

Understanding Graphs and their uses. Level 9-12

Answer Key

Using Bar Graphs

Teacher's Note:

Background information on using bar graphs.

Bar graphs, also known as bar charts, are a widely used graphical representation that can be traced back to the 18th century, when they first emerged as a tool for visualizing data. William Playfair, a Scottish engineer, and political economist is credited with inventing the bar graph in 1786, along with several other chart types such as line graphs and pie charts. Playfair's pioneering work, "The Commercial and Political Atlas," employed bar graphs to represent complex economic data in a more comprehensible and accessible format, illustrating trends and comparisons in trade, exports, and imports. Over time, bar graphs have evolved and become widely adopted across various fields, including science, finance, and social sciences, for their ability to effectively communicate quantitative information by using bars of varying lengths to represent data values. Their versatility and adaptability to diverse contexts have contributed to the enduring popularity and utility of bar graphs in data visualization and analysis.

Card 1:

1. Aaron
2. Aaron
3. Perry and Dana
4. Answers will vary.

Card 2:

1. Dana, Aaron, Akiko, Perry, Juan
2. 4 scoops
3. 4.5 scoops

Card 3:

1. 80 for Mondays and around 105 on Fridays
2. Around 70
3. Around 30

Card 4:

1. Answers will vary.
2. Answers will vary.
3. Answers will vary.

Card 5:

1. Pizza and Chicken nuggets
2. Veg. Patti and Hot dogs
3. Tacos

Card 7:

1. Tuesday and Saturday. Answers will vary, however, the general definition of mode is the number that occurs most often.
2. 60. Answers will vary, however, range is the difference between the lowest and highest values. Her range is 60 sit-ups while her mode is 45.

Card 8:

1. Answers will vary. However, the general idea is that students should understand that the independent variables go on the x axis while the dependent variables go on the y axis.
2. Answers will vary. However, since Sunday is the day that she recorder the lowest count of sit-ups while the rest of the days are higher the answers might be yes.

Card 9:

1. Animal
2. Adventure and Animal
3. Sports
4. Phil by 10

Card 10:

1. Adventure and Mystery
2. Adventure and Animal
3. Robin with a total of approximately 87 books
4. Approximately 14 books

Card 11:

1. Granny Smiths; 1997
2. It will stop. The following years will be 0
3. 1998 produced the most apples.

Card 12:

1. Approximately the average is 10,000 apples; 1998 is the greatest increase; 1999 is the lowest increase by only 5,000 apples
2. Answers will vary, but the answer you are looking for is that you would plant granny smith apples.

Card 13:

1. Styrofoam
2. Fourth
3. First
4. Other
5. Paper

Card 14:

1. Answers will vary. Could be larger lunches or time of day that they eat, or the type of food they eat.
2. Answers will vary. The group I would target would be 4th grade

Card 15:

1. Paper: 1984; Plastic: 2551.7; Styrofoam: 4701.1; Other: 1134.1; Food: 1701.1.
2. 3402.3
3. Styrofoam and food
4. Answers will vary. General answer should be yes.

Card 16:

1. Answers will vary.

Descartes

Teacher's Note:

Historical background on René Descartes:

René Descartes, a French philosopher, mathematician, and scientist, was born on March 31, 1596, in La Haye en Touraine, France, and played a pivotal role in shaping modern Western philosophy and mathematics. Often referred to as the "Father of Modern Philosophy," Descartes introduced a radical shift in philosophical thought through his method of systematic doubt and his famous dictum, "Cogito, ergo sum" (I think, therefore I am), which emphasized the primacy of human consciousness and self-awareness as the foundation for knowledge. In mathematics, Descartes' groundbreaking work on analytical geometry laid the foundation for the Cartesian coordinate system, which enabled the seamless integration of algebra and geometry, revolutionizing the field and paving the way for the development of calculus. His contributions to various scientific disciplines, such as optics and mechanics, further exemplify his profound impact on the evolution of human knowledge. Descartes' innovative ideas continue to influence contemporary thought, underlining the enduring legacy of his intellectual pursuits.

Card 1:

1. Answers will vary.
2. Answers will vary.
3. Answers will vary.
4. Answers will vary.

Card 2:

1. Answers will vary.
2. Answers will vary.
3. Answers will vary.

Card 3:

Answers will vary depending on the figure drawn.

Card 4:

Answers will vary depending on the figure drawn.

Card 5:

Answers will vary depending on the figure drawn.

