

Name Answer key

10-1 Measures of Center and Variation

**Measure of center:** a measure that represents the center, or typical value, of a data set. The mean median and mode are measures of center.

**Mean:** the sum of the data divided by the number of data values. The symbol  $\bar{x}$  represents the mean. It is read as "x-bar."

**Median:** the middle number when the values are written in numerical order.

**Mode:** the value or values that occur most often.

**Example 1:** An amusement park hired students for the summer. The students' hourly wages are shown in the table.

Students' Hourly Wages	
\$16.50	\$8.25
\$8.75	\$8.45
\$8.65	\$8.25
\$9.10	\$9.25

a. Find the mean of the hourly wages.

$$\boxed{9.65}$$

$$\frac{77.2}{8}$$

b. Find the median of the hourly wages.

$$\boxed{8.7}$$

c. Find the mode of the hourly wages.

$$\boxed{8.25}$$

d. Which measure of center best represents the data?

median (mean: too high, mode is the lowest)

**Outlier:** a data value that is much greater than or much less than the other values in a data set.

**Example 2:** Consider the data in Example 1. Identify the outlier. How does the outlier affect the mean, median, and mode?

$$\boxed{\$16.50}$$

mean  $\rightarrow$  raises it, almost \$1  
median  $\rightarrow$  none  
mode  $\rightarrow$  none

**Measure of Variation:** a measure that describes the spread, or distribution, of a data set. One measure of variation is the range.

**Range:** the difference of the greatest value and the least value.

**Example 3:** Two reality cooking shows select 12 contestants each. The ages of the contestants are shown in the tables below. Find the range of the ages for each show. Compare your results.

Show A  
 19 - 31  
 12

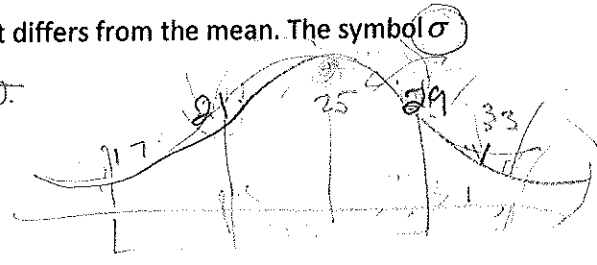
Show B  
 19 - 48  
 29

Ages	
Show A	Show B
20	25
19	20
25	22
27	27
30	48
21	32
29	19
22	27
27	25
29	22
20	21
31	24

**Standard Deviation:** a measure of how much a typical value in the data set differs from the mean. The symbol  $\sigma$  represents the standard deviation. It is read as "sigma."

Steps:

1. Find the mean,  $\bar{X}$
2. Find the deviation of each data value,  $X - \bar{X}$
3. Square each deviation  $(X - \bar{X})^2$
4. Find the mean of the square deviations. This is called the variance.  $(\sigma^2)$
5. Take the square root of the variance.



**Example 4:** Find the standard deviation of the ages for Show A in Example 3. Interpret the standard deviation in the context of the problem.

Variance  $\sigma^2 = \frac{212}{12} = 17.6\bar{6}$  (6 seconds)  
 St. Deviation  $\sigma \approx 4.2$   
 15/6  
 12 | 9 | 6

$X$	$\bar{X}$	$X - \bar{X}$	$(X - \bar{X})^2$
20	25	-5	25
29		4	16
19		-6	36
22		-3	9
25		0	0
27		2	4
27		2	4
29		4	16
30		5	25
20		-5	25
21		-4	16
31		6	36

Total: 0 212  
 always 0

can do in calc, too!

**Data Transformation:** a procedure that uses a mathematical operation to change a data set into a different set.

**Data Transformations Using Addition:** When a real number  $k$  is added to each value in a numerical data set the measures of center of the new data set can be found by adding  $k$  to the original measures of center, and the measures of variation of the new data set are the same as the original measures of data.

**Data Transformations Using Multiplication:** When each value in a numerical data set is multiplied by a real number  $k$ , where  $k > 0$ , the measures of center and variation can be found by multiplying the original measures by  $k$ .

