

LESSON 13: Mean, Median, Mode and Range

Weekly Focus: central tendency
Weekly Skill: computation and real application

Lesson Summary: First, students will solve a problem about buying carpet. In Activity 1, they will do a vocabulary matching activity. In Activity 2, they will do some examples and computation practice. In Activity 3, they will solve word problems in the student book. In Activity 4, they will do problems in the workbook. Activity 5 is an application about the Super Bowl. There is an exit ticket and extra problem. Estimated time for the lesson is two hours.

Materials Needed for Lesson 13:

- Video (3 minutes): Central Tendency Video. It is required for teachers and optional for students.
- Activity 1 to print/project
- Handout 13.1 of definitions and examples (attached)
- Worksheet 13.2 on computation (attached)
- *Mathematical Reasoning Test Preparation for the 2014 GED Test Student Book (pages 30-31)*
- *Mathematical Reasoning Test Preparation for the 2014 GED Test Workbook (pages 38-41)*
- Worksheet 13.3 on Super Bowl for application activity (attached)
- Exit ticket (attached)
- Optional: decks of cards for Activity 2

Objectives: Students will be able to:

- Understand the definitions of measures of central tendency (mean, median, mode)
- Compute these measures
- Solve word problems about mean, median, mode, and range
- Solve real life problems of application

ACES Skills Addressed: N, CT, LS, and EC

CCRS Mathematical Practices Addressed: Use appropriate tools strategically, Math Fluency, Building Solution Pathways, Construct viable arguments and critique the reasoning of others

Levels of Knowing Math Addressed: Concrete, Abstract, Communication and Application

Notes:

You can add more examples if you feel students need them before they work. Any ideas that concretely relates to their lives make good examples.

For more practice as a class, feel free to choose some of the easier problems from the worksheets to do together. The “easier” problems are not necessarily at the beginning of each worksheet. Also, you may decide to have students complete only part of the worksheets in class and assign the rest as homework or extra practice.

The GED Math test is 115 minutes long and includes approximately 46 questions. The questions have a focus on quantitative problem solving (45%) and algebraic problem solving (55%).

Students must be able to understand math concepts and apply them to new situations, use logical reasoning to explain their answers, evaluate and further the reasoning of others, represent real world

Lesson 13: Mean, Median, Mode, and Range

problems algebraically and visually, and manipulate and solve algebraic expressions.

This computer-based test includes questions that may be multiple-choice, fill-in-the-blank, choose from a drop-down menu, or drag-and-drop the response from one place to another.

The purpose of the GED test is to provide students with the skills necessary to either further their education or be ready for the demands of today's careers.

Lesson 13 Warm-up: Solve the carpet question

Time: 10 Minutes

Write on the board: Ronda wants to buy carpet for her bedroom. She measures the length at 10 feet and the width at 8 feet 6 inches. The carpet is sold in 12-foot-wide rolls.

Basic Question:

- What is the area of the bedroom?
 - If students convert inches to decimals and just convert 6 inches to 0.6, ask them why this doesn't work. Because it's 6/12, not 6/10, so they have to do equivalent fractions first. **Answer:** $10 \times 8.5 = 85$ square feet.

Extension Questions:

- How many square feet should she buy knowing she'll have to cut some off one side?
 - Draw a picture on the board if needed for explanation of where the extra is. **She will buy $12 \times 8.5 = 102$ square feet**
- She can buy a clearance carpet at \$0.89/square foot or she can buy carpet that's regularly sold at \$1.29 a square foot but is now 20% off. Which is a better deal?
 - Students may figure out the whole 102 square feet price for each. See if anyone figures out the price for just one square foot, which will give us the information we need. $\$1.29 \times 0.8 = \1.03 , so the clearance carpet is cheaper.

Lesson 13 Activity 1: Vocabulary

Time: 5 Minutes

This activity (below) can be projected on the board and done as a whole class. Have students volunteer to write answers. (**Answers:** 1d, 2a, 3b, 4f, 5c and 6e)

Lesson 13 Activity 2: M,M,M, and Range Computation

Time: 20-25 Minutes

- 1) Example A: Ask five students how many children they have, and write all the numbers on the board. Now you can figure out together:
 - **Mean:** Take all the numbers, add together, and divide by 5, the number of students surveyed. That gives you the average.
 - **Mode:** Are there two students who have the same number of children (could be zero)? If yes, that's the mode. If not, there is no mode.
 - **Median:** Put all five numbers in a row from lowest to greatest. The one in the middle is the median.
 - **Range:** Take the difference of the greatest minus the lowest and that is the range.