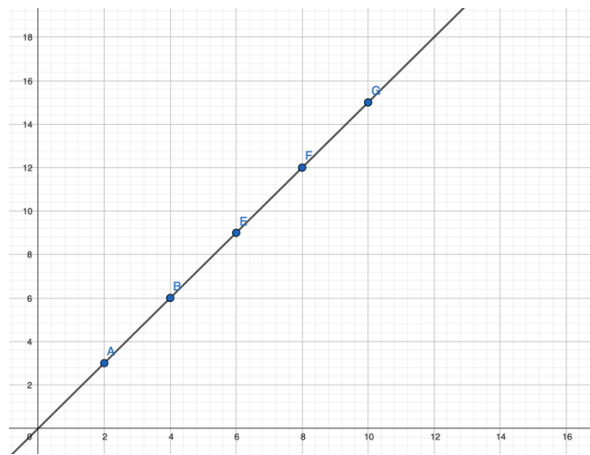
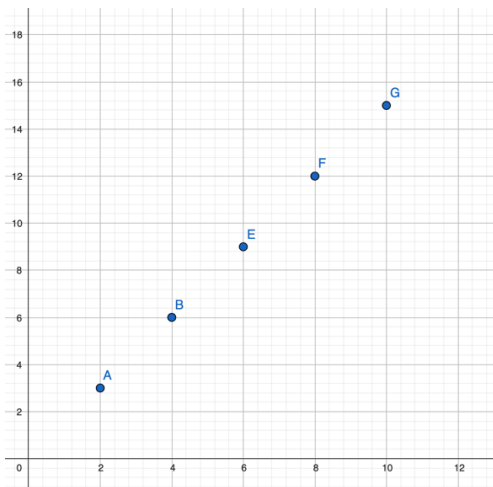
Card 6:

Answers will vary depending on the figure drawn.

Card 7:

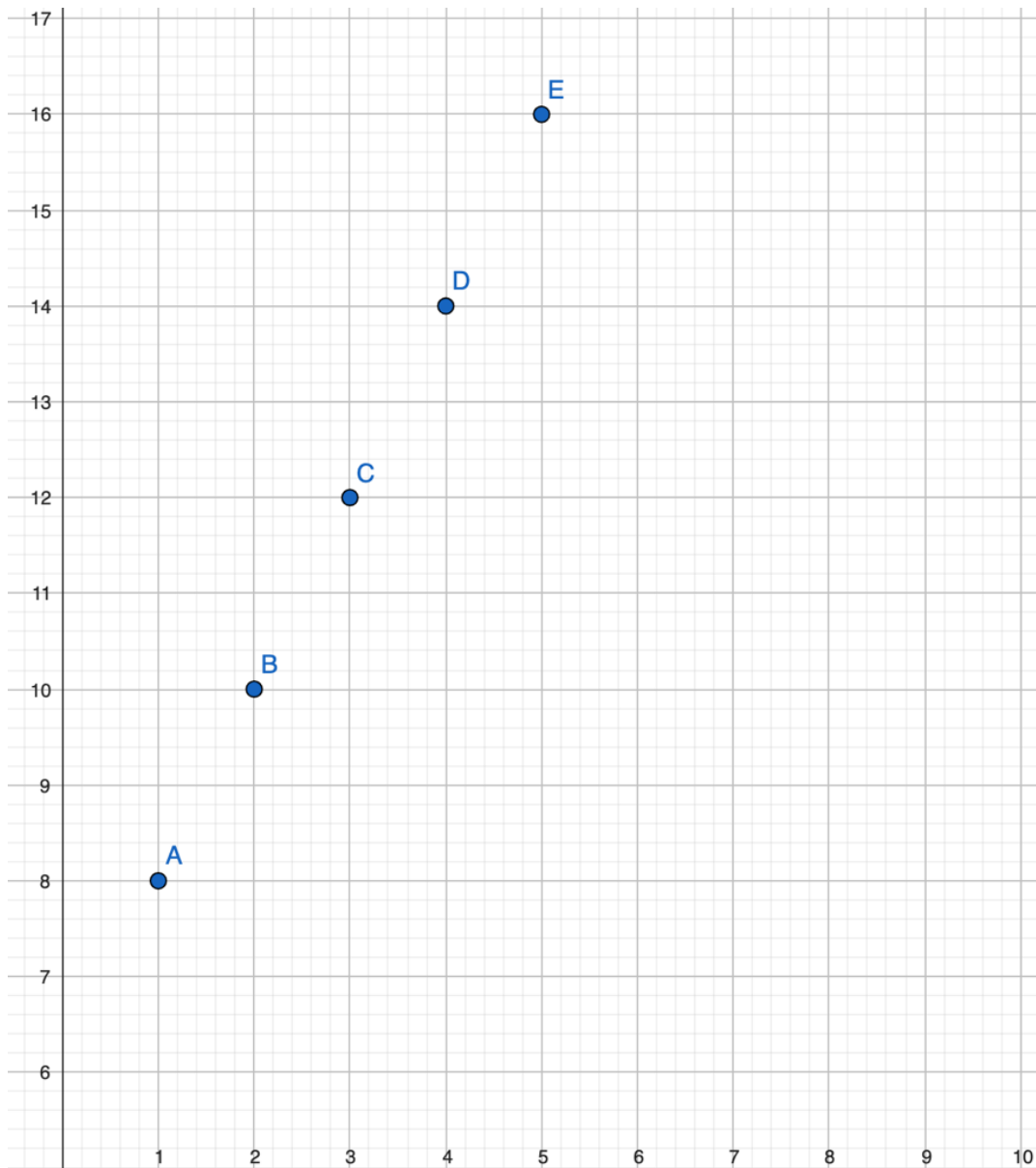
Answers will vary depending on the figure drawn.