**Example 5:** Consider the data in Example 1.

a. Find the mean, median, mode, range, and standard deviation when each hourly wage increases by \$0.50.

mean: \$10.15  
median: \$9.20  
mode: \$8.75

	17	$x - \bar{x}$	
$\frac{81.8}{8}$	9.25	6.85	46.9225
	9.15	-0.9	0.81
	9.6	-1	1
	8.75	-0.55	0.3025
	8.95	-1.4	1.96
	8.75	-1.2	1.44
	8.75	-1.4	1.96
	9.75	-0.4	0.16
		0	54.555
			6.819375

$V: \sigma^2 \approx 6.819375$

SD:  $\sigma \approx 2.61139$  (by hand)

$\sigma = 2.7917$  (by calc)

b. Find the mean, median, mode, range, and standard deviation when each hourly wage increases by 10%.

18.15, 9.075  
9.625, 9.295  
9.515, 9.075  
10.01, 10.175

(Did all in calc this time)

mean: \$10.615  
median: \$9.57  
mode: \$9.075

SD: 3.0709



## 10-1 Measure of Center and Variance Homework

1. Find the mean, median, and mode of each data set. Then, determine which measure of center best represents the data. Explain.

a. 3, 5, 1, 5, 1, 1, 2, 3, 15

mean = 4      median, b/c of  
 med = 3      the outlier  
 mode = 1

b. 13, 30, 16, 19, 20, 22, 25, 31

mean : 22      mean (but  
 med : 21      could argue  
 mode : none      either)

2. The table shows the daily changes in the value of a stock over 12 days.

a. Find the mean, median, and mode of the changes in stock value.

Changes in Stock Values			
1.05	2.03	-13.78	-2.41
2.64	0.67	4.02	1.39
0.66	-0.28	-3.01	2.20

mean  $\approx -4.0167$ med  $\approx .86$ mode  $\approx$  none

b. Which measure of central tendency best represents the data? Explain.

If you say mean: b/c overall, you lost \$ over 12 days, so average change is negative.

If you say med: b/c you gained 8/12 days so tendency is pos.

c. On the 13<sup>th</sup> data, the value of the stock increases by \$4.28. How does this additional value affect the mean, median, and mode? Explain.

Each will increase in value by \$4.28

3. Find the value of x in each of the following.

a. 12.5, -10, -7.5, x; the mean is 11.5

$$\frac{12.5 + (-10) + (-7.5) + x}{4} = 11.5$$

$$x - 5 = 46$$

$$\boxed{x = 51}$$

b. 30, 45, x, 100; the median is 51

$$\frac{45 + x}{2} = 51$$

$$45 + x = 102$$

$$\boxed{x = 57}$$

4. The masses of eight polar bears in kilograms are 455, 262, 471, 358, 364, 553, 62, and 351. Identify the outlier. How does the outlier affect the mean, median, and mode?

62, 262, 351, 358, 364, 455, 471, 553.

↑ found him!

mean: lowers it by  $\approx 40$  lbs (402  $\rightarrow$  359.5)

med: lowers it by  $\approx 3$  lbs (364  $\rightarrow$  361)

mode: none exists

5. The scores of two golfers are shown.

a. Find the range of the scores for each golfer.

$$A: 98 - 83 = 15$$

$$B: 94 - 87 = 7$$

Golfer A	Golfer B
83	89
88	93
84	92
95	88
91	89
89	87
90	95
87	94
98	91
95	92

b. Find the standard deviation for Golfer A. Interpret your result.

$$\sigma = 4.876$$

wider range  
wider deviations from mean

c. Find the standard deviation for Golfer B. Interpret your result.

$$\sigma = 2.667$$

narrower range  
narrower deviations from mean

d. Compare the standard deviations for Golfer A and Golfer B. What can you conclude?

See above

6. Find the mean, median and mode of the data set after the given transformation.

a. In Question #1a, each data value increases by 4.

mean: 8

med: 7

mode: 5

b. In Question #1b, each data value increases by 20%.

mean: 26.4

med: 25.2

mode: none