- 2) Example B: Now ask another student so you have six total. Figure out the mean, the mode (if there is one), and the range. What is the median? It's halfway between the two middle numbers. (If those are 2 and 3, the median is 2.5, for example)

- 3) Give students **Handout 13.1** for more examples.

- 4) Do **Worksheet 13.2** for practice. Do the first one together. An **alternative to the worksheet** is to have groups of 3-4 students use a deck of cards. Together they pick 4-5 cards and compute the M,M,M and range. Every group would have different answers so the teacher would need to circulate to check.

- 5) Note to teacher: These terms are also known as the "measures of central tendency". You may want to mention this to students in case they see this term elsewhere.

Lesson 13 Activity 3: Word Problems

Time: 15 Minutes

Have students work independently in the **student book pages 30-31**. Circulate to help. Review any questions that students found challenging. Choose a few problems to have students volunteer to do on the board and explain if they like.

Activity 1 Vocabulary Match

Vocabulary	Definition
1. mode	A. the average
2. mean	B. middle number
3. median	C. lowest number
4. range	D. most frequently occurring
5. minimum	number
6. maximum	E. highest number
	F. difference between lowest and highest numbers

Handout 13.1

Mean :

The "Mean" is computed by adding all of the numbers in the data together and dividing by the number elements contained in the data set.

Example :

$$\text{Data Set} = 2, 5, 9, 3, 5, 4, 7$$

$$\text{Number of Elements in Data Set} = 7$$

$$\text{Mean} = (2 + 5 + 9 + 7 + 5 + 4 + 3) / 7 = 5$$

Median :

The "Median" of a data set is dependant on whether the number of elements in the data set is odd or even. First reorder the data set from the smallest to the largest then if the number of elements are odd, then the Median is the element in the middle of the data set. If the number of elements are even, then the Median is the average of the two middle terms.

Examples : Odd Number of Elements

$$\text{Data Set} = 2, 5, 9, 3, 5, 4, 7$$

$$\text{Reordered} = 2, 3, 4, 5, 5, 7, 9$$

$$\text{Median} = 5$$

Examples : Even Number of Elements

$$\text{Data Set} = 2, 5, 9, 3, 5, 4$$

$$\text{Reordered} = 2, 3, 4, 5, 5, 9$$

$$\text{Median} = (4 + 5) / 2 = 4.5$$

Mode :

The "Mode" for a data set is the element that occurs the most often.

It is not uncommon for a data set to have more than one mode.

This happens when two or more elements occur with equal frequency in the data set. A data set with two modes is called bimodal.

A data set with three modes is called trimodal.

Examples : Single Mode

Data Set = 2, 5, 9, 3, 5, 4, 7

Mode = 5

Examples : Bimodal

Data Set = 2, 5, 2, 3, 5, 4, 7

Modes = 2 and 5

Examples : Trimodal

Data Set = 2, 5, 2, 7, 5, 4, 7

Modes = 2, 5, and 7

Range :

The "Range" for a data set is the difference between the largest value and smallest value contained in the data set. First reorder the data set from smallest to largest then subtract the first element from the last element.

Examples :

