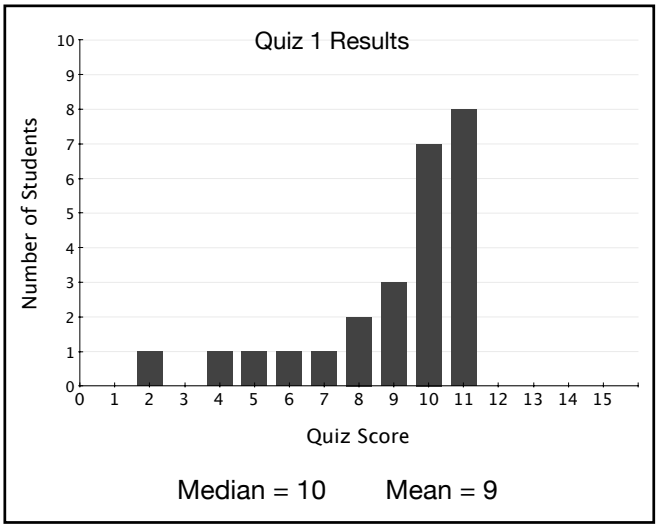
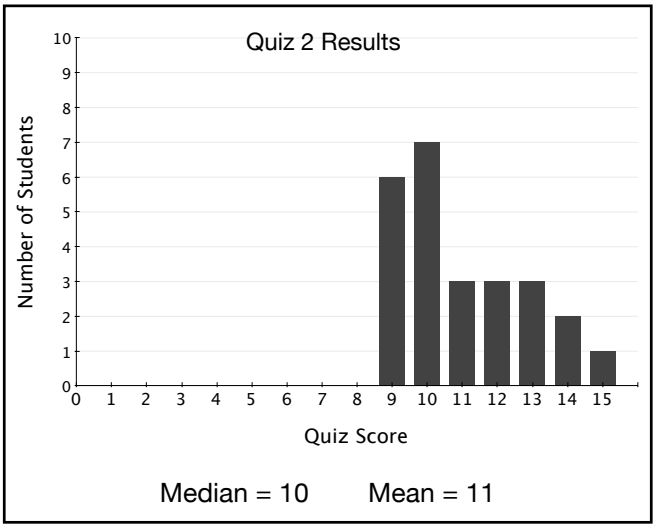
# Mean, Median, Mode (Part 2)

## Extend Your Learning
## Answers and Explanations

The following problems ask you to analyze a situation and predict how the data will impact the mean, median, and mode. Focus on making sense of the data rather than determining exact answers.

1. Mr. Lee gave two 15-point quizzes to his eighth grade mathematics class during the first month of school. The following bar graphs show the results of each quiz.




Study the graphs. Notice that the median score is the same for both quizzes, but the mean scores are different. Explain why mean score for quiz 1 is smaller than the median score, but the mean score for quiz 2 is larger than the median score.

The middle or median score for both quizzes is 10. However, quiz 1 includes several very low scores, while quiz 2 includes several high scores. The low quiz 1 scores impact the mean and cause it to be less than 10 and the high quiz 2 scores impact the mean and cause it to be greater than 10.

2. When Sarah's mom completed her income taxes for the year, she determined that their household income for the year was $59,240. Sarah asked if that was an average income. According to the U.S. Census Bureau, the median U.S. household income is $52,175 and the mean U.S. household income is $71,128.
Source: http://factfinder.census.gov/servlet/STTable?_bm=y&-geo_id=01000US&-qr_name=ACS_2008_3YR_G00_S1901&-ds_name=ACS_2008_3YR_G00_&-redoLog=false

   a. Is $59,240 an average income? Explain your reasoning.
   The term average describes what is common or typical. Mean and median are two different ways to describe the average value of a set of data. Since $59,240 is close to both the median U.S. household income and the mean U.S. household income, you can consider it typical, common, or average.

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b. Why is the mean U.S. household income larger than the median U.S. household income? Explain your reasoning.
One half of all U.S. households make less than or equal to the median and one half make greater than or equal to the median. So one half of all households make between $0 and the median income. Those who make more than the median may have a very large income. Think about the impact that incomes of pro-athletes and entertainers who make more than $1,000,000 a year have on the mean household income. These very high incomes will impact the mean and make it larger than the median.

3. Think about the number of years each U.S. president served in office rounded to the nearest year. Predict what you think the mean, median, and mode might be. Explain your reasoning.
The length of one presidential term is 4 years and many presidents are re-elected for a second 4-year term. It is reasonable to expect the mode of the data to be 4 years or 8 years. The data may even be bimodal. Franklin D. Roosevelt was the only president to serve more than two terms. Based on this knowledge, it is reasonable to predict that the mean and median will be between 4 and 8 years. Your knowledge of history will help you refine this estimate. Consider the following questions to help you get a closer estimate. Have a lot of presidents left office before completing one term? How many presidents who were elected to a second term left office before completing the second term?

Analyzing the data (rounded to the nearest year), the median length of a presidential term is 4 years and the mean length of a presidential term is 5 years. Sixteen presidents served 4 years and 12 presidents served 8 years, so the mode is 4 years.

Visit the following website to see the actual data and other interesting facts about U. S. presidents: http://www.filibustercartoons.com/prezidents.htm

4. The following table shows the total medals won by the five countries with the largest number of medals in the 2010 Olympics in Vancouver. The other participating countries won fewer medals.

| Total Medals by Nation | | | | |
|---|---|---|---|---|
| Nation | Gold | Silver | Bronze | **Total** |
| United States | 9 | 15 | 13 | 37 |
| Germany | 10 | 13 | 7 | 30 |
| Canada | 14 | 7 | 5 | 26 |
| Norway | 9 | 8 | 6 | 23 |
| Austria | 4 | 6 | 6 | 16 |

Source: http://www.vancouver2010.com/

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a. A total of 84 countries competed in the 2010 Winter Olympics for a total of 258 medals. Determine the actual mean, median, and mode for the total number of medals won per country. If you do not have enough information, explain what additional information you need to know.

The mean is equal to the total number of medals divided by the total number of countries, which is 258 ÷ 84, or approximately 3 medals per country.

It is impossible to determine the median or mode without knowing the total number of medals won by each of the 84 countries.

b. Do you think the median and the mode will be smaller or larger than the mean? Why?

If 84 countries participated and five countries won 132 out 258 medals, a lot of countries won very few medals. As a result, the median and mode will probably be very small and smaller than the mean.

If you want to be more precise, consider the remaining 79 countries and the remaining 126 medals. Dividing the 126 medals among the 79 countries results in each country winning one or two medals (126 ÷ 79 ≈ 1.59). This would make the median and mode equal to 1 or 2 medals, which is less than the mean of 3 medals.

If the mode were greater than 3 medals, for example 4 medals, more countries would have to win 4 medals than any other number of medals. There are only enough medals remaining for 31 countries to win 4 medals each (31 x 4 = 124). As a result, more of the remaining 79 countries would win 0 medals than 4 medals, so the mode would equal 0 medals. If this were the case, the median would also equal 0 medals. So, the median and mode must be less than the mean.

If you analyze the actual data for all 84 countries, 26 countries won at least one medal. That means 84 – 26, or 58 countries did not win a medal. Therefore, the median and mode both equal 0 medals.

Visit the following website to see the actual medal totals for each participating country:
http://www.vancouver2010.com/

**Further Exploration:**

Visit the following website to see graphic displays of the total number of medals won by each country for each Summer and Winter Olympics since 1896.
http://www.nytimes.com/interactive/2008/08/04/sports/olympics/20080804_MEDALCOUNT_MAP.html

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