Card 8:



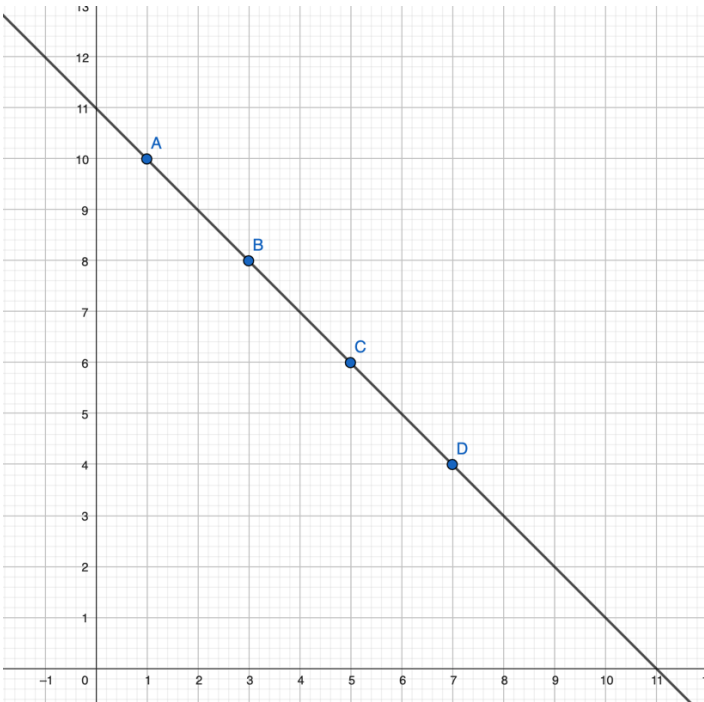
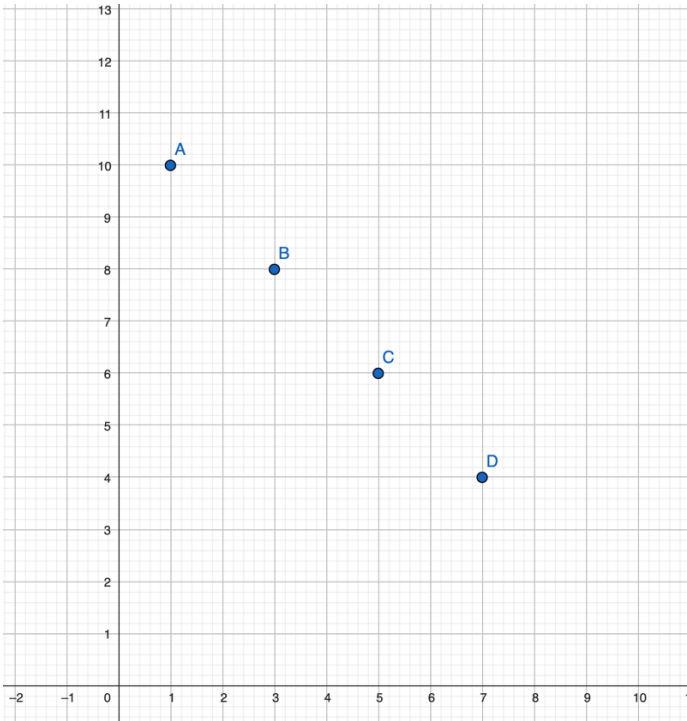
1. The next three points would be (12,18), (14,21), (16,24) Either method would work, and answers will vary. If they used the table, then they would add 2 to the first value while adding 3 to the second value. If using the graph, then they would go up 3 and over 2.
2. 7.5
3. Approximately 6.6

Card 9



1. $(6,18); (7,20)$
2. $(-1,4); (-2,2)$
3. $(-4,-2); (-5,-4)$

Card 10



- 1. It is going the opposite way than the other graphs. Answers will vary.
- 2. (9,2); (11,0)
- 3. Answers will vary.

