3.6 Mean, Median, and Mode

You will need
- a calculator

GOAL
Describe data using the mean, median, and mode.

Learn about the Math

Asha, Peter, and Winnie are the captains of the school math teams. They wrote all their contest results in this table.

Team Captain	Contest								
	# 1	# 2	# 3	# 4	# 5	# 6	# 7	# 8	# 9
Asha	82	82	88	100	74	81	87	83	83
Peter	84	84	90	71	78	87	89	88	86
Winnie	85	85	85	81	81	85	82	85	83

? Why is it difficult to determine which is the top math team?

A. Use a calculator to calculate the **mean** for each team. Round your answer to one decimal place. Which is the top math team based on the mean?

B. Determine the **median** mark for each team. Which is the top math team based on the median mark?

C. Determine the **mode**. Which is the top math team based on the mode?

D. Using the mean, median, and mode, which do you think is the top math team? Why might someone else disagree?

mean
the sum of a set of numbers divided by the number of numbers in the set

median
the middle value in a set of ordered data; when there is an even number of numbers, the median is the mean of the two middle numbers

mode
the number that occurs most often in a set of data; there can be more than one mode or there might be no mode

Reflecting

1. The mean, median, and mode are all used to determine similar information. What do they all measure?

2. If you were asked to determine the most common hair colour in your class, why is only one of the mean, median, or mode possible to use?

NEL

Work with the Math

Example 1: Using a stem-and-leaf plot to calculate the median

Kwami, Indira, and Simon planted seeds as part of their science project. They waited two weeks and then measured the heights of the seedlings. How can they determine the average height?

Kwami, Indira, and Simon's Solution

Height of Plants (cm)	
Stem	**Leaf**
3	9
4	2 4 4 7 7 7
5	0 9 9
6	1 4
7	3 5 6 7
8	7 8 9
9	0 0 2 8 8 8
10	5 8
11	2 6
12	0

We constructed a stem-and-leaf plot to display the measurements.

We decided to use the median as the average height. The median is the number in the middle.

Since there are 30 numbers, the median is the number halfway between the 15th and 16th numbers.

The 15th number is 76.

The 16th number is 77.

$(76 + 77) \div 2 = 76.5$

The median height of the plants is 76.5 cm.

Example 2: Using a spreadsheet to determine the mean

For their science project, Mohammed and Marie wanted to know how the amount of water affects the growth of flower seeds. How can they use a spreadsheet program to analyze their data?

Mohammed and Marie's Solution

	A	B	C	D	E	F
1	Amount of water	Height of plant A (cm)	Height of plant B (cm)	Height of plant C (cm)	Height of plant D (cm)	Mean height (cm)
2	no water	2	2.5	1.5	2	=AVERAGE (B2:E2)
3	lightly watered	20	34	28	33	=AVERAGE (B3:E3)
4	moderate watering	74	84	66	82	=AVERAGE (B4:E4)
5	heavy watering	17	8	23	4	=AVERAGE (B5:E5)

There's no mode in our results.

The median doesn't seem useful because there are big gaps between some numbers.

We decided to use the mean. To find the mean, we entered a formula in each row of the spreadsheet.

