

## 0-9 Measures of Center, Spread, and Position

**Find the mean, median, and mode for each set of data.**

1. number of pages in each novel assigned for summer reading:  
224, 272, 374, 478, 960, 394, 404, 308, 480, 624

**SOLUTION:**

To find the mean divide the sum of all the pages divided by the total of novels.

$$\begin{aligned} \text{mean} &= \frac{224+272+374+478+960+394+404+308+480+624}{10} \\ &= \frac{4518}{10} \\ &= 451.8 \text{ pages} \end{aligned}$$

To find the median. First arrange the page numbers in order.

224, 272, 308, 374, 394, 404, 478, 480, 624, 960.

Because there is an even number of pages, find the mean of the middle two.

$$\begin{aligned} \text{median} &= \frac{394+404}{2} \\ &= \frac{792}{2} \\ &= 396 \text{ pages} \end{aligned}$$

The mode is the value that occurs the most often in the data set. There is not a repetitive number of pages, so there is no mode.

3. number of text messages sent each day during the last two weeks:  
18, 35, 53, 44, 26, 57, 23, 27, 47, 33, 4, 35, 39, 41

**SOLUTION:**

To find the mean, divide the sum of number of all text messages divided by the 14 days.

$$\begin{aligned} \text{mean} &= \frac{18+35+53+44+26+57+23+27+47+33+4+35+39+41}{14} \\ &= \frac{482}{14} \\ &\approx 34.4 \text{ text messages} \end{aligned}$$

To find the median, arrange the values in order.

4, 18, 23, 26, 27, 33, 35, 35, 38, 47, 41, 44, 53, 57.

Because there is an even number of values, find the mean of the middle two values.

$$\begin{aligned} \text{median} &= \frac{35+35}{2} \\ &= \frac{70}{2} \\ &= 35 \text{ text messages} \end{aligned}$$

The mode is the value that occurs the most often in the data set. In this case, it is 35 text messages.

**State whether the data in sets A and B represent *sample* or *population* data. Then find the range, variance, and standard deviation of each set. Use the standard deviations to compare the variability between the data sets.**

Number of Sponsors Obtained by Participants					
Charity Walk A			Charity Walk B		
44	14	61	8	28	15
22	27	25	100	42	19
38	50	49	25	75	82

5.

**SOLUTION:**

9 sponsors for Walk A and Walk B are given. A charity walk will have more than 9 walkers; the data given is for a sample.

Walk A: 47,  $\approx 242.0$ ,  $\approx 15.6$ ;

Walk B: 92,  $\approx 1115.4$ ,  $\approx 33.4$ ;

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The range is the difference between the greatest and least values in the set.

Walk A:  $61 - 14 = 47$  sponsors

Walk B:  $100 - 8 = 92$  sponsors

In order to find the variance and standard deviation, the mean is needed.

mean Walk A

$$= \frac{44+14+61+22+27+25+38+50+49}{9}$$

$$= \frac{330}{9}$$

$\approx 36.7$  sponsors

$x$	$x - \bar{x}$	$(x - \bar{x})^2$
44	$44 - 36.7 = 7.3$	$7.3^2 = 53.29$
14	$14 - 36.7 = -22.7$	$(-22.7)^2 = 515.29$
61	$61 - 36.7 = 24.3$	$24.3^2 = 590.49$
22	$22 - 36.7 = -14.7$	$(-14.7)^2 = 216.09$
27	$27 - 36.7 = -9.7$	$(-9.7)^2 = 94.09$
25	$25 - 36.7 = -11.7$	$(-11.7)^2 = 136.89$
38	$38 - 36.7 = 1.3$	$1.3^2 = 1.69$
50	$50 - 36.7 = 13.3$	$13.3^2 = 176.89$
49	$49 - 36.7 = 12.3$	$12.3^2 = 151.29$
		Sum = 1936.01

The variance of Walk A is  $\frac{1936.01}{8} = 242.0$  sponsors

The standard deviation of Walk A is  $\sqrt{242.0} = 15.6$  sponsors

mean Walk B

$$= \frac{8+28+15+100+42+19+25+75+82}{9}$$

$$= \frac{394}{9}$$

$\approx 43.8$  sponsors

$x$	$x - \bar{x}$	$(x - \bar{x})^2$
8	$35 - 43.8 = -35.8$	$(-35.8)^2 = 1281.64$
28	$50 - 43.8 = -15.8$	$(-15.8)^2 = 249.64$
15	$32 - 43.8 = -28.8$	$(-28.8)^2 = 829.44$
100	$31 - 43.8 = -56.2$	$56.2^2 = 3158.44$
42	$35 - 43.8 = -1.8$	$(-1.8)^2 = 3.24$
19	$45 - 43.8 = -24.8$	$(-24.8)^2 = 615.04$
25	$45 - 43.8 = -18.8$	$(-18.8)^2 = 353.44$

75	$49 - 43.8 = 31.2$	$31.2^2 = 973.44$
82	$45 - 43.8 = 38.2$	$38.2^2 = 1459.24$
		Sum = 8923.56

The variance of Walk B is  $\frac{8923.56}{8} = 1115.4$  sponsors

The standard deviation of Walk B is  $\sqrt{1115.4} = 33.4$  sponsors

Since the sample standard deviation of Walk B is greater than that of Walk A, there is more variability in the number of sponsors obtained by participants in Walk B than in Walk A.

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Find the minimum, lower quartile, median, upper quartile, and maximum of each data set. Then interpret this five-number summary.