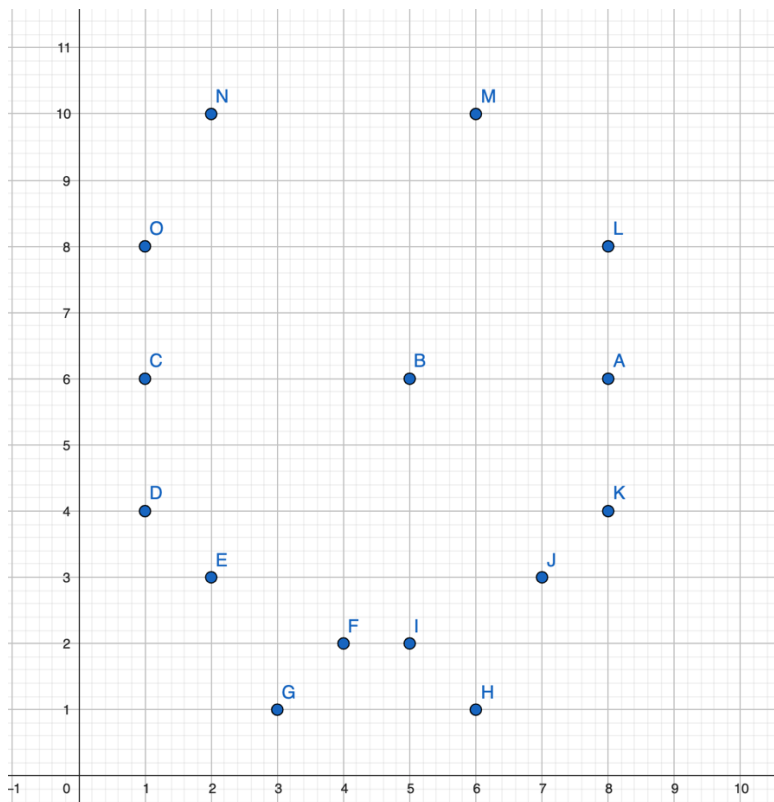
Mapping

Teacher's Notes: Background on understanding why it is important to teach mapping skills.

The ability to map points on a coordinate plane is an essential skill for students, as it forms the foundation for understanding key concepts in mathematics, science, and engineering. Familiarity with the coordinate plane allows students to visualize and analyze the relationships between variables, laying the groundwork for more advanced topics such as algebra, geometry, and calculus. In particular, the Cartesian coordinate system, with its horizontal (x-axis) and vertical (y-axis) axes, enables the representation of two-dimensional relationships and the exploration of functions, equations, and geometric transformations. Additionally, mapping points on a coordinate plane cultivates problem-solving and critical thinking skills, as students learn to interpret graphical information and extract meaningful insights from data. By mastering this fundamental skill, students not only enhance their mathematical proficiency but also acquire a valuable tool for comprehending complex information across a wide range of disciplines, bolstering their overall academic and professional success.

