



Mean and Are They Re

JUDITH S. ZAWOJEWSKI AND J. MICHAEL SHAUGHNESSY

WHEN ARE MEDIAN AND MEAN taught to students in your curriculum? Our first introduction to these terms as students was in college-level statistics courses in the mathematics department. Of course, we had learned to find arithmetic averages during elementary school as an application of long division and again in high school algebra when learning to use variables to represent relationships in equations. One of the authors taught middle school in the 1970s, and the other taught finite mathematics to college students in the 1970s. We were surprised to find these measures of central tendency in the books for middle school and equally surprised that college students had not previously seen median and mode. The procedure for finding the median is much easier than the one for finding the mean, so why not include it in the middle school curriculum? To teach the mean, all we had to say to students was that it was the same as the average that they had already learned in fifth- and sixth-grade mathematics.

Yet, are the concepts really so easy? Do students understand the mean and the median? Do they understand that the median and mean give us information about clustering in a distribution and about centering amid variation and that in some situations one is actually more appropriate to use than the other? Data from the National Assessment of Educational Progress (NAEP) (Brown and Silver 1989; Zawojewski and Heckman 1997; Zawojewski and Shaughnessy in press) over the past fifteen years indi-

cate that middle school students have some difficulty finding the mean and median. Further, results indicate even greater problems in selecting and using the different statistics appropriately and that these difficulties persist into the high school years. Selected insights from different NAEP reports follow:

Most students in the 7th and 11th grades appeared not to understand technical statistical terms such as *mean*, *median*, *mode*, and *range*. However, there is evidence that they could compute the *mean* when asked for the *average* (Brown and Silver 1989, 28).

There is confusion about the meaning of the measures of central tendency, especially that of median, for eighth- and twelfth-grade students (Zawojewski and Heckman 1997, 196)

There was significant growth from 1992 to 1996 in eighth- and twelfth-grade students' performance on NAEP items that required they find the mean and median for particular data sets. However, when given a choice about which statistic to use, students tend to select the mean over the median, regardless of the distribution of the data (Zawojewski and Shaughnessy in press).

Before reading on, have your students respond to the three released NAEP items in **figure 1**. How did your students do on the items? What questions emerge for you as you consider their performance? How can you find out more about what they know and can do? Examine the responses to item 3 in particular. How do students explain their choice of statistic? Do they use the distribution of the data in their explanations, or do they use other reasons?

JUDITH ZAWOJEWSKI, *judiz@purdue.edu*, teaches at Purdue University, West Lafayette, IN 47907. She is particularly interested in students' learning of statistics and number. She currently writes professional development materials based on teachers' assessing their students' understanding. MIKE SHAUGHNESSY, *mike@nth.pdx.edu*, continues to nurture his particular interests in teaching and learning issues surrounding probability and statistics and geometry.

Edited by MARILYN E. STRUCTCHENS, *ms347@umail.umd.edu*, University of Maryland, College Park, MD 20742

Median: ally So Easy?

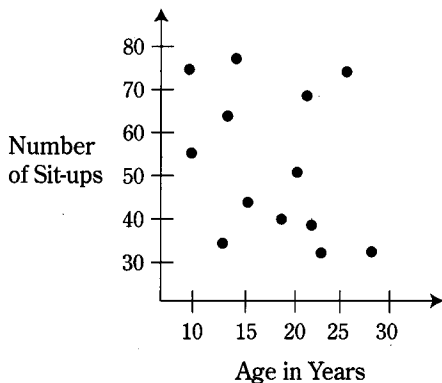
Item 1: Inches of Snow in January

YEAR	INCHES OF SNOW	YEAR	INCHES OF SNOW
1970	15	1978	15
1971	16	1979	17
1972	17	1980	15
1973	15	1981	17
1974	15	1982	16
1975	16	1983	17
1976	16	1984	15
1977	18		

- a. What is the mode? b. What is the median?
c. What is the mean?

Released item from the fourth mathematics assessment in 1985–1986 (Brown and Silver 1989, 28)

Item 2: Number of Sit-ups vs. Age in Years



(Kenney and Silver 1997, 215)

In the graph above, each dot shows the number of sit-ups and the corresponding age for one of 13 people. According to this graph, what is the median number of sit-ups for these 13 people?

- a. 15 b. 20 c. 45 d. 50 e. 55

Released item from the sixth mathematics assessment in 1992 (Zawojewski and Heckman 1997, 215)

Item 3: Movie Theater Attendance

This question requires you to show your work and explain your reasoning. You may use drawings, words, and numbers in your explanation. Your answer should be clear enough so that another person could read it and understand your thinking. It is important that you show *all* of your work.

The table below shows the daily attendance at two movie theaters for 5 days and the mean (average) and the median attendance.

	Theater A	Theater B
Day 1	100	72
Day 2	87	97
Day 3	90	70
Day 4	10	71
Day 5	91	100
Mean (average)	75.6	82
Median	90	72

- (a) Which statistic, the mean or the median, would you use to describe the typical daily attendance for the 5 days at Theater A? Justify your answer.
(b) Which statistic, the mean or the median, would you use to describe the typical daily attendance for the 5 days at Theater B? Justify your answer.

Released item from the seventh mathematics assessment in 1996 (Zawojewski and Shaughnessy in press)

Fig. 1 Released NAEP Items to try with students