2.38 With reference to the preceding exercise, find s using

(a) the formula that defines s;

(b) the handheld calculator formula for s.

2.39 Meat products are regularly monitored for freshness. A trained inspector selects a sample of the product and assigns an offensive smell score between 1 and 7 where 1 is very fresh. The resulting offensive smell scores, for each of 16 samples, are (Courtesy of David Brauch)

3.2	3.9	1.7	5.0	1.9	2.6	2.4	5.3
1.0	2.7	3.8	5.2	1.0	6.3	3.3	4.3

(a) Find the mean.

(b) Find the median.

(c) Draw a boxplot.

2.40 With reference to Exercise 2.31, find s^2 using

(a) the formula that defines s^2;

(b) the handheld calculator formula for s^2.

2.41 Material manufactured continuously before being cut and wound into large rolls must be monitored for thickness (caliper). A sample of 10 measurements on paper, in millimeters, yielded

32.2 32.0 30.4 31.0 31.2 31.2 30.3 29.6 30.5 30.7

Find the mean and quartiles for this sample.

2.42 For the four observations 9 7 15 5

(a) calculate the deviations $(x_i - \bar{x})$ and check that they add to 0;

(b) calculate the variance and the standard deviation.

2.43 With reference to Exercise 2.14 on page 24, draw a boxplot.

2.44 A company was experiencing a chronic weld-defect problem with a water-outlet-tube assembly. Each assembly manufactured is leak tested in a water tank. Data were collected on a gap between the flange and the pipe for 6 bad assemblies that leaked and 6 good assemblies that passed the leak test.

Leaker 0.290 0.104 0.207 0.145 0.104 0.124

(a) Calculate the sample mean $\bar{x}$.

(b) Calculate the sample standard deviation s.

2.45 Refer to Exercise 2.44. The measurements for 6 assemblies that did not leak were

Good 0.207 0.124 0.062 0.301 0.186 0.124

(a) Calculate the sample mean $\bar{x}$.

(b) Calculate the sample standard deviation s.

(c) Does there appear to be a major difference in gap between assemblies that leaked and those that did not? The quality improvement group turned their focus to welding process variables.

2.46 Find the mean and the standard deviation of the 20 humidity readings on page 21 by using

(a) the raw (ungrouped) data

(b) the distribution obtained in that example

2.47 Use the distribution in Exercise 2.10 on page 22 to find the mean and the variance of the nanopillar diameters.

2.48 Use the distribution obtained in Exercise 2.12 on page 23 to find the mean and the standard deviation of the ignition times. Also determine the coefficient of variation.

2.49 Use the distribution obtained in Exercise 2.14 on page 23 to find the coefficient of variation of the temperature data.

2.50 Show that

$$\sum_{i=1}^{n} (x_i - \bar{x}) = 0$$

for any set of observations $x_1, x_2, \ldots, x_n$.

2.51 Show that the computing formula for s^2 on page 34 is equivalent to the one used to define s^2 on page 27.

2.52 If data are coded so that $x_i = c \cdot u_i + a$, show that $\bar{x} = c \cdot \bar{u} + a$ and $s_x = |c| \cdot s_u$.

2.53 **Median of grouped data** To find the *median* of a distribution obtained for n observations, we first determine the class into which the median must fall. Then, if there are j values in this class and k values below it, the median is located $\dfrac{(n/2) - k}{j}$ of the way into this class, and to obtain the median we multiply this fraction by the class interval and add the result to the lower boundary of the class into which the median must fall. This method is based on the assumption that the observations in each class are "spread uniformly" throughout the class interval, and this is why we count $\dfrac{n}{2}$ of the observations instead of $\dfrac{n+1}{2}$ as on page 25.

To illustrate, let us refer to the nanopillar height data on page 15 and the frequency distribution on page 16. Since $n = 50$, it can be seen that the median must fall in class (285, 325], which contains $j = 23$ observations. The class has width 40 and there are $k = 3 + 11 = 14$ values below it, so the median is

$$285 + \frac{25 - 14}{23} \times 40 = 264.13$$

(a) Use the distribution obtained in Exercise 2.10 on page 22 to find the median of the grouped nanopillar diameters.

(b) Use the distribution obtained in Exercise 2.12 on page 23 to find the median of the grouped ignition times.