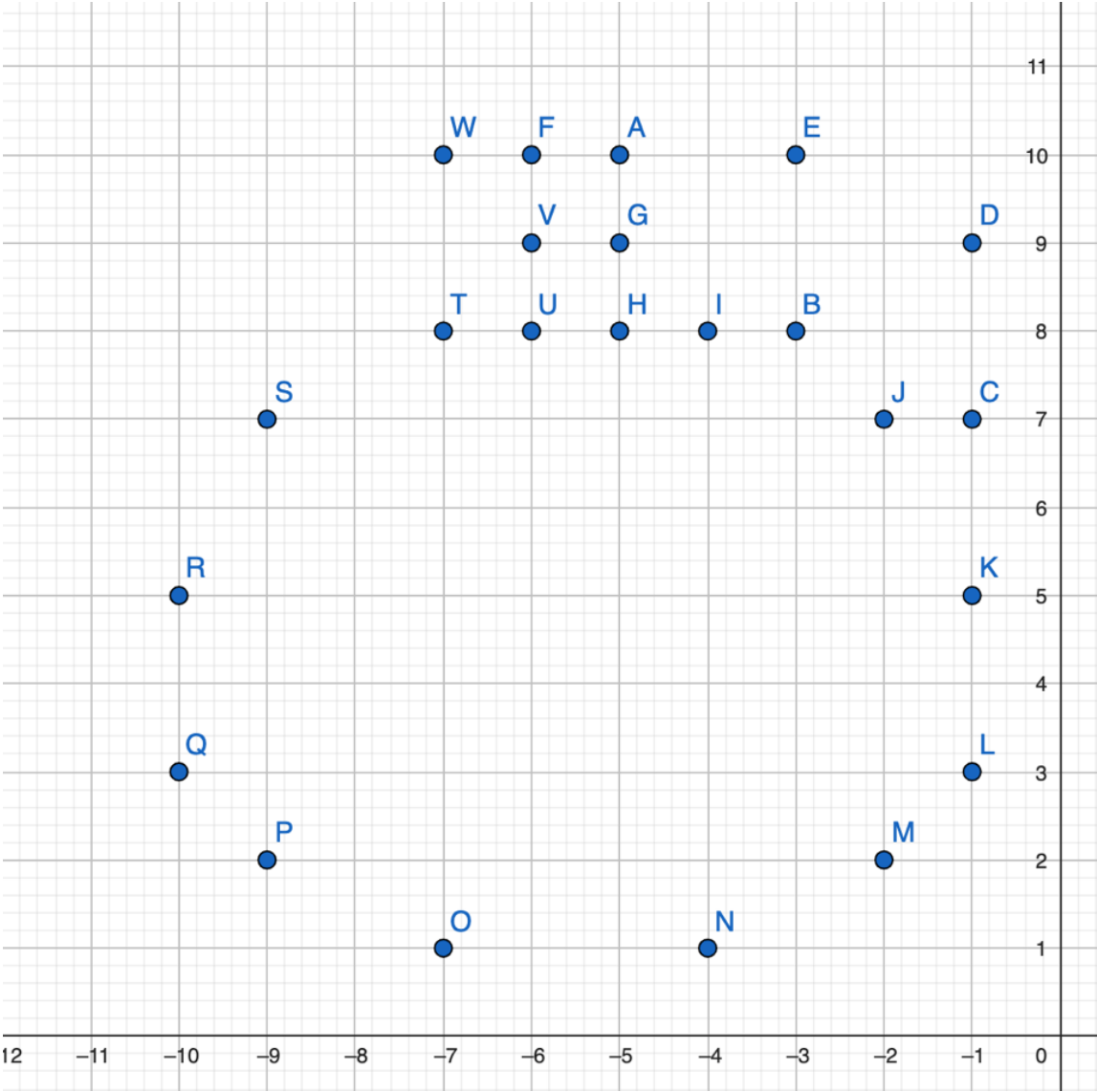
Card 1

Points are as follows:



