4.1 Statistical Measures

Student Text Pages
200–213

Suggested Timing
80 min

Tools
- scientific calculators

Optional
- TI-Nspire™ CAS graphing calculators

Related Resources
BLM 4-3 Section 4.1 Statistical Measures
BLM 4-4 Section 4.1 Achievement Check Rubric

Link to Prerequisite Skills

Students should complete Rates, Percent, and Measures of Central Tendency in the Prerequisite Skills before proceeding with this section.

Warm-Up

1. Calculate the unit rate.
- **a)** \$8.99 for 24 cans of cola
- **b)** 420 km in 6 h
- **c)** 3 kg of food for four people
- **d)** 1278 words on five pages

2. Convert each amount to a percent.
- **a)** $\frac{15}{20}$
- **b)** 6 out of 8
- **c)** a mark of 35 on a test out of 40
- **d)** profit of \$4000 on an investment of \$120 000

Warm-Up Answers

1. a) \$0.374 per can
b) 70 km/h
c) 0.75 kg/person
d) 255.6 words/page

2. a) 75%
b) 75%
c) 87.5%
d) 3.33%

Teaching Suggestions

Warm-Up

- Display the Warm-Up questions. Have students complete the questions independently. Then, discuss the solutions as a class.

Section Opener

- Introduce the statistical measures that will be discussed in this section: per capita, percent change, percentile, percentile rank, and weighted mean.

Examples

- Example 1 extends students' knowledge of unit rates to per capita rates, a type of rate often used in the media.
- Example 2 develops the concept of percent change. The media sometimes make errors when calculating percent change (for example, a doubling in value may be described as a 200% increase). You may wish to have students find examples of correct and incorrect use of percent change in the media.

- In Example 3, consider introducing percentile with statements such as, "If 70% of the population were the same height or shorter than you, then you are in the 70th percentile. If 70% of the population were shorter than you, then your height has a percentile rank of 70%." Ensure students note the difference between *rank, percentile,* and *percentile rank.*
- In Example 4, remind students to divide by the sum of the weights.

Technology

- You may wish to use the Use Technology section on pages 212 to 213 as an alternative to **Example 4**. The Use Technology activity provides instructions for using the TI-Nspire™ CAS graphing calculator to calculate the weighted mean.
- Using a Smartboard® or projector would be an efficient way to demonstrate the CAS features as part of the lesson.

Key Concepts

- Ensure students understand the Key Concepts. You may wish to have students record the Key Concepts in their notebooks with an example for each point.

Discuss the Concepts

- These questions will allow you to assess students' understanding of statistical measures. Have students discuss the questions in pairs, then follow up with a class discussion.

Discuss the Concepts Suggested Answers (page 205)

D1. a) If health care spending increases faster than the population, then the per capita spending will also increase.

b) If the population grows faster than health care spending, then the per capita spending will decrease.

D2. Suppose a student scores 30 out of 40 on one mathematics test and 32 out of 40 on another.

$\frac{30}{40} \times 100 = 75$ $\frac{32}{40} \times 100 = 80$

The student has a grade of 75% on the first test and 80% on the second test.

The percent change between the first test and the second test is:

$\frac{32 - 30}{40} \times 100 = 5$

The student's grade increased by 5%.

If 10 out of 25 students in the class had grades lower than 30 on the first test, and there was only one test with a grade of 30, the percentile rank of that grade would be:

$$p = \frac{L + 0.5E}{n}$$
$$= \frac{10 + 0.5(1)}{25}$$
$$= 0.42$$

So, the percentile rank of a grade of 30 on the first test is 42%, which means that 42% of grades on the test were less than 30.

Practise (A)

- You may wish to have students work in pairs or small groups to complete the Practise questions.
- Encourage students to refer to the Examples before asking for assistance.

Apply (B)

- For **question 5**, you may need to explain how to calculate the crime rate per 100 000 people.
- **Question 6** is an Achievement Check question. It can be used for diagnostic or formative assessment, or assigned as a small summative assessment piece. You may wish to use **BLM 4-4 Section 4.1 Achievement Check Rubric** to assist you in assessing your students.
- For **question 7**, discuss the meaning of *net worth* in the **Literacy Connect** and the 25th, 50th, and 75th percentiles in the **Math Connect**.
- You might need to explain the meaning of singles, doubles, triples, and homeruns in **question 8** for students not familiar with baseball.
- **Question 12** is a **Literacy Connect** question. You may wish to book time in the computer lab for students to research and then enter their findings in a journal. You may wish to have students discuss their findings in small groups or as a class.

