THINKING WITH MATHEMATICAL MODELS   Linear and Inverse Variation

Instructional Time and Investigations	26 days	• Inv. 1: Exploring Data Patterns (3 Problems) • Inv. 2: Linear Models and Equations (5 Problems) • Inv. 3: Inverse Variation (4 Problems) • Inv. 4: Variability and Associations in Numerical Data (4 Problems) • Inv. 5: Variability and Associations in Categorical Data (3 Problems)
Goals	**Linear and Nonlinear Relationships:** Recognize and model linear and nonlinear relationships in bivariate data. • A function is a special relationship between values; each input value gives back exactly one output value. A function can be used to create a model of a data pattern. Function models allow you to answer questions or make predictions about a relationship between two variables. Linear relationships are functions. Inverse variation relationships are not linear, but they are functions.	**Data Analysis:** Measure variation in data and strength of association in bivariate data. • Data about two variables from real-world observations or experiments can be collected and represented in graphs and tables. These representations are useful for analyzing relationships among data, including the variability in the data. • Data may show a pattern or association between the variables. Sometimes you can fit a line to data, find the equation of the line, and measure how well the line fits the data pattern. This is useful for making predictions about data points not observed. • Categorical data must be analyzed in different ways than numerical data including using 2-way tables to analyze relative frequencies.
Common Core Standards	**Common Core Standards for Mathematical Practice** **MP.1:** Make sense of problems and persevere in solving them. **MP.2:** Reason abstractly and quantitatively. **MP.3:** Construct viable arguments and critique the reasoning of others. **MP.4:** Model with mathematics. **MP.5:** Use appropriate tools strategically. **MP.6:** Attend to precision. **MP.7:** Look for and make use of structure. **MP.8:** Look for and express regularity in repeated reasoning.	**Common Core Content Standards** **8.EE.B.5:** Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways. For example, compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed. **8.F.B.4:** Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x, y) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values. **8.SP.A.1:** Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association. **8.SP.A.2:** Know that straight lines are widely used to model relationships between two quantitative variables. For scatter plots that suggest a linear association, informally fit a straight line, and informally assess the model fit by judging the closeness of the data points to the line. **Also 8.EE.C.7, 8.EE.C.7b, 8.EE.C.8, 8.EE.C.8a, 8.EE.C.8c, 8.F.A.1, 8.F.A.2, 8.F.A.3, 8.F.B.5, 8.SP.A.3, 8.SP.A.4**

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Content Connections to Other Units		
Goals of the Unit	**Prior Work**	**Future Work**
Linear and Nonlinear Relationships: Recognize and model linear and nonlinear relationships in bivariate data.	• Recognizing patterns in tables and graphs and describing those patterns using words and equations (*Variables and Patterns; Comparing and Scaling; Moving Straight Ahead*) • Finding slopes of lines and investigating parallel lines (*Moving Straight Ahead*) • Formulating, reading, and interpreting symbolic rules (*Variables and Patterns; Comparing and Scaling; Moving Straight Ahead*) • Solving problems in geometric and algebraic contexts (*Covering and Surrounding; Let's Be Rational; Decimal Ops; Variables and Patterns; Shapes and Designs; Comparing and Scaling; Moving Straight Ahead; Filling and Wrapping*) • Modeling situations with linear equations (*Variables and Patterns; Comparing and Scaling; Moving Straight Ahead*) • Formulating, reading, and interpreting symbolic rules (*Variables and Patterns; Comparing and Scaling; Moving Straight Ahead*) • Recognizing patterns and proportional relationships (*Comparing Bits and Pieces; Variables and Patterns; Comparing and Scaling; Moving Straight Ahead*)	• Recognizing and comparing functions (*Growing, Growing, Growing; Say It With Symbols; It's In the System; Frogs, Fleas, and Painted Cubes; Function Junction*) • Writing equations to represent functions (*Growing, Growing, Growing; Say It With Symbols; It's In the System; Frogs, Fleas, and Painted Cubes; Function Junction*) • Solving geometric and algebraic problems (*Looking for Pythagoras; Growing, Growing, Growing; Butterflies, Pinwheels, and Wallpaper; Say It With Symbols; It's In the System; Frogs, Fleas, and Painted Cubes; Function Junction*) • Finding exact solutions of linear inequalities (*It's In the System; Frogs, Fleas, and Painted Cubes; Function Junction*) • Modeling situations with other functions (*Growing, Growing, Growing; Say It With Symbols; Frogs, Fleas, and Painted Cubes; Function Junction*) • Comparing functions (*Growing, Growing, Growing; Say It With Symbols; Frogs, Fleas, and Painted Cubes; Function Junction*) • Solving quadratic equations and systems of equations (*Say It With Symbols; It's In the System; Frogs, Fleas, and Painted Cubes; Function Junction*)
Data Analysis: Measure variation in data and strength of association in bivariate data.	• Analyzing data using various representations (*Data About Us; Variables and Patterns; Samples and Populations; Moving Straight Ahead*) • Describing shape of the data (*Data About Us; Variables and Patterns; Samples and Populations; Moving Straight Ahead*) • Describing variability (*Data About Us; Variables and Patterns; Samples and Populations; Moving Straight Ahead*) • Exploring different kinds of data (*Data About Us*)	• Summarizing, representing, and interpreting data on a single count or measurement variable (*High School*) • Interpreting linear models (*High School*) • Summarizing, representing, and interpreting data on two categorical and quantitative variables (*High School*)