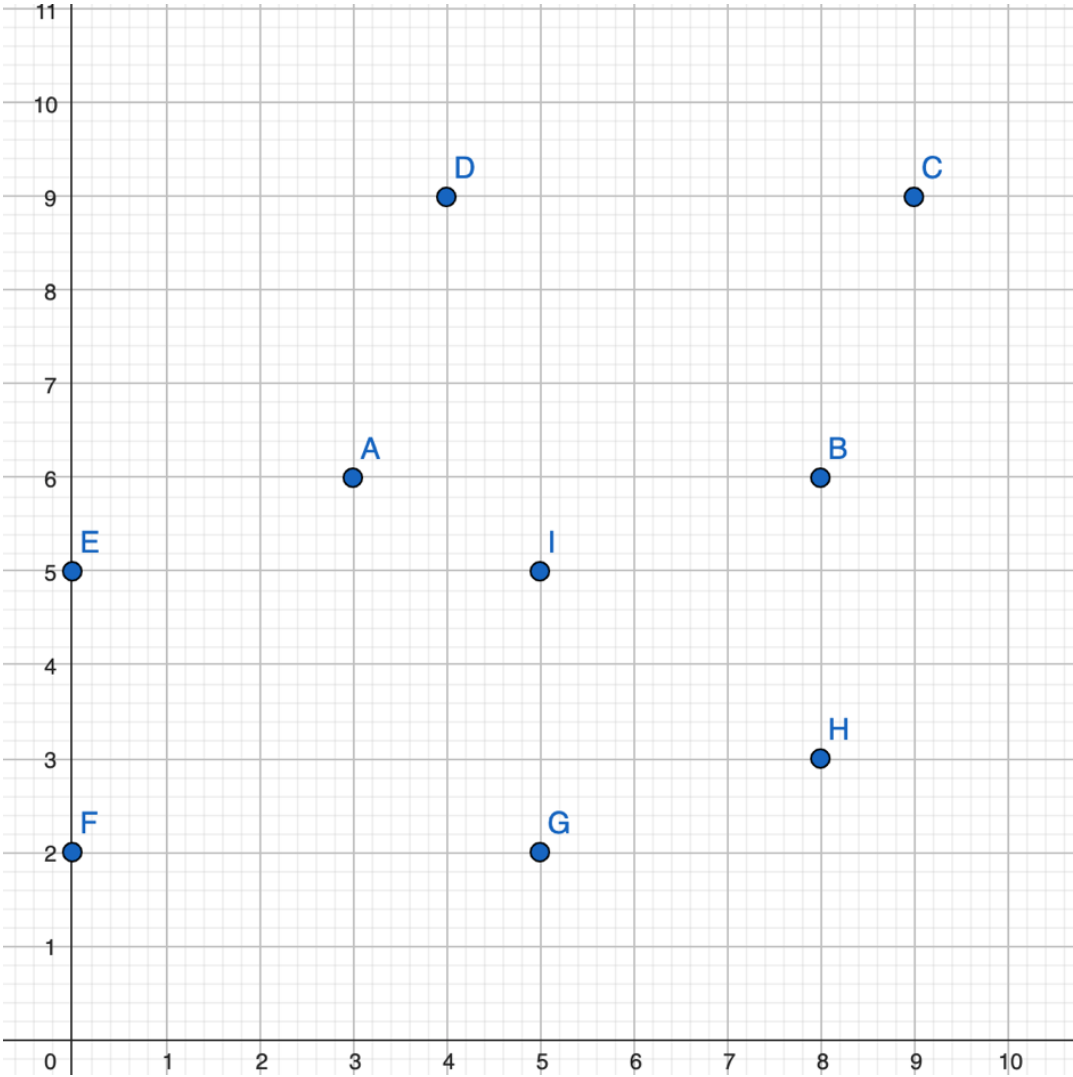
Card 2:

Points are as follows:



Card 3:

Points are as follows:



Card 4:

Answers will vary.

Range Median Mean

Application Activities

Teacher's Note: Why must students understand and use range, median, and mean when analyzing a dataset.

The ability to find the range, median, and mean of a dataset is crucial in understanding its underlying characteristics, as these statistical measures provide valuable insights into the central tendency, dispersion, and distribution of the data. The mean, or average, represents the arithmetic center of the dataset, offering a general sense of the data's typical value. The median serves as the middle value when the data is arranged in ascending or descending order, providing a robust measure of central tendency that is less susceptible to the influence of outliers. The range, which denotes the difference between the maximum and minimum values, reveals the overall spread of the dataset and can help identify potential outliers or extreme values. By calculating these fundamental measures, analysts, researchers, and professionals across various fields can draw meaningful conclusions, identify patterns, and make informed decisions based on the data. Additionally, these statistics are vital in further data analysis, such as hypothesis testing and predictive modeling, and contribute to a comprehensive understanding of complex information.

Card 1:

Range = 11; Mean 92.5; Median = 92

He cannot get a 95. Even if he gets a 100 on his final test then the mean will still be 93.5.

Card 2:

For the Highs the following is true:

Mean: 82

Range: 17

Mode: 88

Median: 83

For the Lows the following is true:

Mean: 67.1

Range: 9

Mode: 68

Median: 68

To calculate the average temperature difference for each day, we first need to find the temperature differences between consecutive days, then find the average of those differences.

Here are the temperature differences:

1. Day 2 - Day 1: $88 - 71 = 17$
2. Day 3 - Day 2: $78 - 88 = -10$
3. Day 4 - Day 3: $83 - 78 = 5$
4. Day 5 - Day 4: $79 - 83 = -4$
5. Day 6 - Day 5: $87 - 79 = 8$
6. Day 7 - Day 6: $88 - 87 = 1$

Now, we'll find the average of these differences:

$$(17 + (-10) + 5 + (-4) + 8 + 1) / 6 = 17 / 6 \approx 2.83$$

The average temperature difference for each day is approximately 2.83 degrees.

The method used will vary by student.

Card 3:

Here's an imaginary, but realistic set of weights for 6 sumo wrestlers that would equal the mean of 330 pounds:

1. 315 pounds
2. 325 pounds
3. 330 pounds
4. 340 pounds
5. 345 pounds
6. 335 pounds

The sum of these weights is 1990 pounds, and the mean is $1990/6 = 330$ pounds.

