Instructional Activity: Mean and Median with Spreadsheets

Scores on a Geography Exam:

1. A college Geography class has 18 students. 17 of the students have taken an exam, but one student was sick and will need to take the exam later. The scores for the 17 students are listed below.

   89, 71, 43, 94, 56, 68, 73, 75, 100, 83, 68, 75, 96, 82, 68, 82, 85

(a) Use an Excel spreadsheet to find the mean and median for the 17 test scores. Round the mean to two decimal places.

Mean: 76.94 Median: 75

(b) Without using trial-and-error, what score will the student who was sick need to make in order to bring the class average (mean) up to 78?

[Hint: How many total points did the original 17 students score? How many total points will the 18 students need in order for the average (mean) to be exactly 78?]

Answer: 96

Explain how you found your answer (without using trial-and-error):

The total points of the original 17 scores is 1308, found using "=SUM(B4:B20)". (This could also be found by multiplying 76.94 by 17.) The total points needed to have an average of 78 for 18 students is 1404 (found by multiplying 78 by 18). Finally, 1404-1308=96.

(c) Round your answers here to 2 decimal places.

How much would the class average (mean) go up if the missing student (i.e., the 18th student) scores 100? 1.28

How much would it go down if the student scores a 0? 4.27

Why does scoring a 0 drag the average down more than scoring 100 would bump it up?

A score of 0 is farther from the class average (76.94) than a score of 100. So the score of 0 is more of an outlier and will have a stronger "pull" on the mean.

Household Income in a Small Town

2. The household incomes of a small town (with only 15 households) are given below. The incomes are rounded to the nearest $1000.

$74,000	$38,000	$58,000
$46,000	$91,000	$79,000
$87,000	$69,000	$1,256,000
$53,000	$87,000	$63,000
$119,000	$136,000	$107,000

*Later, two additional families move into the town who each have $105,000 in household income.

(a) Use an Excel spreadsheet to find the mean and median for the original 15 household incomes in this town.

Mean: ___$157,533___ Median: ___$79,000___

(b) Why is the mean income so much greater than the median income?

There is one household that has $1,256,000 in income, which is far more than all the other households. This one household brings the average (mean) income of the whole town up a lot, but it doesn't have much effect on the median.

(c) Which better represents the household income of the "typical" family in the town: the mean or the median? Why?

The median household income better represents the typical household income because the mean income is skewed so high by the one household with $1,256,000 in income.

(d) Two additional families move into the town who each have $105,000 in household income.

Without doing any calculations on the spreadsheet, will the mean household income of the town increase or decrease? ___decrease___

Will the median income increase or decrease? ___increase___

Explain your reasoning. Since $105,000 is less than the mean income ($157,533), the mean will go down. But since $105,000 is greater than the median income ($79,000), the median will go up.

Now use the spreadsheet to find the mean and median income for the 17 households.

Mean: ___$151,353___ Median: ___$87,000___

Batting Average (Baseball)

3. Suppose a baseball player has 10 at-bats, with 3 of those at-bats resulting in "hits," and 7 resulting in "outs." We say the player has a "batting average" of .300 (because 3/10 = .300).

   In general, a player's **batting average** is calculated as follows:

   (hits) ÷ (at-bats)

   The batting average is expressed using 3 digits past the decimal (i.e., to the nearest thousandth). For example, a player who has 159 hits out of 563 at-bats has a batting average of .282 (because 159/563 = .282, rounded to the nearest thousandth). A typical batting average for a full season (for a Major League Baseball player) is about .260. Anything above .300 is considered to be very good, and anything below .220 is considered to be very bad.

   Is the batting average an "average?" Yes!

   (a) Consider again the player who has 3 hits in 10 at-bats. Suppose the at-bats are as follows, where "1" represents a hit, and "0" represents an out:

   0, 0, 1, 0, 1, 0, 0, 0, 1, 0

   Find the mean of the above 10 numbers: 0.3 (= .300)

   Find the median of the above 10 numbers: 0

   Notice that a batting average is an average (i.e., a mean) of 0's and 1's, where the 0's represent outs and the 1's represent hits.

   Which is a better indicator of how good a hitter is, the *mean* of the 0's and 1's (i.e., the batting average) or the *median*? the mean

   Why? The median will just be 0 for every player whose batting average is below .500 (which is everyone), but the mean tells you how often the player gets a hit.

   (b) Player A has been playing all season and is 100 for 400 (.250 batting average). Player B is new to the team and only has 4 at-bats. That player is 1 for 4 (.250 batting average). Suppose both players get a hit on their next at-bat. What are their new batting averages?

   Player A .252 Player B .400

   Why did Player B's batting average go up more than Player A's?

Player B has fewer at-bats, so each at-bat has more of an impact on the average (mean) than the player with more at-bats.

Questions for Understanding:

4. Provide responses to the following questions:

(a) Suppose a student in a college class has a quiz average of 75%. Which of the following would have a greater effect on the student's quiz average: scoring 100% on the next quiz, or scoring 0% on it? Why?

Scoring 0% will have more of an impact, because 0 is farther from the current average (75) than 100.

(b) Suppose a basketball player has a free throw percentage of 83%. If the player makes 3 of their next 4 free throws, will their free throw percentage go up, or go down? Explain your reasoning.

Their free throw percentage will go down because 3 divided by 4 is .75 (i.e., 75%), and .75 is less than .83.

(c) Suppose a baseball player has a batting average of .296. Which would have a greater effect on the player's batting average: getting one hit out of their next four at-bats, or getting 3 hits out of their next 12 at-bats? Explain your reasoning.

Going 3 for 12 will have more of an impact on their batting average than going 1 for 4 because even though 3/12 and 1/4 are both .250, twelve is greater than four, so the higher number of additional at-bats will have a greater effect (i.e., greater downward "pull") on the batting average.

(d) Which do you expect is higher: mean household income in the U.S., or median household income in the U.S.? Why? Which do you expect would better represent the "typical" household income in the U.S.: the mean, or the median? Why?

The mean income likely will be higher, because some households with very high income will bring the mean up a lot without affecting the median much.