Data Set = 2, 5, 9, 3, 5, 4, 7

Reordered = 2, 3, 4, 5, 5, 7, 9

Range = (9 - 2) = 7

Worksheet 13.2—Computation

1) 5 , 3 , 6 , 5 , 2 , 9

Mean ____ Median ____ Mode _____ Range ____

6) 2 , 2 , 3 , 6 , 9 , 4 , 9 , 5

Mean ____ Median ____ Mode _____ Range ____

2) 9 , 7 , 3 , 9 , 7

Mean ____ Median ____ Mode _____ Range ____

7) 8 , 9 , 2 , 2 , 3 , 5 , 2 , 9

Mean ____ Median ____ Mode _____ Range ____

3) 5 , 7 , 4 , 9 , 7 , 6 , 4 , 6

Mean ____ Median ____ Mode _____ Range ____

8) 5 , 3 , 9 , 4 , 5 , 4

Mean ____ Median ____ Mode _____ Range ____

4) 6 , 2 , 6 , 2 , 4

Mean ____ Median ____ Mode _____ Range ____

9) 4 , 4 , 7 , 3 , 2

Mean ____ Median ____ Mode _____ Range ____

5) 2 , 4 , 7 , 2 , 3 , 6 , 7 , 2 , 3

Mean ____ Median ____ Mode _____ Range ____

10) 5 , 4 , 3 , 5 , 8

Mean ____ Median ____ Mode _____ Range ____

Worksheet 13.2—Computation Answers

1) 5, 3, 6, 5, 2, 9
2, 3, 5, 5, 6, 9
Mean 5 Median 5 Mode 5 Range 7

6) 2, 2, 3, 6, 9, 4, 9, 5
2, 2, 3, 4, 5, 6, 9, 9
Mean 5 Median 4.5 Mode 2 9 Range 7

2) 9, 7, 3, 9, 7
3, 7, 7, 9, 9
Mean 7 Median 7 Mode 7 9 Range 6

7) 8, 9, 2, 2, 3, 5, 2, 9
2, 2, 2, 3, 5, 8, 9, 9
Mean 5 Median 4 Mode 2 Range 7

3) 5, 7, 4, 9, 7, 6, 4, 6
4, 4, 5, 6, 6, 7, 7, 9
Mean 6 Median 6 Mode 4 6 7 Range 5

8) 5, 3, 9, 4, 5, 4
3, 4, 4, 5, 5, 9
Mean 5 Median 4.5 Mode 4 5 Range 6

4) 6, 2, 6, 2, 4
2, 2, 4, 6, 6
Mean 4 Median 4 Mode 2 6 Range 4

9) 4, 4, 7, 3, 2
2, 3, 4, 4, 7
Mean 4 Median 4 Mode 4 Range 5

5) 2, 4, 7, 2, 3, 6, 7, 2, 3
2, 2, 2, 3, 3, 4, 6, 7, 7
Mean 4 Median 3 Mode 2 Range 5

10) 5, 4, 3, 5, 8
3, 4, 5, 5, 8
Mean 5 Median 5 Mode 5 Range 5

Lesson 13 Activity 4: Word Problems

Time: 20-25 Minutes

Do the problems in the **workbook pages 38-41**. Do some of the challenging ones on the board.

Lesson 13 Activity 5 Application: Super Bowl Stats

Time: 20-25 Minutes

Mean, median, and mode are used when comparing statistics in many areas in our society.

Ask students what areas these statistics are used in. They should have lots of ideas after doing the workbook problems. Some are school, sports, weather, business, housing sales, and work hours.

The following activity asks students to figure out the numbers for a popular American event, the Super Bowl. Students may use their calculators to save time since the point is to understand how to solve the problems. The activity is from the website yummymath.com.

Lesson 13 Exit Ticket

Time: 5 Minutes

This activity can be done as a class survey/discussion. Ask everyone how many TV sets they have in their homes. Then figure out together the mean, median, mode, and range.

The numbers are small so it should happen quickly. If there isn't much time, just ask a few students.

Lesson 13 Extra Word Problem on Test Scores

Time: 5-10 Minutes

Write on the board:

Shonda met with her son's English class teacher at parent conferences. The teacher told Shonda that her son got 78, 89, 63, and 82 on his first four tests. There is one test left and he needs to increase his average to 80% to get a B in the class.

Basic Questions:

- What is her son's average in English class now? ($78 + 89 + 63 + 82$ divided by $4 = 312/4 = 78\%$)
- Is this the mean, the median, or the mode? (*mean*)

Extension Question:

- By what percent does he need to increase his test scores? (2%)
- Does this mean he needs to get 80% on the last test? (No, 80% is the average of all 5 tests)
- What does he need to get on the last test to have an 80% average?
 - This question is challenging, but see if the students can talk it through.
 - $(78 + 89 + 63 + 82 + x) \div 5 = 80$
 - $312 + x = 5 \cdot 80$
 - $x = 400 - 312 = 88\%$ on the last test

Worksheet 13.3—Super Bowl Activity

The Typical Super Bowl Score?

