

## Median and Mean of a Sample

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**Grade Level:** Probability and Statistics (Grades 11-12)

**Objectives:** The purpose of this lesson is to examine the “meaning” of the location statistics median and mean while introducing the student to the difference between population and sample. At the end of the lesson, the student should be able to:

- Calculate the mean and median of a set of data using the TI-86 LIST and STAT menus
- Analyze what accounts for the differences in the median and mean of a given sample
- Recognize the mean as the “balancing point” of a set of data
- Make inferences from a sample about a population, while recognizing the limitations of the sample

**Materials:** The TI-86 and the accompanying activity worksheet/assignment are the necessary materials for the lesson.

**Role of Technology:** The necessary technology for this lesson is a classroom set of TI-86 calculators. The TI-86 will allow students to quickly calculate the median and mean of a sample, freeing students to interpret the two measures of location and decide which is the appropriate statistic to use with the sample. The use of the LIST menu will allow the student to change a particular value(s) quickly and examine the effects on the median and mean.

**Previous Knowledge Base:** The students will need to have already learned the definitions of median and mean and know how to calculate these by hand. It will also be necessary that the students already know the definition of population. Students need to know how to enter and manipulate lists in the LIST menu of the TI-86 and be capable of using the other four functions of the calculator prior to the lesson.

### LESSON

#### **Set (5-10 Minutes)**

Announce that today the class will be doing a brief statistical analysis of the school population using the median and mean. Ask students to recall the definitions of the median and mean. The students should report that to find the mean, the elements of a list of data are added and then that sum is divided by the size of the list. Similarly, students should report that to find the median, the data must be listed in ascending order and then the value “in the middle” of the list serves as the median.

In applying this to an analysis of the school population, have students decide what they want to measure about the population. It must be a measurable quantity (such as shoe size, number of pets, etc.) and an appropriate one that students will willingly report to the class. After taking a few suggestions from the class, decide the item to be measured.

### **Introduction to Activity (10 minutes)**

Now the concept of a *sample* can be introduced. Tell the students that the class will serve as a sample for the school population. Ask students what they think of when they hear of a sample. Expect an answer such as “a representation of something” (i.e. a sample test question) or some variation on this theme. Direct the students that for us, a sample will be a group that represents a population. Specifically, in today’s investigation, the class will serve as a representation of the school population as a whole. Have each student report on what is being measured (i.e. how many pets he/she has) and list this data clearly on the board.

Students now are informed that they will analyze this sample by calculating the median and mean. Their task will be to decide by the end of the activity which measure of location is the most appropriate one to use as a representation of the population. The students will also think about how “good” of a sample we have used in the activity.

### **Student Investigation (20 minutes)**

Handout the activity worksheet to students. They may work in pairs or individually. Be prepared to float around the classroom to answer students’ questions about the activity. Though the activity is illustrated on the accompanying handout, the following summary highlights the important aspects of the investigation.

The students will enter the data from the board into a list, and then use ONE-VAR under STAT to calculate the mean and median. The students then will report the differences in the two values and speculate what accounts for these differences. They may report that one is larger than the other one. Ideally, students will realize that possible skewed data has influenced these values, and that the mean really is the “balancing point of the data.” However, to emphasize this add a couple of values to the list on the board that “skews” the data in one direction or the other (in other words, create a couple of outliers). Then have the students edit their lists, adjoining these new values. They will then recalculate the median and the mean, and then refine their ideas as to what is affecting the values and why.

The student assignment is to complete the investigation worksheet. The worksheet involves some extension questions about the median, mean, and taking a sample of a population. The students should work on this in class as other students finish and then may take home the worksheet to complete (depending on how much is done in class, the students may have to calculate means/medians either by hand or the long way on another calculator.) When about 10 minutes remain in class, bring the students together for a short closing discussion.

### **Closure (5-10 minutes)**

Ask the students about their findings so far. What are the major differences between the median and the mean? How do these values change when data changes? Have any conclusions been drawn about the “meanings” of the median and mean? Which would you use to accurately report your findings of a study? Again, students’ answers will vary, but students should begin to notice that the median is the balancing point of the particular data set and take into account the outliers of the data. Thus the mean more accurately reflects your observations and data. Now draw the students’ attention to some of the extension homework questions about samples. What conclusions can be drawn about the school population? Is this what is expected? Why? Does

our sample accurately reflect the student population? Students will recognize that our sample wasn't really a "random" sample of the school population. Students will also list reasons why the sample was not random (i.e. all students are juniors/seniors).

The teacher may use remaining time for students to work on the assignment. It should be noted that this activity provides a segueway for further discussion of sampling in future class periods. It may be appropriate to refer back to this activity/worksheet.

Name \_\_\_\_\_

### Mean and Median of a Sample

We will be studying the \_\_\_\_\_ of students in our school. Using our class as a sample, we will attempt to draw a conclusion about the student population as a whole. We will use either the mean or the median of our sample to report our findings.

- Enter the data from the board into a list on the calculator. Give your list a name that is easy to remember.
- Calculate the median and the mean of your list of data. Enter the STAT menu (2<sup>nd</sup> “+”) and then choose CALC (F1) and ONEVA (F1 again). Input the name of your list and push Enter. Several statistics are reported. The mean is  $\bar{x}$  in the calculator. You will need to scroll down to find the median (Med in the calculator).
- Record your findings.

Mean \_\_\_\_\_

Median \_\_\_\_\_

What differences do you find in the median and mean? Can you account for these differences? Explain.

Two new pieces of data will be added to our list on the board. Edit your list by adjoining these two new pieces of data. Then recalculate the median and mean as you did earlier. What effect does this new data have on the mean and median? Why? Explain.

### Assignment

Based on your findings, develop a conjecture as to the “meaning” of the mean and median. What do these values really tell us about a set of data? You may need to do some more exploring to develop your conjecture. Edit the list you have already created several times by adding in new data. Examine the results. Once you have a strong conjecture, be sure to test its accuracy. Write out the conjecture below in complete sentences. (HINT: It is important to keep in mind that the median and mean are measures of *location*.)

You should now summarize the original findings of our study of the student population (use the data from our first list on the board). Answer the following questions with complete sentences.

What can we conclude about the student population at large? Are these the results you expected? Explain.

How accurate is this conclusion? In other words, does our sample effectively represent the student body? If so, why? If not, list as many reasons as you can as to why our class is not an appropriate sample of the school population.

#### **Additional Questions**

1. If you were to report your results to a newspaper, would you report the median or the mean? Why? You may want to refer to your conjecture.
2. Can the median and mean of a sample ever have the same value? If so, describe this situation. If not, why?
3. Our class might serve as a more representative sample for other population. Name the populations and explain your point of view.