

# 12.3

## Range and Outliers

### Focus on...

After this lesson, you will be able to...

- determine the range for data sets
- identify outliers in data sets

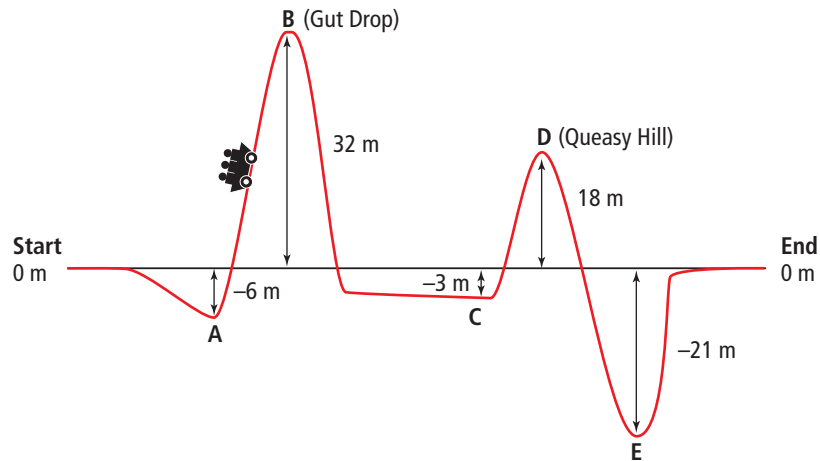


The wooden roller coaster at Playland in Vancouver was built in 1958. It is one of the oldest wooden roller coasters that is still in use. Most newer roller coasters are made of steel.

### Discuss the Math

#### How can the largest and smallest values be used to describe a set of data?

The following diagram shows the elevation changes for the Stomach Bender roller coaster. The measurements represent the heights of the roller coaster relative to the starting point of the ride.



- Copy the table below into your notebook.

Location Along Ride	Start	A	B	C	D	E	End
Elevation Relative to Starting Point (m)							

2. Fill in the elevations at each point.
3. a) What is the largest value?  
b) What is the smallest value?  
c) What is the **range** of heights for the roller coaster?
4. Do you think there are any **outliers** in the set of 7 locations on the roller coaster? If so, what are they?

### range

- the positive difference between the largest and smallest values in a data set

### outlier

- a value that is much smaller or larger than the other data values
- a data set may have one or more outliers or no outliers

## Reflect on Your Findings

5. How would you use the highest and lowest values of a data set to help you describe the data?

## Example 1: Calculate the Range

A hospital recorded the following number of births one week.

Day	Mon	Tues	Wed	Thurs	Fri	Sat	Sun
Number of Births	7	10	4	6	7	8	3

- a) What is the highest number of births?
- b) What is the lowest number of births?
- c) What is the range of the data?

### Solution

- a) The highest number of births is 10 births on Tuesday.
- b) The lowest number of births is 3 births on Sunday.
- c) The range is calculated by subtracting the lowest value from the highest value.

$$\begin{aligned}
 \text{Range} &= \text{highest value} - \text{lowest value} \\
 &= 10 - 3 \\
 &= 7
 \end{aligned}$$



## Show You Know

What is the range of each set of values?

- a) 7, 4, 3, 6, 2, 5, 8, 3
- b) 11, 8, 8, 5, 7, 6, 7, 6, 6
- c) -4, 3, -1, 0, 2

## Example 2: Identify Outliers in a Data Set

In the 1985–1986 NHL hockey season, Wayne Gretzky set a record for the most points (goals + assists) recorded during a single regular season. The following table shows the top five point leaders for the 1985–1986 season and the 2005–2006 season.

NHL Point Leaders			
1985–1986 Season	Points	2005–2006 Season	Points
Wayne Gretzky	215	Joe Thornton	125
Mario Lemieux	141	Jaromir Jagr	123
Paul Coffey	138	Alexander Ovechkin	106
Jari Kurri	131	Dany Heatley	103
Mike Bossy	123	Daniel Alfredsson	103

- Determine the range for each season. Compare the two ranges.
- Which data value appears to be an outlier in one of the two seasons?
- Remove the outlier and determine the new range for that season. Compare the new range with the range from the other season.

### Solution

- a) 1985–1986 Season:

215 is the highest value, and 123 is the lowest value

$$\begin{aligned}\text{Range} &= 215 - 123 \\ &= 92\end{aligned}$$

2005–2006 Season:

125 is the highest value, and 103 is the lowest value

$$\begin{aligned}\text{Range} &= 125 - 103 \\ &= 22\end{aligned}$$

The ranges are very different: 92 and 22.

- b) The outlier appears to be Gretzky's 215 points in the 1985–1986 season.

- c) The new highest value is 141.

$$\begin{aligned}\text{The new range} &= 141 - 123 \\ &= 18\end{aligned}$$

The two ranges are more comparable in size: 22 and 18.

### Show You Know

What value(s) appear to be outliers in each set of data?

- 18, 19, 79, 17, 20, 12
- 14, 14, 16, 15, 1, 16
- 98, 202, 99, 91, 2, 95, 89, 88, 94

## Key Ideas

- The range provides information about the spread of the data.  
Range = highest value – lowest value
- Outliers are values that are very different from the rest of the numbers in a set of data. A data set can have no outliers, or one or more outliers.

