Measures of Spread

Learning Goal

Minds on Math

Austin and Zach are in different classes.

Austin's mark was 89%; Zach's, 88%.

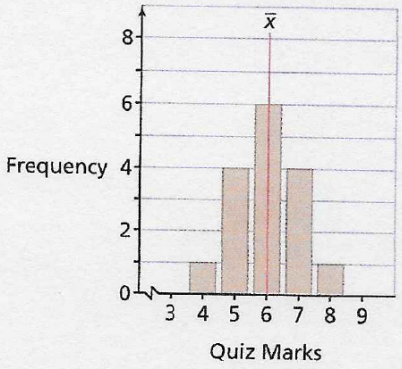
Minds on Math

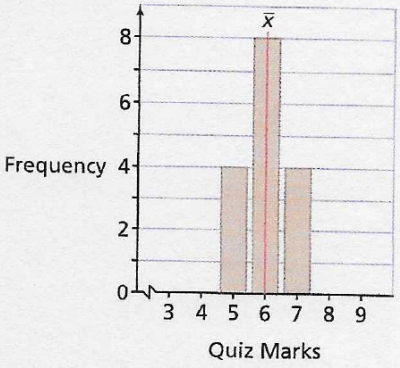
Consider the following scenario:

In a group of test results, how different are the values 80 and 90? To answer the question, one must learn about the distribution of the data. If all the data are clustered around 85, with 80 and 90 at either extreme, the values would be considered very different. On the other hand, if the data values were dispersed from 40 to 100, 80 and 90 would not be so different.

In this section, you will learn how to calculate numerical measures of spread and will use measures of spread to describe data sets.

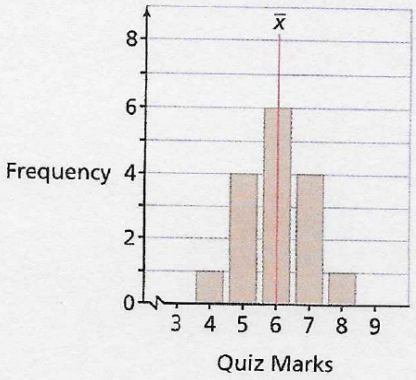
How would you describe the difference between these two data sets?

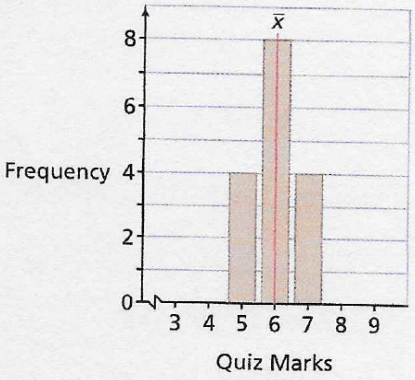




While both have 16 elements and a mean of 6, the data appear more spread out on the left and more tightly clustered about the mean on the right.

The terms *spread*, *dispersion*, and *variation* all refer to a measure of the way a data set is distributed about some central value. These measures will give us another numerical value that will allow us to describe a data set.





Q: Which class is more consistent in achieving the mean quiz score?

One measure that you can calculate and use to determine the degree of variation in a data set is called the ***standard deviation***.

Standard Deviation:

-the typical distance a particular data value is from the mean

-the greater the standard deviation, the greater the spread of the data

Use this definition, as you consider the next example.

Example

Compare Measures of Spread in Two Set of Data

Not all manufactured items will be identical in size or shape. Usually companies have guidelines as to how much an item can vary from the specified measurements. The decision to accept or reject an item depends on whether the item falls within the specified limits of variation.

A company needs bolts for its heavy machinery. The company must choose between two bolt manufacturers: CanInco and QualiTek. Both manufacturers produce bolts with a mean length of 72 mm. According to quality control records, bolts from CanInco have a standard deviation of 2 mm while bolts from QualiTek have a standard deviation of 0.1 mm. Which manufacturer should the company choose?

Pull

Take Action!

How do you calculate the standard deviation?

$$\text{Variance} = \frac{(x_1 - \text{mean})^2 + (x_2 - \text{mean})^2 + (x_3 - \text{mean})^2 + \ldots + (x_n - \text{mean})^2}{n}$$

where $x_1, x_2, x_3, \ldots$ are values in the set of data, and n is the number of values in the set of data.

$$\text{Standard deviation} = \sqrt{\text{variance}}$$

http://www.mathsisfun.com/data/standard-deviation.html#WhySquare

Example: Calculating & Interpreting the Standard Deviation

The following represents the midterm marks for two, first-year college classes.

Class 1	59	79	89	49	71	68	67	48	69	67	75
	82	80	59	58	74	66	90	73	81	59	
Class 2	91	88	50	44	42	88	79	92	83	77	43
	62	98	52	67	84	70	55	89	48		

The mean score and standard deviation for Class 1 is as follows:

mean = 69.7% ; sd = 11.7%

a) Calculate the mean mark for Class 2

Class 2	91	88	50	44	42	88	79	92	83	77	43
	62	98	52	67	84	70	55	89	48		

mean =

b) Use the table below to organize a calculation for the standard deviation for Class 2.

x	x – mean	$(x - \text{mean})^2$
91		
88		
50		
44		
42		
88		
79		
92		
83		
77		
43		
62		
98		
52		
67		
84		
70		
55		
89		
48		

b)

	Mean	**sd**
Class 1	69.7%	11.7%
Class 2		

mean

sd

Practice

p147 #11abc, 12