

Kansas State Mathematics Standards and Assessment Guide

Based on the 2005 Kansas State Curricular Standards for Mathematics
adopted by the Kansas State Board of Education on July 8, 2003

High School

Developed by the Kansas State Department of Education
and
Mathematics Specialists in the Private Sector
from Kansas

2005

Standard/Benchmark/Indicator

M.HS.1.2.K3a-e

Standard: Number and ComputationBenchmark: Number Systems and Properties

Indicator: Names, uses, and describes these properties with real number system and demonstrates their meaning including the use of concrete objects: a) commutative ($a + b = b + a$ and $ab = ba$), associative [$a + (b + c) = (a + b) + c$ and $a(bc) = (ab)c$], distributive [$a(b + c) = ab + ac$], and substitution properties (if $a = 2$, then $3a = 3 \times 2 = 6$); b) identity properties for addition and multiplication and inverse properties of addition and multiplication (additive identity: $a + 0 = a$, multiplicative identity: $a \cdot 1 = a$, additive inverse: $+5 + -5 = 0$, multiplicative inverse: $8 \times 1/8 = 1$); c) symmetric property of equality (if $a = b$, then $b = a$); d) addition and multiplication properties of equality (if $a = b$, then $a + c = b + c$ and if $a = b$, then $ac = bc$) and inequalities (if $a > b$, then $a + c > b + c$ and if $a > b$, and $c > 0$ then $ac > bc$); e) zero product property (if $ab = 0$, then $a = 0$ and/or $b = 0$)

Explanation of Indicator

Numbers can be added or multiplied in any order resulting with the same answer (commutative). When a series of numbers is added or multiplied, the order in which the values are added or multiplied doesn't affect the result (associative). When multiplying a number by the sum of numbers, you can multiply each of the numbers by the factor first and then add (distributive). A number may be substituted for a variable or equivalent quantity (substitution). When 0 is added to another number it doesn't change the value of the number (identity for addition). When a number is multiplied by 1 it doesn't change the value of the number (identity for multiplication). A number plus its opposite is 0 (additive inverse). A number multiplied by its reciprocal is 1 (multiplicative inverse). It is important that students know the name of the property as used in the indicator.

Instructional Example

Distributive property: Each class will get a third of the concession stand profits. One night has \$100 profit and the next night has \$200 profit. You can either, add the profits from each night and then multiply the sum of \$300 by one third or you can multiply each night's profit by one third and add the results.

Item Specification

Category 1: Memorize Facts/Definitions/Formulas: 1b. Recall or recognize mathematical terms, definitions, or concepts

Category 2: Perform Procedures: 2b. Do computational procedures or algorithms

Category 3: Demonstrate Understanding of Mathematical Ideas: 3a. Communicate mathematical ideas or rules and/or explain the process

Assessment Item Example

The first step Leon took to solve $2(x - 4) - 3 = 27$ was to rewrite the equation as $2x - 8 - 3 = 27$. Which property justifies this step?

- A. associative
- B. commutative
- C. distributive
- D. substitution

Correct Answer: C

Indicator					
M.HS 1.2.K3a-e					

Standard/Benchmark/Indicator

M.HS. 2.2.K3c N

Standard: AlgebraBenchmark: Variables, Equations, and InequalitiesIndicator: Solves: c) systems of linear equations with two unknowns using integer coefficients and constants**Explanation of Indicator**

Finds the solution for a pair of equations that do not have fractions or decimals in the original equations. Students may choose to do this in any way that is successful and makes sense to them.

Instructional Example

At a restaurant, use the menu to create problems like the one below:

You and your friends are leaving the restaurant. Three people had 3 hamburgers and 3 orders of French fries and their bill was \$9. Four people had 5 hamburgers and 4 orders of French fries and their bill was \$14. How much does a hamburger cost?

Then have your child solve the problem. Trade roles and solve the problems your child creates.

Item Specification

Category 1: Memorize Facts/Definitions/Formulas: 1b. Recall or recognize mathematical terms, definitions, or concepts

Category 2: Perform Procedures: 2d. Solve equations, formulas, or routine word problems

Assessment Item Example

What is the solution of the system of linear equations $5x + 2y = 11$ and $x + y = 4$?