A Checking

3. Calculate the mean, the median, and the mode for each set of data.

a) 5, 8, 4, 8, 7, 8, 6, 10

b) 4, 5, 7, 10, 7, 2, 5, 7

c) 18, 22, 22, 17, 30, 18, 12

d) 5, 5, 5, 0, 5, 10, 10

B Practising

4. Calculate the mean for each set of data.

a) 23, 52, 40, 23, 56, 96

b) 208, 112, 321, 207, 308, 171

c) 6.2, 7.4, 6.74, 8.33, 8.8, 3.2

d) 55%, 58%, 92%, 74%, 63%, 78%

e) 42, 84, 99, 103, 33, 61

5. Calculate the median for each set of data.

a) 4, 8, 2, 9, 3, 3, 0

b) 32, 88, 13, 54, 84

c) 80%, 69%, 72%, 86%, 91%, 42%

d) 312, 221, 873, 992, 223, 224

e) 5.40, 2.88, 1.71, 3.50, 9.02

6. Determine the mode for each set of data.

a) 7, 8, 9, 9, 8, 6, 6, 9, 8, 4

b) 18, 19, 19, 12, 17, 16, 18, 18, 12, 16

c) 4.3, 7.1, 8.8, 7.1, 7.2, 7.6, 4.3, 7.1, 8.8, 7.0

d) B, G, F, G, G, A, F, F, C, D

e) 93%, 75%, 61%, 93%, 75%, 93%

7. Suppose that you are planning a winter vacation. You want to spend a lot of time outdoors, so you are checking the "average" temperature in different locations. Would you prefer to have the "average" temperature reported as a mean, a median, or a mode? Why?

8. Andrew is conducting a survey to determine the most common eye colour. Why does he need to use the mode, not the mean or the median, to analyze his results?

9. Chocolate bars are on sale for the prices shown in this stem-and-leaf plot.

Cost of a Chocolate Bar (in cents) at Several Different Stores

Stem	Leaf
7	7
8	5 5 7 8 9
9	3 3 3
10	0 5

a) Calculate the mean, median, and mode prices for the chocolate bars.

b) Which measure (mean, median, or mode) do you think is the most appropriate for analyzing this set of data? Why?

10. The following table shows the number of picture books that Grade 7 students read to their Grade 1 reading buddies during the first three months of the year.

Number of Books Read So Far This Year

Student	Tally	Frequency
Maryann	𝍸 𝍸 𝍸 𝍸 |	21
Rachel	𝍸 𝍸 𝍸 |||	18
Peter	𝍸 𝍸 𝍸	
Raj	𝍸 𝍸 𝍸 ||||	
Terry	𝍸 𝍸 𝍸 ||||	
Sam	𝍸 𝍸 |||	
Petra	𝍸 𝍸 𝍸 ||||	
Shioban	𝍸 𝍸 𝍸 ||	
Alex	𝍸 𝍸 ||	
Suki	𝍸 𝍸 𝍸 ||||	

a) Complete the frequency table.

b) What is the mean, median, and mode number of books read by all the students?

11. The ages, in years, of the members of a children's choir are listed below.

9	10	11	7	14	11
10	8	7	7	11	11

a) Calculate the mean, median, and mode for the ages.

b) If two new 7-year-olds join the choir, how do the mean, median, and mode change?

12. If the mean of six numbers is 48, does one of the numbers have to be 48? Explain why or why not. Give an example with six numbers to show your answer.

13. A company employs 16 people. The chief executive earns $200 000 a year, the director earns $150 000, the two supervisors earn $100 000 each, the four managers earn $50 000 each, and the eight factory workers earn $35 000 each.

a) Calculate the mean, median, and mode salary for the company.

b) If the director wants to attract new factory workers, how should she report the "average" salary?

c) If one of the factory workers wants a raise, should he use the mean, the median, or the mode to justify his demands?

d) Which measure (mean, median, or mode) best describes the "average" salary at this company? Explain your answer.

14. We often use the word "average" when we are referring to something that is the most common or frequent. In each phrase below, does "average" refer to the mean, median, or mode? Justify your answer.

a) the average monthly temperature

b) just an average day in the life of a student

c) the average hairstyle in the 1980s

d) the average number of cars in the parking lot

C Extending

15. A teacher records the test marks of 25 students and calculates the class mean to be 72. Jean-Pierre finds out that his mark of 86 was recorded incorrectly as 36. What will the corrected class mean be?

16. The mean of five different numbers is 4. When the greatest number is removed from the set, the mean of the remaining numbers is 2. What number is removed?

17. Six numbers are all less than 10. The greatest number is 9, and the least number is 1. The mean of these numbers is 6, the median is 7, and the mode is 8. When the number 6 is removed, the mean of the remaining five numbers is 6, the median is 8, and the mode is 8. What three numbers are missing?

	Numbers: 9, 1, 6, ■, ■, ■	**Numbers: 9, 1, ~~6~~, ■, ■, ■**
Mean	6	6
Median	7	8
Mode	8	8