Extend (C)

- Assign the Extend questions to students who are not being challenged by the Apply questions.
- The solution to **question 13** can be found by solving the system of equations: $43x + 53y = 50$ and $78x + 81y = 80$, where x is the weighting factor for Course Mark and y is the weighting factor for Exam Mark.

Achievement Check Answers (page 207)

6. a) b) Methods may vary. For example: Use a spreadsheet to calculate the crime rate and the percent change in crime rate.

	A	B	C	D	E
1	Year	Number of Crimes	Population (as of July 1)	Crime rate (per 100K)	Crime Rate (% change)
2	2001	2622453	31021251	84.5	
3	2002	2667918	31372587	85.0	0.6
4	2003	2819346	31676077	89.0	4.7
5	2004	2863255	31995199	89.5	0.5
6	2005	2756880	32312077	85.3	-4.7
7	2006	2697647	32976026	81.8	-4.1
8					
9					
10		"D2=B2/C2*1000"			
11		"E3=(D3-D2)/D2*100"			

c) The crime rate increased from 2001 to 2004. In 2005 and 2006, the crime rate decreased.

Common Errors

- Some students may confuse percentile with percentile rank.

R_x Distinguish statements such as "a score of 500 has a percentile rank of 60" from statements such as "the 60th percentile is 500." The first statement says that 60% of the population had scores that were less than 500, while the second statement says that 60% of the population had scores less than or equal to 500. Statements involving *n*th percentiles are typically used to define the cut-off when the range of scores has been divided into 100 equal intervals. Also, the method used to determine the value indicates whether the calculation yields a percentile rank (using the equation with *L*, *E*, and *n*), or a percentile.

Accommodations

Perceptual—find the non-weighted mean in **Example 4** to compare the effect of weighting on the final result

Language—add definitions for *per capita*, *net worth*, *percent change*, *percentile*, *percentile rank*, *quartile*, and *weighted mean* to the Word Wall

Memory—create a poster or handout reviewing rounding, significant digits, and scientific notation

Motor—model keystrokes for calculating weighted means and percentile rank on scientific calculators to ensure students follow the order of operations and use brackets correctly

Visual—provide graphing calculators for calculations involving large values. Use graphing calculators to check weighted means calculated by hand or on spreadsheets.

Spatial—create archery targets out of construction paper and attach the targets to the chalkboard. Provide magnetic darts and have students calculate their total score and mean score per dart as in **question 10**.

Gifted and Enrichment—have students research the Consumer Price Index (CPI) and prepare a brief presentation as an introduction to section 4.2

ESL— ask students to record unfamiliar words and terms in their personal math dictionaries. Pair them with a classmate who can help them read and understand the Examples and Practise questions, and explain the meanings of new terms, such as *per capita*, *net worth*, *percent change*, *percentile*, *percentile rank*, *median*, *mean*, and *weighted mean*.

Literacy Connect

- Discuss the Literacy Connect on page 200 as it relates to Example 1.
- Have one student read Percentile and Percentile Rank on page 202. Have students compare and discuss the terms *percent change* (from Example 2), *percentile*, and *percentile rank*.
- Provide examples to ensure students understand the difference between mean and weighted mean.
- Encourage students to continue adding new terms to their personal math dictionaries.
- Allow students to work in pairs so they can assist each other in completing the questions.

Mathematical Process Expectations

Process Expectation	Questions
Problem Solving	7, 10, 12, 13
Reasoning and Proving	8, 14
Reflecting	5, 9, 10
Selecting Tools and Computational Strategies	4, 5, 7–9, 13
Connecting	5–9, 11, 12, 14
Representing	n/a
Communicating	6, 8, 9, 12, 14

Extra Practice

- Use **BLM 4-3 Section 4.1 Statistical Measures** for remediation or extra practice.