- A. (-1, 8)
- B. (1, 3)
- C. (2, 2)
- D. (3, -2)

Correct Answer: B

	Indicator				
	M.HS.2.2.K3c				

Standard/Benchmark/Indicator

M.HS.2.3.K6

Standard: AlgebraBenchmark: FunctionsIndicator: Recognizes how changes in the constant and/or slope within a linear function changes the appearance of a graph**Explanation of Indicator**

If changes are made in the equation of a line, the graph will look different. For example, it might be steeper or moved vertically on the graph. In the form $y=mx+b$, the variable m controls the steepness (slope) and b controls the vertical position.

Instructional Example

Look at a roof and consider its steepness (slope). What would happen to the steepness if the height were changed? What would happen to the steepness if the width were changed? Or both?

Item Specification

Category 3: Demonstrate Understanding of Mathematical Ideas: 3e. Show and/or explain relationships between models, diagrams, and/or other representations

Assessment Item Example

A problem in Robin's math book asks her to graph the line $y = -2x + 5$. However, there is a misprint in her book; it should read $y = -2x + 50$. Which statement describes how the graph of $y = -2x + 5$ compares to the graph of $y = -2x + 50$?

- A. The y -intercept of $y = -2x + 5$ is less than the y -intercept of $y = -2x + 50$.
- B. The y -intercept of $y = -2x + 5$ is greater than the y -intercept of $y = -2x + 50$.
- C. The slope of $y = -2x + 5$ is steeper than the slope of $y = -2x + 50$.
- D. The slope of $y = -2x + 5$ is less steep than the slope of $y = -2x + 50$.

Correct Answer: A

		Indicator			
		M.HS.2.3.K6			

Standard/Benchmark/Indicator

M.HS. 3.4.K4

Standard: GeometryBenchmark: Geometry from an Algebraic PerspectiveIndicator: Finds and explains the relationship between the slopes of parallel and perpendicular lines**Explanation of Indicator**

Parallel lines have the same slope since they have the same steepness. Perpendicular lines have a special relationship as well in that their slopes are opposite reciprocals.

Instructional Example

1. Student will identify streets on a map that appear to have the same slope (parallel).
2. Student will identify streets on a map that appear to have perpendicular slopes (perpendicular).

Item Specification**Category 2: Perform Procedures: 2b.** Do computational procedures or algorithms**Category 3: Demonstrate Understanding of Mathematical Ideas: 3d.** Develop and/or explain relationships between concepts**Assessment Item Example**

Two equations are shown below.

$$y = 3x + 4 \text{ and } y = 3x - \frac{1}{4}$$

The lines represented by these equations are parallel. Which statement explains why this is true?

- A. The coefficients of x in the two equations are the same, because they have the same slope.
- B. The coefficients of y in the two equations are the same, because they have the same slope.
- C. Both equations have two terms to the right of the equal sign.
- D. The constants in the two equations are reciprocals and have opposite signs.

Correct Answer: A

			Indicator		
			M.HS.3.4.K4		

Standard/Benchmark/Indicator

M.HS.3.4.K6

Standard: GeometryBenchmark: Geometry from an Algebraic PerspectiveIndicator: Recognizes the equation of a line and transforms the equation into slope-intercept form in order to identify the slope and y-intercept and uses this information to graph the line**Explanation of Indicator**

An equation of a line can take many forms. $3x + 2y = 6$, $2y = 4x - 7$, $2x + 5y + 7 = 0$ are all examples. A particular form (slope intercept) is in the form $y = mx + b$ where m represents the slope and b represents the y-intercept. Students need be able to transform the equation into the $y=mx + b$ form and pull out the needed pieces. For example, with $y=4x - 3$ the slope would be 4 and the y-intercept would be -3.

Instructional Example

Have student use the equation for starting a lemonade stand of $-1x + 2y + 40 = 0$ to find the slope intercept for the stand.

Item Specification

Category 1: Memorize Facts/Definitions/Formulas: 1b. Recall or recognize mathematical terms, definitions, or concepts

Category 2: Perform Procedures: 2b. Do computational procedures or algorithms

Category 3: Demonstrate Understanding of Mathematical Ideas: 3a. Communicate mathematical ideas or rules and/or explain the process

Assessment Item Example

Which would transform the equation $2y = x + 3$ into slope-intercept form?

