

Predict sales trends = Summarize, represent, and interpret data on a single count or measurement variable

Program Task: Predict sales trends.

Program Associated Vocabulary:
SALES GOALS, AVERAGE PRICE

Program Formulas and Procedures:
People in the fields of Marketing and Sales calculate the mean of data sets to determine average sales, satisfaction ratings, and hourly wages of employees. Sometimes certain numbers can “throw off” the average. These numbers are called outliers.

Example:
Ally is a customer service representative at a local car dealership that prides itself in excellent customer service. At the end of each call, customers are asked to rate the customer service representative using a scale of 1-5, with 1 representing poor service and 5 representing excellent service. The data in the table below represents Ally’s ratings for June 1.

4	3	4
5	3	4
4	4	5
1	4	3
4	3	3

Outlier: 1

Mean:
$$\frac{1 + 3 + 3 + 3 + 3 + 3 + 3 + 4 + 4 + 4 + 4 + 4 + 4 + 4 + 4 + 5 + 5}{15} = 3.6$$

Median: 4

The customer service representative goal for customer satisfaction is a mean of 4.

If the manager removes the outlier from the data and reconfigures it, the new number is 3.79. This number is much closer to the goal that Ally has to make for customer service. The outlier in this scenario could be a customer who is unhappy with the answer that was received rather than the manner in which it was handled by Ally.

PA Core Standard: CC.2.4.HS.B.1

Description: Summarize, represent, and interpret data on a single count or measurement variable.

Math Associated Vocabulary:
MEAN, MEDIAN, MODE, OUTLIER

Formulas and Procedures:

Outlier	An extreme value in a set of data which is much higher or lower than the other numbers.
Mean (Average)	The average of set of data that is calculated by dividing the sum of the data by the number of items in the set.
Median	The middle value when data are arranged in numerical order or the average of the two middle numbers when the set has an even number of data items.
Mode	The value that occurs most frequently in a set of data.

Measures of central tendency are mean, median and mode. Outliers affect the mean value of the data but have little effect on the median or mode of a given set of data.

Example:
A student receives a zero on a quiz and subsequently has the following scores:

0, 70, 70, 80, 85, 90, 90, 90, 95, 100

Outlier: 0

Mean:
$$\frac{0 + 70 + 70 + 80 + 85 + 90 + 90 + 90 + 95 + 100}{10} = 77$$

Median: since the data set has 10 values, there are two middle numbers, so one must find the mean of these two values, 85 and 90.

$$\frac{85 + 90}{2} = 87.5$$

Mode: The score 90 occurs more frequently than the other values (three times), so 90 is the mode.

Receiving a zero on a quiz significantly affects a student’s mean, or average. Notice that the outlier had a small effect on the median and mode of the data.

It should be noted that because outliers affect the mean and have little effect on the median, the median is often used to describe “average” income. Often, one hears that the median income for a group is a certain value. Mean is not typically used because outliers, people who make significantly more or make no money at all, affect this measure.

Instructor's Script - Comparing and Contrasting

Outliers are numbers in a data set that are vastly larger or smaller than the other values in the set. Mean, median and mode are measures of central tendency. Mean is the only measure of central tendency that is always affected by an outlier. Mean (the average) is the most popular measure of central tendency. Mode, the value that occurs most frequently, is often not used in applications dealing with money, because values rarely repeat. Mode is applicable to the example on the Marketing side of the T-chart on page one and in that example, the mode would be 4, since that is the rating that Ally received most frequently.

Common Mistakes Made By Students

Calculator error when finding the mean: Students often forget to use parenthesis when finding the mean of a data set. For instance, to find the average of 40 and 50, parenthesis must be used for the sum before dividing by two. Students often enter $40 + 50/2$, which yields an answer of 65 instead of entering $(40 + 50)/2$ which yields the correct answer of 45.

Changing the divisor: When determining how an outlier affects the mean of a data set, the student must find the mean with the outlier, then find the mean again once the outlier is removed. Removing the outlier decreases the number of data by one and therefore you must decrease the divisor. For instance, when you find the mean of 0, 10, 10, 12, 12, you must divide the sum by 5, but when you remove the outlier of 0, you must then divide by 4.

Finding the median of an even set of data: Before beginning to find the the median, students must list the data need in numerical order. Finding the median or middle number of a set of data is simple when there is an odd number of data. When there is an even number, there are two middle numbers, and these numbers must be averaged to obtain the median. For instance, the median of 1, 1, 2, 3, 3 is 2 because 2 is the middle number. If the data set is 1, 2, 3, 3, then 2 and 3 are the middle numbers and must be averaged to obtain the median of 2.5.

CTE Instructor's Extended Discussion

There are many businesses that are affected by outliers in sales, revenue, production, and demand. A great example to share with students would be to discuss the advantages and disadvantages of having a business in a college town. For example, a restaurant located in a college town will experience months during the year that are significantly higher than others and then it will experience months where the sales are significantly lower. During the months of June, July, August, December, and January the business tends to experience extreme dips in sales because the college students are home on break. During these months the business relies on the local population to patronize the restaurant. During the months of September, October, November, February, March, April, and May, the restaurant experiences significantly higher earnings because the student population is in town patronizing the business..

Additional examples of outliers in business would be increased airfare travel in the summer, increased revenue during the months of November and December for retail businesses, and economic fluctuation which cause outliers to occur during the year.

Problems	Career and Technical Math Concepts	Solutions																												
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<p>6. Angela recorded the number of hours she spent watching TV for one week. The results were as follows: 6, 2, 2, 1.5, 3, 2.5, 2. How would removing the outlier affect the mean, median, and mode of the data?</p>																														
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<p>9. How would removing the outlier affect the mean of the following data: 1200, 2400, 2400, 2500 and 9000?</p>		<p>The mean would decrease from 3500 to 2125.</p>																												