Activity 3 Statistics in Everyday Life

Objectives

- Understand the concepts of mean, median, and mode

- Understand the concept of sampling

- Use observations about differences between samples to make conjectures about the populations involved

- Recognize misleading statistics

- Use mathematics to analyze media messages

Materials	paper, pencils
Time	30–45 minutes
Math Idea	Most people use statistics and know more about statistics than they think they know. Charts of average heights and weights, batting averages, the number of hamburgers sold to date are all examples of statistics we encounter in everyday life. When you refer to information you read about health—for example, that regular exercise reduces the risk of cardiovascular disease—you are relying on statistical analyses from research studies.

Prior Understanding

Students should know how to find the mean, median, and mode for a set of values.

Introduction

You can use or adapt the following scenario as an introduction to the activity.

> *During the baseball strike of 1994, players' annual salaries were constantly being discussed in the media. The average baseball player's annual salary was often quoted as being $1.2 million. If you chose a player at random, would you be guaranteed that he would make $1.2 million a year?*

Discussion

Discuss how useful the salary figure alone is. Ask why someone would choose to report the $1.2 million figure, which represents the mean salary, rather than the **median** salary, which was $500,000.

Knowing the $1.2 million figure alone is not particularly useful, since most people would not know which average measure (**mean**, **median**, or **mode**) was being reported. Knowing that it is the **mean** salary does not guarantee that a randomly selected player will earn that much. A few salaries could be much, much higher and many salaries could be much lower, producing the same **mean**. Someone who wanted the public to believe that baseball players are millionaires would want to report the **mean** salary; however, knowing that the median baseball player's salary was $500,000 tells you that half the players earned less than that amount and half earned more. In this case, the **median** salary is a more accurate portrayal of what the "average" baseball player earns.

Exercise 1

Tell students that you read in the newspaper that the average Harvard graduate from the class of 1990 makes $600,000 a year. Ask students what thoughts first come to mind when they hear this information. Discuss whether they should accept figures quoted in the media on faith.

Discussion

Students should recognize that they should not accept figures on faith. When students encounter statistics, some of the questions they should ask are:

• How were they obtained? Were they derived from a random sample or from a collection of anecdotes?

• How accurate are the figures? Do the figures measure what they purport to measure? Does the correlation suggest a causal relationship or is it merely a coincidence?

• How is the reporter connected to the story? Are there other ways to tally any figures presented? Is the precision of measurements meaningful?

From the Harvard salary information, most students will initially conclude that Harvard graduates make a lot of money, or that they (or their children) should go to Harvard, or something similar. The first item students should question is how representative of the class of 1990 was the sample used.

Students should want to know how the average income of Harvard graduates compares with the average incomes of graduates from

other colleges. If the figures are close to being the same, then perhaps attending Harvard is not an important factor in earning potential.

Suppose the average income reported by the researchers is correct (representative). Should students immediately assume that Harvard is a better college to attend than any other college? What other information would they need?

Suppose researchers learned that the average person who graduated from college in 1990 makes $600,000, how would that change students' assumptions about Harvard?

Exercise 2

Suppose the researchers gathered data by mailing questionnaires to every member of the 1990 graduating class. Discuss some of the potential problems they might have encountered and how these problems might have affected the data they obtained. Discuss whether some of the problems could have been avoided by choosing a random **sample**.

Discussion

Discuss whether students believe that all the graduates are likely complete and return the questionnaires. What are the characteristics of the people who are likely to participate in the survey? Why might some people chose not to participate? Discuss other factors that might make affect the accuracy of this salary figure.

People who are contacted but refuse to participate in the survey could be significantly different from those who do. Students should consider factors such as who would be more likely to disclose his or her income to a stranger—the president of a successful company or

an unpublished poet who works a low-paying job? Students should also consider what incentives might have been offered to get people to participate. Students should realize that the groups discussed above would bring the average annual income level down considerably if they were included in the study. In addition, it would help to know whether the researchers just asked people about their salaries or did they verify the figures somehow. The respondents' self-reported data could have been too high (because of pride) or too low (because they also lied on their income tax reports). In addition, respondents could have had many sources of income other than salary (consulting fees, investments, etc.), and simply estimated inaccurately.

The researchers may not have been able to locate all the members of the class of 1990. The people who could not be located might be significantly different from those who were located; for example, there may be a group of 1990 class members who are homeless, in jail, or are difficult to locate for some similar reason. In terms of income, these people would probably be very different from those who attended class reunions and kept in touch with the college. The same potential problems exist with a random sample. If the researchers only succeed in obtaining responses from 20% of a random sample, the results of the study may not be representative of the population being investigated.

Activity 3 Statistics in Everyday Life Teacher Support

Vocabulary

mean the arithmetic average of a set of numbers

median the middle value in a set of values that have been ar-
ranged in ascending or descending order; the midpoint, or the value
in a distribution above and below which 50% of the values lie

mode the number that occurs most frequently in a set of numbers

sampling the process of selecting a group of people to be used
as representative of an entire population

Ongoing Assessment

Assume that the reported annual average of $600,000 is represen-
tative of the Harvard class of 1990. If you learn that the average 50-
year-old surgeon makes $800,000, and 85% of the Harvard class of
1965 are surgeons, how would this information change your interpre-
tation of the reported figure? *(Students might then say that Harvard
graduates do have high incomes, but their income level is not nec-
essarily related to their attendance at Harvard or the year they at-
tended.)*

Added Practice 3 Statistics in Everyday Life

Name _____ **Date** _____

1.   This week ask your family to help you locate everyday statistics in newspapers or magazines you have at home. Cut out at least one example of statistics used in an article. Read the article with whichever family member is helping you with this project, and try to answer the following questions:

(a) What sample is being used to describe the data? (Who did the researchers interview or survey in order to come up with their data?)

(b) How big is the sample?

(c) Do you think this sample is representative of the overall population being discussed?

(d) What is the conclusion being drawn from the statistics?

(e) How much do you trust the information in this article?

2.   *How much money do you think you need to fulfill your dreams?*

The Roper organization regularly polls Americans on this question. Every year the figures go up, in yearly leaps as great as $18,200. Last year 1,993 people were asked the question, and the *median* sum mentioned was $102,000 a year. However, the number of those requiring a million a year for their dreams had nearly doubled since the year before. Why does this example state the median sum as the average measure?

Answer Key Added Practice 3 Statistics in Everyday Life

1. Answers will vary.

2. The median is probably the most accurate measure of the "average" value. This is true because there are a lot of people who say they would need a very large amount (for example, a million dollars). If the researchers used the mean value, these large amounts would inflate the average to a value that may not be representative of the group as a whole. For example, suppose you were surveying 10 people about the amount of money they would need to fulfill their dreams. If 7 of the 10 reported figure between $100,000 and $150,000 and the other three said that they needed a million dollars, the mean value would be somewhere around $400,000, which is not really representative of the group as a whole, or even the majority of the group. The median value, which would be around $130,000, would be a better approximation of the "average" member of the group.