- A. divide both sides of the equation by $\frac{1}{2}$
- B. divide both sides of the equation by 2
- C. subtract 3 from both sides of the equation
- D. subtract 2y from both sides of the equation

Correct Answer: B

				Indicator	
				M.HS.3.4.K6	

Standard/Benchmark/Indicator

M.HS.4.1.K3

Standard: DataBenchmark: ProbabilityIndicator: Explains the relationship between probability and odds and computes one given the other**Explanation of Indicator**

Probability is the ratio of the number of desired outcomes to the total number of outcomes possible. Odds is the ratio of the number of desired outcomes to the number of undesired outcomes.

Instructional Example

1. Student will compute probability and odds of winning a drawing when they know they name is in the drawing twice and there are 80 entries in the drawing.
2. If there are 8 members in a family and they are drawing names in order to establish who they will buy a present for, they student will figure probability and odds of drawing their own name, if they draw first.

Item Specification

Category 1: Memorize Facts/Definitions/Formulas: 1b. Recall or recognize mathematical terms, definitions, or concepts

Category 2: Perform Procedures: 2b. Do computational procedures or algorithms

Assessment Item Example

The odds that an event will occur are 8:3. Which expression describes the **probability** that the event will occur?

A $\frac{3}{8}$

B $\frac{8-3}{3}$

C $\frac{3}{5}$

D $\frac{8}{8+3}$

Correct Answer: D

					Indicator
					M.HS.4.1.K3

Standard/Benchmark/Indicator

M.HS.4.2.K4

Standard: DataBenchmark: StatisticsIndicator: Explains the effects of outliers on the measures of central tendency (mean, median, mode) and range and interquartile range of a real number data set**Explanation of Indicator**

When there are data in a set that are very far away from the others they are called an outlier. Students need to explain how outliers affect the measures of central tendencies (sometimes called averages), range, and the interquartile ranges (range of the middle half of the data).

Instructional Example

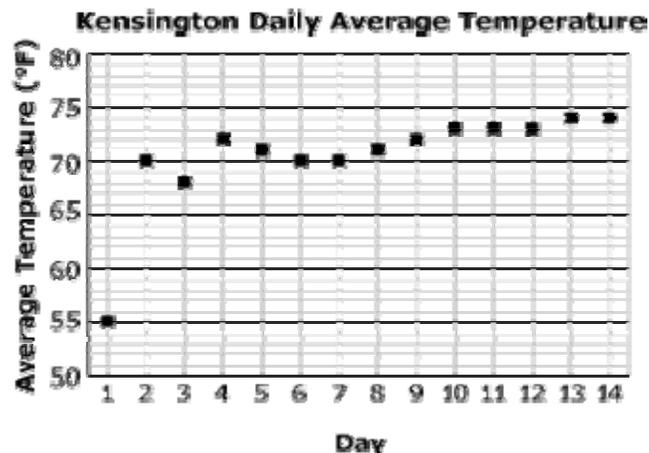
Have your student figure a mean, median, mode, and range on a set of data for the price of used cars that cost 6,000, 7,500, 6,250, 8,000, 7,700, 6,500, and 7,500. Then have the student recomputed them when a used car costing 800 is added. Have them explain how this car affected the mean, median, mode, and range. Which were affected and which were not?

Item Specification

Category 3: Demonstrate Understanding of Mathematical Ideas: 3c. Explain findings and/or results from data analysis strategies or experiments/simulations

Assessment Item Example

The graph below shows the daily average temperature in the town of Kensington over a two-week period.



The average temperature on Day 1 was significantly lower than the average temperature measured on the other days. Which statement **best** describes how the removal of this outlier will affect the statistical measures of the data?

- A. The mean will increase and the mode will remain the same.
- B. The range will increase and the median will remain the same.
- C. The mean will remain the same and the median will increase.
- D. The mean will decrease and the mode increase.

Correct Answer: A

Indicator					
M.HS.4.2.K4					

Standard/Benchmark/Indicator

M.HS.4.2.K5

Standard: DataBenchmark: StatisticsIndicator: Approximates a line of best fit given a scatter plot and makes predictions using the equation of that line**Explanation of Indicator**

Students can find an equation that could be used to represent a set of data points and then make predictions based on the equation.

Instructional Example

Have students compare electricity costs for several months by using kilowatt hours used and price of electric bill as the coordinates, for example in one month 1,100 kilowatt hours were used and the electric bill was \$105, in another month 1,500 kilowatt hours were used and the bill was \$143, and in another month 800 kilowatt hours were used and the bill was \$76. Have student plot the points and make predictions about how much the electric bill would be if 2,200 kilowatt hours would cost.