Now, let's create an unrealistic set of weights using the range and median that would give the same arithmetical mean:

1. 10 pounds (an extremely underweight person)
2. 100 pounds (a very lightweight person)
3. 330 pounds (a typical sumo wrestler)
4. 560 pounds (a very heavy sumo wrestler)
5. 650 pounds (an extremely heavy sumo wrestler)
6. 340 pounds (a slightly heavier-than-average sumo wrestler)

The sum of these unrealistic weights is also 1990 pounds, and the mean is still $1990/6 = 330$ pounds

Card 4:

1. The first eight prime numbers: 2, 3, 5, 7, 11, 13, 17, 19
Mean: $(2+3+5+7+11+13+17+19) / 8 = 77 / 8 \approx 9.63$ Median: $(5 + 7) / 2 = 6$
2. All the odd numerals from 1-20: 1, 3, 5, 7, 9, 11, 13, 15, 17, 19
Mean: $(1+3+5+7+9+11+13+15+17+19) / 10 = 100 / 10 = 10$ Median: $(7 + 9) / 2 = 8$
3. All the numerals more than 10, but less than 25: 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24
Mean: $(11+12+13+14+15+16+17+18+19+20+21+22+23+24) / 14 = 315 / 14 \approx 22.50$
Median: $(15 + 16) / 2 = 15.5$
4. All the odd, prime numerals from 1 to 40: 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37
Mean: $(3+5+7+11+13+17+19+23+29+31+37) / 11 \approx 195 / 11 \approx 17.73$ Median: 13

Card 5:

The heights in inches of the starting players on the hometown basketball team are: 79, 82, 81, 78, 82.

Range: The range is the difference between the highest and lowest values in the dataset. In this case, the range is $82 - 78 = 4$ inches. The range shows the spread of the data.

Mean: The mean is the sum of all values divided by the number of values. In this case, the mean is $(79 + 82 + 81 + 78 + 82) / 5 = 402 / 5 = 80.4$ inches. The mean represents the average height of the players.

Median: The median is the middle value of a dataset when it's ordered from smallest to largest. In this case, we first order the heights: 78, 79, 81, 82, 82. The median is the middle value, which is 81 inches. The median gives us the central tendency of the data, which is less affected by extreme values than the mean.

Mode: The mode is the value that appears most frequently in a dataset. In this case, the mode is 82 inches, as it appears twice. The mode helps us identify the most common height among the players.

Each of these statistical measures provides different information:

1. Range gives us an idea of the spread or variability of the data.
2. Mean is a measure of central tendency and gives us an idea of the average value, but it can be affected by extreme values.
3. Median is also a measure of central tendency, but it is less affected by extreme values.
4. Mode tells us the most common value in the dataset.

Answers will vary. However, a possible explanation that should be accepted is as follows:

Depending on the context and the purpose of the analysis, you might choose one method over another. For example, if you want to know the average height of the players, you will use the mean. If you're more interested in the most common height, you would use the mode. To understand the variability or spread of the heights, you would look at the range. And if you want to know the central value that is less affected by extreme values, you will use the median.

Card 6

Answers will vary based on updated information offered at the website.

Card 7:

Answers will vary based on updated information offered at the website.

Card 8:

Answers will vary based on updated information offered at the website.

Using Scatter Plots

Teacher's Note: Definition of a scatter plot.

A scatter plot, also known as a scatter diagram or scatter graph, is a type of graphical representation used to display the relationship between two variables by plotting data points on a Cartesian coordinate system. Each data point represents a pair of values, with one variable mapped along the horizontal axis (x-axis) and the other along the vertical axis (y-axis). Scatter plots are particularly appropriate when investigating the correlation, trends, or patterns between two continuous variables, as they allow for the visualization of possible connections or dependencies between the variables. They can also reveal outliers and clusters within the data, offering insights into the underlying structure of the dataset. Scatter plots are widely used in various fields such as statistics, data analysis, finance, and engineering, where understanding the relationship between variables is essential for informed decision-making, predictive modeling, and hypothesis testing.

Card 1:

Answers will vary.

Card 2:

Answers will vary.

Card 3:

Answers will vary.

Card 4:

Answers will vary.

Graphing Stories

Teacher's Notes: Graphs are provided to allow children to be creative in composing their own stories based on the information that is provided. There is no discrete answer or set of answers that will fit the mold. Students are and should be encouraged to be creative.

Card 1:

Answers will vary. Any reasonable story that fits the data should be accepted.