Name _____

How many points will be scored this Super Bowl? Round to the nearest hundredth when necessary.
To get a clearer idea lets look at the last twelve Super Bowl scores:

XLVII	Feb. 3, 2013	Ravens 34, 49ers 31
XLVI	Feb. 5, 2012	Giants 21, Patriots 17
XLV	Feb. 6, 2011	Packers 31 Pittsburg 25
XLIV	Feb. 7, 2010	Saints 31 Colts 17
XLIII	Feb. 1, 2009	Pittsburgh 27 Arizona 23
XLII	Feb. 3, 2008	New York 17, New England 14
XLI	Feb. 4, 2007	Indianapolis 29, Chicago 17
XL	Feb. 5, 2006	Pittsburgh 21, Seattle 10
XXXIX	Feb. 6, 2005	New England 24, Philadelphia 21
XXXVIII	Feb. 1, 2004	New England 32, Carolina 29
XXXVII	Jan. 26, 2003	Tampa Bay 48, Oakland 21
XXXVI	Feb. 3, 2002	New England 20, St. Louis 17

1. What is the mean score for the winning team in the Super Bowl? Make sure to show or explain your method.
2. What is the mean score for the losing team in the Super Bowl? Make sure to show or explain your method.
3. By using the mean of the winning and losing scores, what is the mean Super Bowl final score? By how many points on average does the winning team beat the losing team by?
4. Find the median score of the winning teams in the Super Bowl. Make sure to show or explain your method.
5. Find the median score of the losing teams in the Super Bowl. Make sure to show or explain your method.

Worksheet 13.3 [cont.]—Super Bowl Activity

6. By using the median of the winning and losing scores, what is the median Super Bowl final score? Using the median, by how many points on does the winning team beat the losing team by?

7. Now that you have used both the mean and median to explore the typical Super Bowl score, which statistic seems to better represent the data? Why?

8. Looking at all scores, winning or losing, is there a mode of the data set? If so, what is it? Knowing what you know about football, does it make sense that this score would be the mode?

9. Another statistic that we have not talked about is the range. Find the range for each:
 - a. Which of the twelve Super Bowls had the greatest range? Which Super Bowl was that and what was the range?

Worksheet 13.3—Super Bowl Activity Answers

1. What is the mean score for the winning team in the Super Bowl? Make sure to show or explain your method.

$$(34+21+31+31+27+17+29+21+24+32+48+20) / 12 = 335 / 12 = 27.92$$

2. What is the mean score for the losing team in the Super Bowl? Make sure to show or explain your method.

$$(31+17+25+17+23+14+17+10+21+29+21+17) / 12 = 242 / 12 = 20.17$$

3. By using the mean of the winning and losing scores, what is the mean Super Bowl final score? By how many points on average does the winning team beat the losing team by?

$$\text{Mean of the winning and losing scores} = (27.92 + 20.17) / 2 = 24.05$$

Differences between the winning and losing scores are; 3, 4, 6, 14, 4, 3, 12, 11, 3, 3, 27, 3. The mean of those differences is $93/12 = 7.75$

4. Find the median score of the winning teams in the Super Bowl. Make sure to show or explain your method.

17 20 21 21 24 27 29 31 31 32 34 48

= winning scores arranged from smallest to largest.

$$\text{So, the median winning score is } (27 + 29) / 2 = 28.$$

5. Find the median score of the losing teams in the Super Bowl. Make sure to show or explain your method.

10 14 17 17 17 17 21 21 23 25 29 31

= losing team scores arranged from smallest to largest.

$$\text{So, the median losing score is } (17+21)/2 = 19.$$

6. By using the median of the winning and losing scores, what is the median Super Bowl final score? Using the median, by how many points on does the winning team beat the losing team by?

Maybe the median final Super Bowl score would be the average of 28 and 19 which is $28 + 19 = 47/2 = 23.5$. The winning team usually wins by $28 - 19 = 9$ points.

7. Now that you have used both the mean and median to explore the typical Super Bowl score, which statistic seems to better represent the data? Why?

I'm not sure that either is more representative. The median losing team score is a score that is much closer to the lowest losing score than the highest losing score. There are also 4 losing scores of 17. So the mode is 17 and 19 is pretty close to the mode. The mode of 17 makes the median values weighted more heavily in the 17 score.

8. Looking at all scores, winning or losing, is there a mode of the data set? If so, what is it? Knowing what you know about football, does it make sense that this score would be the mode?

17 appears in the losing scores four times and once in the winning scores. It appears a total of five times making it the only mode.

9. Another statistic that we have not talked about is the range. Find the range for each:

- a. Which of the twelve Super Bowls had the greatest range? Which Super Bowl was that and what was the range?

Tampa Bay 48, Oakland 21 range = 27 points
Super Bowl 37 = XXXVII