Item Specification

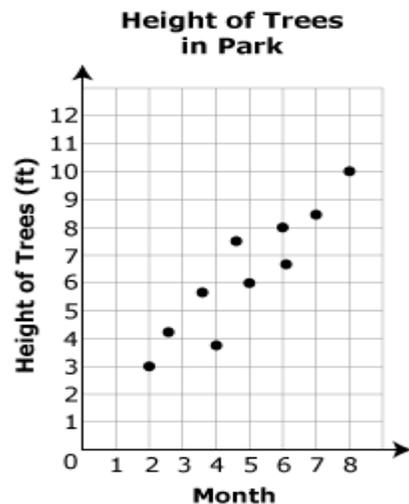
Category 1: Memorize Facts/Definitions/Formulas: 1b. Recall or recognize mathematical terms, definitions, or concepts

Category 3: Demonstrate Understanding of Mathematical Ideas: 3e. Show and/or explain relationships between models, diagrams, and/or other representations

Category 5: Solve Non-routine Problems/Make Connections: 5c. Analyze data or recognize patterns

Assessment Item Example

The scatter plot below shows the height of trees in the months after they were planted in a park.



Based on the data in the scatter plot, **approximately** how tall should the trees be in month 12?

- A. 10 ft C. 25 ft
- B. 15 ft D. 40 ft

Correct Answer: B

	Indicator			
	M.HS.4.2.K5			

Standard/Benchmark/Indicator

M.HS.1.3.A1

Standard: Numbers and ComputationBenchmark: EstimationIndicator: Adjusts original rational number estimate of a real-world problem based on additional information (a frame of reference)**Explanation of Indicator**

A student will use known information to adjust an estimate.

Instructional Example

1. Have students make an estimation to figure monthly cost for gasoline if the price per gallon rises from current price by \$.48 per gallon.
2. Have students estimate electrical costs if the price per kilowatt hour rises by \$.05 per kilowatt hour.

Item Specification**Category 3: Demonstrate Understanding of Mathematical Ideas: 3c.** Explain findings and/or results from data analysis strategies or experiments/simulations**Category 4: Conjecture/Generalize/Prove: 4f.** Identify faulty arguments or identify misrepresentations of data**Category 5: Solve Non-routine Problems/Make Connections: 5b.** Apply mathematics in contexts outside of mathematics (whenever possible, include diagrams/visuals)**Assessment Item Example**

Mark's bowling scores last week were 151, 108, 151, and 152. Based on these scores he ESTIMATED his average score to be about 140. In the first two games Mark bowled this week he scored 165 and 162. Which statement best explains how Mark should adjust his ESTIMATE of his average score based on the additional information from his last two games?

- A. His new estimate should be lower because there are more scores to include in the calculation.
- B. His new estimate should be about the same because the lower score and higher score cancel out.
- C. His new estimate should be higher because the range of scores has increased.
- D. His new estimate should be higher because his new scores are higher than his old scores.

Correct Answer: D

		Indicator			
		M.HS.1.3.A1			

Standard/Benchmark/Indicator

M.HS.1.4.A1a,b,d

Standard: Number and ComputationBenchmark: Computation

Indicator: Generates and/or solves multi-step real-world problems with real numbers and algebraic expressions using computational procedures (addition, subtraction, multiplication, division, roots, and powers excluding logarithms), and mathematical concepts with:

a) applications from business, chemistry, and physics that involve addition, subtraction, multiplication, division, squares, and square roots when the formulae are given as part of the problem and variables are defined; b) volume and surface area given the measurement formulas of rectangular solids and cylinders; d) application of percents

Explanation of Indicator

Students can solve real-world problems from the fields of business, chemistry, physics, measurement, and percents.

Instructional Example

Student will compute the amount (A) in a savings account if they deposited \$500 (p), left it in the account for 10 years(t), the interest rate is 3.5% (r), and it compounds quarterly(n) (four times per year). Use the formula: $A = p(1 + r/n)^{nt}$.

Item Specification

Category 5: Solve Non-routine Problems/Make Connections: 5b. Apply mathematics in contexts outside of mathematics (whenever possible, include diagrams/visuals)

Assessment Item Example

The diameter of a cylindrical can of motor oil is 3.5 inches (in). The height of the can is 6.5 in. Approximately how many cubic inches of oil will the can hold?