## Communicate the Ideas

1. In your own words, explain the meaning of range and outliers.
2. How can you determine the smallest value in a data set if you are given the range and the largest value? Use an example to explain your response.

## Practise

For help with #3 to #5, refer to Example 1 on page 435.

3. What is the range of each set of data?
  - a) 11, 8, 7, 10, 6, 5, 18, 13
  - b) 4, -5, 3, -2, 0, 7
4. Determine the range of each set of data.
  - a) 16, 11, 7, 29, 31, 18, 21, 18
  - b) 7, 1, -1, -2, 9, -7, 4
5. Leanne timed how long she could hold her breath while swimming under water. She recorded the following timings, in seconds: 47, 55, 42, 65, 61  
What is the range of the data?

For help with #6 to #8, refer to Example 2 on page 436.

6. What value(s) appear to be outliers in each set of data?
  - a) 6, 9, 9, 37, 8, 7
  - b) 24, 34, 46, 26, 32, 43, 115
  - c) 48, 32, 67, 61, 47, 95, 89, 888, 1

7. Identify any possible outlier(s) in each set of data.
  - a) 666, 11, 9, 12, 8, 13, 10
  - b) 43, 54, 62, 64, 0, 211, 45
  - c) 82, 75, 76, 85, 89, 95, 92, 88, 80
8. Curb-cut ramps are often built at intersections to allow wheelchairs and strollers to cross streets more easily. In one town, a study was done to count the number of curb-cuts at ten random intersections. The results for five different neighbourhoods are given:  
9, 8, 8, 1, 7
  - a) What is the range?
  - b) Which data value may be an outlier?
  - c) If you remove the outlier, what is the new range?



## Apply

9. Vincent received a 200-piece jigsaw puzzle for his birthday. The following times indicate how long it took him to complete the puzzle the first six times he did it:

54 min, 36 min, 34 min, 29 min,  
27 min, 28 min

- What is the range?
  - Which time may be an outlier?
  - Why might this particular value be so different from the others?
  - If you remove the outlier, what is the new range?
10. The following table shows the mean high temperature for each month in Whitehorse, Yukon Territory.

Month	Mean Temp.
January	-13°C
February	-7°C
March	-1°C
April	6°C
May	13°C
June	18°C
July	20°C
August	18°C
September	12°C
October	4°C
November	-5°C
December	-11°C

- What is the highest value?
- What is the lowest value?
- What is the range of the data?

11. The table gives the mean number of wet days per year for several locations across Canada. What is the range of wet days?

Location	Mean Number of Wet Days
St. John's	217
Halifax	170
Fredericton	156
Toronto	139
Winnipeg	119
Regina	109
Edmonton	123
Vancouver	164
Whitehorse	122
Yellowknife	118

12. The table gives the magnitudes of five of the largest earthquakes that have occurred in western Canada.

Location	Date	Magnitude
West of Vancouver Island, BC	Jan 26, 1700	9.0
South of Hope, BC	Dec 14, 1872	7.4
West Coast of Vancouver Island	Dec 6, 1918	7.0
Central Vancouver Island	June 23, 1946	7.3
Queen Charlotte Islands, BC	Aug 22, 1949	8.1

Magnitude refers to the relative size of an earthquake. Magnitude measurements are recorded using the Richter scale, which is a special scale that goes from 0 to 10. What is the range of magnitudes of the five earthquakes in the table?

### WWW Web Link

To learn more about earthquakes in Canada, go to [www.mathlinks7.ca](http://www.mathlinks7.ca) and follow the links.



- 13.** Final times, in minutes, for the top ten contestants in a race were 55.2, 56.7, 56.9, 57.3, 58.8, 58.9, 59.2, 59.3, 59.3, and 59.7.
- What is the range of times?
  - Do you think this set of data contains any outliers? Explain.

### Extend

- 14.** A data set contains five numbers: 12, 20, 18, 15, 5
- Determine the range, median, mode, and mean of the data set.
  - Add 10 to each of the five numbers and recalculate the range, median, mode, and mean. How do your answers compare with your answers to part a)?
  - Multiply the numbers in the original data set by 10 and calculate the new measures of central tendency. How do your answers compare with your answers to part a)?
- 15.** Five students competed in a pie-eating contest.
- The range of times for the group to finish eating their pies was 9 min.
  - The least amount of time it took for someone to finish their pie was 1 min.
  - The mode was 4 min.
  - One boy took 2 min more than the median.
- What are the finishing times for the five contestants?

- What was the mean number of minutes it took the five contestants to eat their pies?
- What strategy did you use to determine the mean?

- 16.** Conduct the following experiment to simulate rolling two 10-sided dice each numbered from 0 to 9.

- Randomly choose a page from your textbook.
- Calculate the sum of the last two digits of the page number. For example, for page 108 you would add 0 and 8 to get 8.
- Randomly choose 49 more pages for a total of 50 pages.
- Copy and complete the frequency table.

Sum	Tally	Freq.	Sum	Tally	Freq.
0			10		
1			11		
2			12		
3			13		
4			14		
5			15		
6			16		
7			17		
8			18		
9			19		

- What is the mode?
- What is the mean?
- What is the median?
- What is the range?
- Why are there no tally marks on 19?

## MATH LINK

Measure and record the heights of ten people in your class, including your teacher.

- What is the range of heights?
- Identify any possible outliers.