Number of Students in Each Math Class at Central High							
25	27	26	26	19	27	24	23
24	26	18	28	29	29	26	24
19	28	25	24	20	22	22	
24	23	23	25	25	29	28	

7.

**SOLUTION:**

Enter the data into **L1**.

Press **STAT** **▶** **ENTER** to display the 1-Var statistics.

```
1-Var Stats
↑n=30
minX=18
Q1=23
Med=25
Q3=27
maxX=29
```

The minimum is 18.

The lower quartile is 23.

The median is 25.

The upper quartile is 27.

The maximum is 29.

There are 18 students in the smallest math class at Central High and 29 students in the largest class. 25% of the classes have less than 23 students, 50% of the classes have less than 25 students, and 75% of the classes have less than 27 students.

**Identify any outliers in each data set, and explain your reasoning. Then find the mean, median, mode, range, and standard deviation of the data set with and without the outlier. Describe the effect on each measure.**

9. fuel efficiency in miles per gallon of 15 randomly selected automobiles:  
40, 36, 29, 45, 51, 36, 48, 34, 36, 22, 13, 42, 31, 44, 32, 34

**SOLUTION:**

Enter the data into **L1**.

**Keystrokes:** **STAT** **▶** **ENTER**

Use the 1-Var statistics to identify  $Q_1$  and  $Q_3$ .

```
1-Var Stats
↑n=16
minX=13
Q1=31.5
Med=36
Q3=43
maxX=51
```

$Q_1 = 31.5$  and  $Q_3 = 43$ .  $IQR = Q_3 - Q_1$  or  $43 - 31.5 = 11.5$ .

Find and use the IQR to find the values beyond which any outlier would lie.

$Q_1 - 1.5(IQR)$  and  $Q_3 + 1.5(IQR)$

$31.5 - 1.5(11.5)$        $43 + 1.5(11.5)$   
14.25                      60.25

The only outlier on the low end is 13. There are no outliers on the upper end.

With outlier:

```
1-Var Stats
x̄=35.8125
Σx=573
Σx²=21909
Sx=9.620940702
σx=9.315435779
↓n=16
```

Without outlier:

```
1-Var Stats
x̄=37.33333333
Σx=560
Σx²=21740
Sx=7.715167498
σx=7.453559925
↓n=15
```

```
1-Var Stats
↑n=15
minX=22
Q1=32
Med=36
Q3=44
maxX=51
```

## 0-9 Measures of Center, Spread, and Position


Data Set	Mean	Median	Mode	Range	Standard Deviation
with outlier	≈35.8	36	36	38	≈9.3
without outlier	≈37.3	36	36	29	≈7.5

Removing the outlier did not affect the median or mode. However, the removal did affect the mean, standard deviation, and range. The mean and standard deviation increased, and the range decreased.

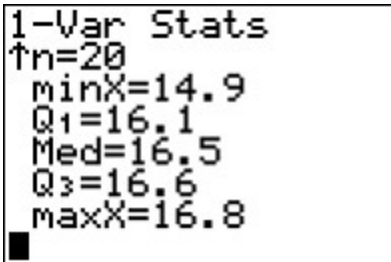
11. **CEREAL** The weights, in ounces, of 20 randomly selected boxes of a certain brand of cereal are shown.  
 16.7, 16.8, 15.9, 16.1, 16.5, 16.6, 16.5, 15.9, 16.7, 16.5,  
 16.6, 14.9, 16.5, 16.1, 15.8, 16.7, 16.2, 16.5, 16.4, 16.6
- Identify any outliers in the data set, and explain your reasoning.
  - If the outlier was removed and an additional cereal box that was 17.35 ounces was added, would this value be an outlier of the new data set? Explain.
  - What are some possible causes of outliers in this situation?

**SOLUTION:**

- Enter the data into **L1**.

**Keystrokes:**   

Use the 1-Var statistics to identify  $Q_1$  and  $Q_3$ .



$Q_1 = 16.1$  and  $Q_3 = 16.6$ .  $IQR = Q_3 - Q_1$  or  $16.6 - 16.1 = 0.5$ .

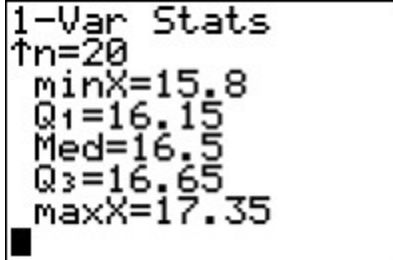
Find and use the IQR to find the values beyond which any outlier would lie.

$$Q_1 - 1.5(IQR) \quad \text{and} \quad Q_3 + 1.5(IQR)$$

$$16.1 - 1.5(0.5) \quad 16.6 + 1.5(0.5)$$

$$15.35 \quad 17.35$$

The interval beyond which any outliers would lie is  $15.35 < x < 17.35$ . Since  $14.9 < 15.35$ , it is an outlier.



b.

$Q_1 = 16.15$  and  $Q_3 = 16.65$ .  $IQR = Q_3 - Q_1$  or  $16.65 - 16.15 = 0.5$ .

Find and use the IQR to find the values beyond which any outlier would lie.

$$Q_1 - 1.5(IQR) \quad \text{and} \quad Q_3 + 1.5(IQR)$$

$$16.15 - 1.5(0.5) \quad 16.65 + 1.5(0.5)$$

$$15.4 \quad 17.4$$

The new interval beyond which any outliers would lie would be  $15.4 < x < 17.4$ . Since  $17.4 > 17.35$ , it would not be an outlier.

- Outliers can be caused by data recording errors or manufacturing errors.