

Chapter 6 Statistics

6.1 Data summary and presentation: Boiling down the numbers

▶ **Example:** The Chelsea Football Club (FC) is a British soccer team. The following table shows the goals scored in the games played by Chelsea FC between September 2007 and May 2008. The data are arranged according to the total number of goals scored in each game.

Goals scored by either team	0	1	2	3	4	5	6	7	8
Number of games	7	14	20	11	3	2	1	2	2

0, 14, 40, 33, 12, 10, 6
14, 16

▶ Find the mean, median, and mode for the number of goals scored per game.

goals → 145
games → 62 = 2.3

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▶ **Solution:**

- ▶ To find the mean, we add the data values (the total number of goals scored) and divide by the number of data points.
- ▶ To find the total number of goals scored, for each entry we multiply the goals scored by the corresponding number of games. Then we add.
- ▶ The total number of goals scored:
 $(7 \times 0) + (14 \times 1) + (20 \times 2) + (11 \times 3) + (3 \times 4) + (2 \times 5) + (1 \times 6) + (2 \times 7) + (2 \times 8) = 145$
- ▶ The number of data points or the total number of games:
 $7 + 14 + 20 + 11 + 3 + 2 + 1 + 2 + 2 = 62$

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Model	City Mileage (mpg)	Highway Mileage (mpg)
Toyota Prius	51	48
Honda Civic Hybrid	40	43
Honda CR-Z	35	39
Toyota Yaris	29	35
Audi A3	30	42
Hyundai Sonata	22	35
Hyundai Tucson	23	31
Chevrolet Equinox	22	32
Kia Rondo	20	27
Chevrolet Colorado/GMC Canyon	18	25

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► **Solution:**

- The list for city mileage, in order from lowest to highest: 18, 20, 22, 22, 23, 29, 30, 35, 40, 51

To find the median, we average the two numbers in the middle:

$$\text{Median} = \frac{23 + 29}{2} = 26 \text{ mpg}$$

The lower half of the list is 18, 20, 22, 22, 23, and the median of this half is 22. Thus, the first quartile is 22 mpg.

The upper half of the list is 29, 30, 35, 40, 51, and the median of this half is 35. Thus, the third quartile is 35 mpg.

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▶ **Example:** Two leading pitchers in Major League Baseball for 2011 were Roy Halladay of the Philadelphia Phillies and Felix Hernandez of the Seattle Mariners. Their ERA (Earned Run Average—the lower the number, the better) histories are given in the table below.

Pitcher	ERA 2006	ERA 2007	ERA 2008	ERA 2009	ERA 2010
R. Halladay	3.19	3.71	2.78	2.79	2.44
F. Hernandez	4.52	3.92	3.45	2.49	2.27

Calculate the mean and the standard deviation for Halladay's ERA history. It turns out that the mean and standard deviation for Hernandez's ERA history are $\mu = 3.33$ and $\sigma = 0.85$. What comparisons between Halladay and Hernandez can you make based on these numbers?

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▶ **Solution:** The mean for Halladay is:

$$\mu = \frac{3.19 + 3.71 + 2.78 + 2.79 + 2.44}{5} = 2.98$$

ERA x_i	Deviation $x_i - 2.98$	Square of deviation $(x_i - 2.98)^2$
3.19	$3.19 - 2.98 = 0.21$	$(0.21)^2 = 0.044$
3.71	$3.71 - 2.98 = 0.73$	$(0.73)^2 = 0.533$
2.78	$2.78 - 2.98 = -0.20$	$(-0.20)^2 = 0.040$
2.79	$2.79 - 2.98 = -0.19$	$(-0.19)^2 = 0.036$
2.44	$2.44 - 2.98 = -0.54$	$(-0.54)^2 = 0.292$
Sum of third column		0.945
Sum divided by $n = 5$, square root		$\sigma = \sqrt{0.945/5} = 0.43$

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Team	Free-throw percentage at home	Free-throw percentage away	Team	Free-throw percentage at home	Free-throw percentage away
Toronto	81.2	77.6	Milwaukee	73.3	76.6
Washington	78.2	75.4	Miami	72.7	75.5
Atlanta	77.2	75.2	New York	72.7	73.9
Boston	77.1	74.3	Orlando	72.1	75.4
Indiana	76.8	75.7	Cleveland	71.7	74.8
Detroit	76.7	74.4	Charlotte	71.4	74.7
Chicago	75.6	76.6	Philadelphia	70.6	77.2
New Jersey	73.6	76.8			
Mean	74.73	75.61			
Standard deviation	2.95	1.09			

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- ▶ **Solution:** The means for free-throw percentages are 74.73 at home and 75.61 away, so on average the teams do somewhat better on the road than at home.
 - ▶ The standard deviation for home is 2.95 percentage points, which is considerably larger than the standard deviation of 1.09 percentage points away from home. This means that the free-throw percentages at home vary from the mean much more than the free-throw percentages away.
 - ▶ The difference between the maximum and minimum percentages shows the same thing: The free-throw percentages at home range from 70.6 to 81.2%, and the free-throw percentages away range from 73.9% to 77.6%.

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