- A 62.51 in³
- B 71.44 in³
- C 232.16 in³
- D 252.02 in³

Correct Answer: A

			Indicator		
			M.HS.1.4.A1a,b,d		

Standard/Benchmark/Indicator

M.HS.2.2.A2a N

Standard: AlgebraBenchmark: Variables, Equations, and InequalitiesIndicator: Represents and/or solves real-world problems with: a) linear equations and inequalities both analytically and graphically**Explanation of Indicator**

Students will be able to use equations or inequalities to represent real-world situations. Students will then be able to solve the equation or inequality either by using any method that is successful and makes sense to them.

Instructional Example

If car rental company A charges \$45 for the day with unlimited mileage and company B charges \$25 for the day and \$.10 per mile (represented by $C = \$45$ for company A and $C = \$25 + .10x$ for company B), how many miles must driven to make Company B a cheaper option to rent?

Item Specification**Category 2: Perform Procedures: 2d.** Solve equations, formulas, or routine word problems**Category 3: Demonstrate Understanding of Mathematical Ideas: 3b.** Use representations to model mathematical ideas**Category 5: Solve Non-routine Problems/Make Connections: 5b.** Apply mathematics in contexts outside of mathematics (whenever possible, include diagrams/visuals)**Assessment Item Example**

Paula and Ben are going to paint 6,000 square feet of wall space inside a house. Paula (p) can paint 150 square feet per hour and Ben (b) can paint 100 square feet per hour. Which pair of values represents a possible number of hours Paula and Ben will each need to finish painting the wall space?

- A. $p = 20$ hours $b = 20$ hours
- B. $p = 20$ hours $b = 30$ hours
- C. $p = 30$ hours $b = 30$ hours
- D. $p = 40$ hours $b = 60$ hours

Correct Answer: B

				Indicator	
				M.HS.2.2.A2a	

Standard/Benchmark/Indicator

M.HS.2.3.A2

Standard: AlgebraBenchmark: FunctionsIndicator: Interprets the meaning of the x- and y- intercepts, slope, and/or points on and off the line on a graph in the context of a real-world situation**Explanation of Indicator**

The equation of a line represents points that are on that line. Students need to be able to interpret the meaning of some points such as where the line crosses the x- or y- axes (x-intercept and y-intercept). Students should also be able to interpret the meaning of a point that lies on or off the line as well as the slope (rate of change) in terms of the provided context.

Instructional Example

Have students use a state map to identify cities that lie on a given interstate highway and a few that do not, have them give the location of the cities such as (1,A) where the horizontal axis is numbers and the vertical axis is letters.

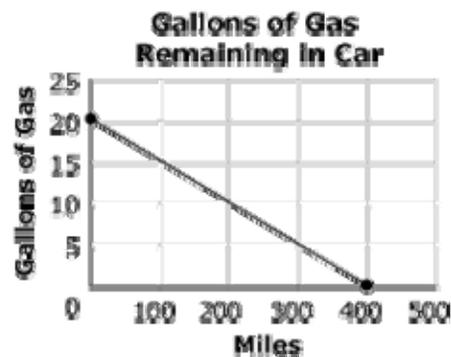
Item Specification

Category 3: Demonstrate Understanding of Mathematical Ideas: 3e. Show and/or explain relationships between models, diagrams, and/or other representations

Category 5: Solve Non-routine Problems/Make Connections: 5b. Apply mathematics in contexts outside of mathematics (whenever possible, include diagrams/visuals)

Assessment Item Example

The number of gallons (g) of gasoline remaining in Kim's car is a function of how many miles the car is driven. An equation representing this is $g = -0.05m + 20$, and it is shown on the graph below.



What does the y-intercept represent?

- A. The number of gallons of gasoline in the car at zero miles.
- B. The number of miles that are driven per gallon of gasoline.
- C. The rate at which the gasoline is being used per mile driven.
- D. The number of miles to be driven in order to use all 20 gallons of gasoline.

Correct Answer: A

					Indicator
					M.HS.2.3.A2

Standard/Benchmark/Indicator

M.HS.3.1.A1b

Standard: GeometryBenchmark: Geometric Figures and Their PropertiesIndicator: Solves real-world problems by: b) applying the Pythagorean Theorem**Explanation of Indicator**

Solves real-world problems by applying the Pythagorean Theorem. (The sum of the squares of the legs is equal to the square of the hypotenuse in a right triangle.)

