

2.3 Measures of the Location of the Data

Learning Objectives:

In this section, you will:

- Measure the centers of data, including mean, median, and mode

Percentile and Quartiles

Percentiles divide ordered data into hundredths. To score in the 90th percentile of an exam does not mean, necessarily, that you received 90% on a test. It means that 90% of test scores are the same or less than your score and 10% of the test scores are the same or greater than your test score.

Quartiles divide ordered data into quarters. Quartiles may or may not be part of the data. The first quartile, Q_1 , is the same as the 25th percentile, and the third quartile, Q_3 , is the same as the 75th percentile. The median, M , is called both the second quartile, Q_2 same as the 50th percentile.

Example 1: Consider the following data. 1; 11.5; 6; 7.2; 4; 8; 9; 10; 6.8; 8.3; 2; 2; 10; 1

Order Data:

- Find 50th percentile: ____ What is another name for this value?
- Find 25th percentile: ____ Find 75th percentile: ____ What is another name for this value?
- What is another name for this value?

The **interquartile range (IQR)** is a number that indicates the spread of the middle half or the middle 50% of the data. It is the difference between the third quartile (Q_3) and the first quartile (Q_1).

$$IQR = Q_3 - Q_1$$

The IQR can help to determine potential outliers. A value is suspected to be a potential outlier if it is less than $(1.5)(IQR)$ below the first quartile or more than $(1.5)(IQR)$ above the third quartile.

Potential outliers: Lower bound = $Q_1 - 1.5 \cdot IQR$ and Upper bound = $Q_3 + 1.5 \cdot IQR$

Example 2

For the following 13 real estate prices, calculate the IQR and determine if any prices are potential outliers. Prices are in dollars. 389,950; 230,500; 158,000; 479,000; 639,000; 114,950; 5,500,000; 387,000; 659,000; 529,000; 575,000; 488,800; 1,095,000

A Formula for Finding the k th Percentile

- k = the k th percentile. It may or may not be part of the data.
 - i = the index (ranking or position of a data value)
 - n = the total number of data
- Order the data from smallest to largest.
 - Calculate $i = k/100 \cdot n$
 - If i is not a whole number, round up to the next whole number. The value of the k th percentile is the i th value, starting from the lowest value.
 - If i is a whole number, the percentile is between the i th value and the next data value. Find the mean of those two values.

Example 3

Listed are 28 ages for Academy Award winning best actors in order from smallest to largest. 18; 21; 22; 25; 26; 27; 29; 30; 31; 33; 36; 37; 41; 42; 47; 52; 55; 57; 58; 62; 64; 67; 69; 71; 72; 73; 74; 76

- Find the 70th percentile.
- Find the 25th percentile.

Example 4

Fifty statistics students were asked how much sleep they get per school night (rounded to the nearest hour). The results were:

Amount of sleep per school night (hours)	Frequency	Relative Frequency	Cumulative Relative Frequency
4	2	0.04	0.04
5	5	0.10	0.14
6	7	0.14	0.28
7	12	0.24	0.52
8	14	0.28	0.80
9	7	0.14	0.94
10	3	0.06	1.00

- a. Find the median. _____
- b.c.Find the third quartile. _____
- Find the 28th percentile. _____

Formula for Finding the Percentile of a Value in a Data Set

- Order the data from smallest to largest.
- x = the number of data values counting from the bottom of the data list up to but not including the data value for which you want to find the percentile.
- n = the total number of data.
- Calculate $x/n * 100$. Then round to the nearest whole number.

Example 5

Listed are 29 ages for Academy Award winning best actors in order from smallest to largest. 18; 21; 22; 25; 26; 27; 29; 30; 31; 33; 36; 37; 41; 42; 47; 52; 55; 57; 58; 62; 64; 67; 69; 71; 72; 73; 74; 76; 77

- a. Find the percentile for 58.
- b. Find the percentile for 25.

For more information and examples see online textbook OpenStax Introductory Statistics pages 87-96.

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