

Teacher Guide: Movie Reviewer



Learning Objectives

Students will...

- Calculate the mean of a set of data.
- Understand and interpret mean as a balanced center of data.
- Calculate the median of a set of data.
- Identify outliers and understand their effect on mean and median.



Vocabulary

data, mean, median, outlier



Lesson Overview

In the *Movie Reviewer Gizmo*[™], students explore mean and median by analyzing numerical movie reviews. The Gizmo contains pre-loaded sets of reviews for nine movies. Students can analyze the data as-is, change any reviews, and add or remove reviewers. The Gizmo shows visuals for mean, median, mode, and range.

The Student Exploration sheet contains three activities:

- Activity A – Students explore mean visually and mathematically.
- Activity B – Students explore median visually and mathematically.
- Activity C – Students experiment with outliers and compare mean and median.



Suggested Lesson Sequence

1. **Prior to using the Gizmo** (🕒 10 – 15 minutes)
Before students are at the computers, pass out the Student Exploration sheets and ask them to complete the Prior Knowledge Questions. Have students share answers as a class and lead a discussion on what makes one number a good overall representation of a group of numbers.
2. **Gizmo activity** (🕒 15 – 20 minutes per activity)
 Assign students to computers. Students can work individually or in small groups. Have students work part of the Student Exploration sheet using the Gizmo. Alternatively, you can use a projector and do the Exploration as a teacher-led activity.

It may be overwhelming for students to do all of the activities in the Student Exploration in one sitting. We recommend starting with the first page of the Student Exploration sheet (Prior Knowledge Questions and Gizmo Warm-up) and working through the activities in order. Extend the lesson if you want using the extensions below. Return to the Gizmo and the unused activities in future class periods to reinforce the concepts.

3. **Extending the Gizmo** (🕒 15 – 20 minutes each)
Here are some suggestions for extending the activities in the Student Exploration sheet:

For each of the activity extensions below, have students explore the topics by making sets of data in the Gizmo. In each case, share student responses on the board and have students explain how they came up with their data sets. It is important (and possibly surprising) for students to see that most of the requirements below have many different data sets that satisfy them!

Activity A Extension – Start by having each student make a data set with a mean of 5. Extend the activity by having students make data sets with each of the requirements as shown below. (We recommend that students work with the Gizmo in **Balance** mode selected to help construct these data sets.)

- Make a data set that has a mean of 5 and includes the number 10.
- Find 3 different pairs of numbers that have a mean of 7.
- Using the numbers 6 and 9 find one other number so that the mean of the three numbers is 6.
- Make a data set (without the Gizmo) that has a mean of 20.

Activity B Extension – Start by having students make a data set with a median of 5. Then add the variations below. (We recommend that students use the Gizmo in **Order** mode and with **Find middle rating** checked to help develop these data sets.)

- Make a data set that has a median of 5 and includes the numbers 8 and 9.
- Make a data set in which the median is a number that is not part of the set.
- Make a data set in which the median is not a whole number.
- Make a data set (without the Gizmo) that has a median of 32.

Activity C Extension – To compare mean and median, have students start by creating a data set in which they are the same. Expand the activity by working out the scenarios below, using the Gizmo to help.

- Make a data set with one outlier in which the mean is greater than the median.
- Make a data set with no outliers in which the mean is less than the median.
- Using 10 numbers from 1-10 make a data set in which the difference between the mean and median is as large as possible.

Another way to extend students' work with the Gizmo is class discussion. After students are done with their activity, discuss the following questions:

- How would the mean and median change if the data set 1, 3, 3, 4, 10 were changed to be 1, 3, 3, 4, 5?
- For the data 1, 3, 3, 4, 10, is the mean or median a more "fair" overall score?
- What are some real life examples of data in which there might be outliers?

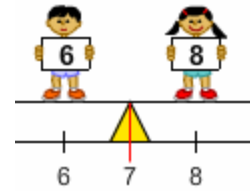
4. **Follow-up activity: Analyzing data** (🕒 30 – 40 minutes)

Have students come up with questions they can ask their classmates that require numeric responses. For example, how many brothers and sisters do you have? Working individually, or in pairs, have students poll their classmates, using their questions and record all responses. Then, each student should calculate the mean and median of their data and present their findings to the class. They should explain which measure they believe best represents their scores better and why.



Mathematical Background

Students should understand mean as the mathematical “center” or balancing point of a set of numbers. This is easily seen in the mean of two numbers. For example, the mean of 6 and 8 is 7 because $\frac{6+8}{2} = 7$. This is clear because 7 is exactly halfway between 6 and 8 on a number line.



In general, to find the mean, add the data together and divide by the number of pieces of data. Every number is used to calculate the mean, so every number has some effect on its value.

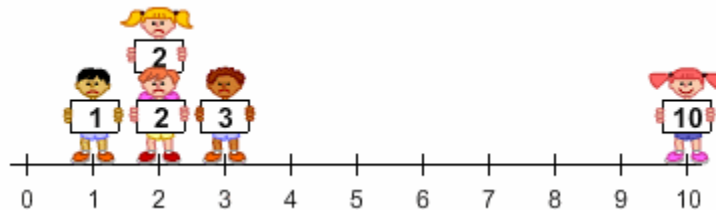
The median is the middle value in a data set. For example, the median of the data set 2, 4, 5, 7, 9 (shown to the right) is 5.



If there is an even number of data values, there is no one number that is perfectly at the middle. In that case, the median is the mean of the *two* center pieces of data. For example, in the

set 2, 4, 5, 7, 9, 10, the median is $\frac{5+7}{2} = 6$.

An outlier is a piece of data that is particularly larger or smaller than the majority of the data. For example, in 1, 2, 2, 3, 10 the number 10 is an outlier. An outlier has an effect on the mean, but not the median. For example, in the data set above, 1, 2, 2, 3, 10 the median is 2 and the mean is 3.6. However, if the data were changed slightly to be 1, 2, 2, 3, 4, the median would still be 2, but the mean would be 2.4.



The effects of outliers become more pronounced if we allow values greater than 10. For example, if a group of students test scores were 0, 90, 95, 98, 99, 99, 100, the median would be 98 and the mean would be 83. In this case, the 0 strongly affects the mean, but doesn't affect the median at all. You could make a strong argument that the median is a more appropriate overall value to summarize the scores than the mean.

It is important to note that the mean and median are both measures of the center of data. For some, “average” is synonymous with mean, but more and more frequently, “average” is being used as a more general term that includes both mean and median. Be careful to be clear about what you mean when you say “average.”



Selected Web Resources

Mean vs. median: <http://standards.nctm.org/document/eexamples/chap6/6.6/index.htm#inst1>

Calculating mean and median: <http://www.purplemath.com/modules/meanmode.htm>

Mean-median calculator: <http://www.easycalculation.com/statistics/mean-median-mode.php>

BBC activity: <http://www.bbc.co.uk/schools/ks2bitesize/maths/activities/modemedianmean.shtml>