Instructional Example

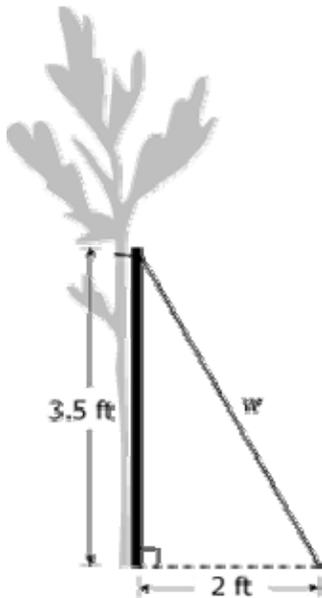
Think about your backyard. If it is rectangular and you know the length and the width, you should be able to determine how far you will walk if you walked diagonally.

Item Specification

Category 5: Solve Non-routine Problems/Make Connections: 5b. Apply mathematics in contexts outside of mathematics (whenever possible, include diagrams/visuals)

Assessment Item Example

A gardener braces a young tree with a vertical stake, as shown below.



A wire anchors the stake to the ground. To the nearest foot (ft), how long is the wire (w) from the tree to the ground?

- A. 3 ft
- B. 4 ft
- C. 6 ft
- D. 7 ft

Correct Answer: B

Indicator					
M.HS.3.1.A1b					

Standard/Benchmark/Indicator

M.HS.3.3.A1

Standard: GeometryBenchmark: Transformational GeometryIndicator: Analyzes the impact of transformations on the perimeter and area of circles, rectangles, and triangles and volume of rectangular prisms and cylinders**Explanation of Indicator**

When the dimensions of a figure change (double, triple, halve...), the area, perimeter, and volume will change according to a pattern.

Instructional Example

Use square blocks to construct a rectangular prism. Investigate what happens to the volume when the length doubles, when the width triples, when the height halves, or when multiple dimensions change.

Item Specification

Category 3: Demonstrate Understanding of Mathematical Ideas: 3a. Communicate mathematical ideas or rules and/or explain the process

Category 4: Conjecture/Generalize/Prove: 4a. Determine the truth of a mathematical pattern, a mathematical statement, and/or proposition or make predictions

Category 5: Solve Non-routine Problems/Make Connections: 5b. Apply mathematics in contexts outside of mathematics (whenever possible, include diagrams/visuals)

Assessment Item Example

A company is going to increase both the height and the radius length of a cylindrical jelly jar by a factor of 4. As a result of the increase, the **volume** of jelly that the cylinder will hold will increase by a factor of

- A. 4
- B. 16
- C. 32
- D. 64

Correct Answer: D

	Indicator				
	M.HS.3.3.A1				

Standard/Benchmark/Indicator

M.HS.4.2.A1a-h

Standard: DataBenchmark: Statistics

Indicator: Uses data analysis (mean, median, mode, range, quartile, interquartile range) in real-world problems with rational number data sets to compare and contrast two sets of data, to make accurate inferences and predictions, to analyze decisions, and to develop convincing arguments from these data displays: a) frequency tables and line plots; b) bar, line, and circle graph; c) Venn diagrams or other pictorial displays; d) charts and tables; e) stem-and-leaf plots (single and double); f) scatter plots; g) box-and-whiskers plots; h) histograms

Explanation of Indicator

Data displays (tables, graphs, etc.) can be constructed in a variety of ways. Students will need to use these data displays to make inferences, predictions, decisions and arguments about two sets of data.

Instructional Example

1. Have the student identify a variety of methods for representing data from a variety of media sources.
2. Have student make predictions form these data displays.
3. Have students figure mean, median, mode, and range from data displays.

Item Specification

Category 5: Solve Non-routine Problems/Make Connections: 5c. Analyze data or recognize patterns

Assessment Item Example

The tables below show the number of calories a student consumed each day for two weeks.

Number of Calories Consumed, Week 1

Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.	Sun.
1710	1850	1710	1920	1830	2000	1650

Number of Calories Consumed, Week 2

Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.	Sun.
1820	2010	3000	1680	1920	1500	2250

Which statement about the number of calories the student consumed is true?

- A. The mean number of calories consumed in week 1 is the same as the mean number of calories consumed in week 2.
- B. The mean number of calories consumed in week 1 is less than the mean number of calories consumed in week 2.
- C. The median number of calories consumed in week 1 is the same as the median number of calories consumed in week 2.
- D. The median number of calories consumed in week 1 is greater than the median number of calories consumed in week 2.

Correct Answer: B

		Indicator			
		M.HS.4.2.A1a-h			