Card 2:

Answers will vary. Any reasonable story that fits the data should be accepted.

Card 3:

Answers will vary. Any reasonable story that fits the data should be accepted.

Card 4:

Answers will vary. Any reasonable story that fits the data should be accepted.

Using Line Graphs

Teacher's Note: Why use line graphs:

Line graphs are widely employed for their ability to effectively visualize trends, patterns, and relationships between two sets of data, particularly when one variable changes over time or across a sequence of data points. By plotting data points along two axes and connecting them with straight lines, line graphs create a continuous curve that facilitates the interpretation of the data's behavior, such as increasing or decreasing trends, periodic fluctuations, and turning points. The simplicity and clarity of line graphs make them an ideal tool for presenting complex information in an easily digestible manner, allowing for quick comparison and analysis of data. Their versatility and adaptability make line graphs suitable for various fields, including finance, science, engineering, and social sciences, where understanding trends and changes in data is crucial for informed decision-making, predictions, and evaluation of results.

Card 1:

1. \$39
2. \$120
3. The older they are the more money is donated.
4. Answers will vary. However one possible answer is that the older an individual is the more money they make and the more they can support their donations

Card 2:

1. 0 miles. When it is new
2. 120,000 miles
3. \$2,000
4. Between 20,000 miles and 40,000 miles
5. Between 80,000 miles and 100,000 miles

Card 3:

Answers will vary.

Card 4 - 5:

Answers will vary based on relevant data.

Line Graphs and Cultural Activities

Teacher's Note: Definition of a line graph:

A line graph, also known as a line chart or linear graph, is a type of graphical representation used to visualize the relationship between two sets of data, typically illustrating trends or changes over time. It consists of a horizontal axis (x-axis) representing one variable, often time or sequential data points, and a vertical axis (y-axis) representing another variable, often a quantity or measurement. Data points are plotted on the graph and connected by straight lines, creating a continuous curve that highlights patterns, trends, or fluctuations in the data. Line graphs are widely used in various fields, such as finance, science, and engineering, for their ability to effectively communicate complex information in an easily interpretable manner.

Cards 1-6B

Answers will vary.

Stem and Leaf Plots

Teacher's Note: Definition of a Stem and Leaf Plot:

A stem and leaf plot, also known as a stemplot or stem-and-leaf display, is a type of graphical representation that organizes numerical data by dividing each data point into two parts: the stem and the leaf. The stem typically represents the higher-order digits of the data, while the leaf represents the lower-order digits. This plot helps in visualizing the distribution, shape, and central tendency of a dataset, as well as identifying outliers and gaps in the data. Stem and leaf plots are particularly appropriate when dealing with small to moderately sized datasets, as they preserve the actual data values and provide a clear view of the individual data points. They are commonly used in exploratory data analysis, especially in fields like statistics and education, where a quick, concise representation of data is desired for initial insights and understanding of the data's characteristics.

Card 1 – 6

Answers will vary.

Using Histograms

Teacher's Note: Definition of a Histogram.

A histogram is a graphical representation used to display the distribution of a continuous or discrete dataset by partitioning the data into intervals, also known as bins, and representing the frequency of data points within each bin using rectangular bars. The height of each bar corresponds to the number of data points within a specific interval, illustrating the underlying frequency distribution of the data. Histograms are particularly appropriate when analyzing large datasets, as they provide a concise, visual representation of the data's central tendency, dispersion, and shape, including insights into skewness and the presence of outliers. They are widely employed in various fields, such as statistics, data analysis, finance, and engineering, where understanding the distribution of data is essential for informed decision-making and further statistical analysis.

Card 1-4

Answers will vary.

Using Box Plots

Teacher's Note: Definition of a box plot.

A box plot, also known as a box-and-whisker plot or box-and-whisker diagram, is a graphical representation used to display the distribution, central tendency, and dispersion of a dataset by visually representing its five-number summary: minimum, first quartile (Q1), median (Q2), third quartile (Q3), and maximum. The plot consists of a rectangular box, which spans the interquartile range (IQR) between Q1 and Q3, with a line inside the box indicating the median. Whiskers extend from the box to the minimum and maximum values, or to a specified range determined by a multiple of the IQR to identify potential outliers. Box plots are particularly appropriate when comparing multiple datasets or analyzing the spread and skewness of a dataset, as they provide a clear and concise visualization of the data's distribution. They are widely used in fields such as statistics, data analysis, and research, where a compact representation of data is essential for comparing groups or identifying distribution characteristics.

Cards 1-4:

Answers will vary based on current data.