find the skewness of \(x\). (We'll treat it as a sample.)

Using the numbers in the table at left,

\[
sample\ S_k = \frac{n}{(n-1)(n-2)} \sum_{i=1}^{n} \left( \frac{x_i - \bar{x}}{s} \right)^3
\]

\[
= \frac{15}{(15-1)(15-2)} \times -0.0839
\]

\[
= 0.0824 \times -0.0839
\]

\[
= -0.0069
\]

Hence, the distribution of \(x\), with a skewness coefficient of nearly zero, is approximately symmetrical. Here's the histogram from Minitab:
Data for homework problems

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<th>$b$</th>
<th>$c$</th>
<th>$d$</th>
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<td>12</td>
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<td>5</td>
<td>4</td>
<td>7</td>
<td>1</td>
<td>6</td>
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</tbody>
</table>