Math I UNIT 2 OVERVIEW: Linear Functions

Unit Outcomes At the end of this unit, your student should be able to:	**Key Vocabulary** Terms to deepen the student's understanding
• Identify and interpret rate of change and the initial value of a function in terms of the situation it models • Construct and interpret a linear function given a graph, verbal description, a table or a set of ordered pairs • Compare two different linear functions represented in different forms. • Prove that linear functions grow by equal differences over equal intervals • Construct a linear function from two quantities • Create a NOW-NEXT equation to describe an arithmetic sequence • Determine if a function is a linear function • Transform a linear function expressed in recursive form into explicit form and vice versa • Write arithmetic sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms • Create a linear model for bivariate data • Use the equation of a linear model to make predictions about the data • Predict the strength and direction (+/-) of the correlation coefficient from a scatter plot. • Recognize linear and exponential functions numerically, graphically, algebraically, and descriptively. • Create a scatter plot when given two quantitative variables. • Interpret the constants and coefficients of a calculated function in context of the problem. • Use the fitted function to make predictions and solve problems. • Calculate the residuals for each data point that has been fitted to a function. • Create and analyze a residual plot. • Utilize technology to compute and interpret the correlation coefficient. • Distinguish between association and causation of independent and dependent variables in a given context.	• Association • Average rate of change • Causation • Correlation coefficient • Domain • Explicit Rule • Extrapolate • Interpolate • Line of Best Fit • Linear • Linear Function • Modeling • Nonlinear • Rate of Change • Recursive Rule • Regression line • Residual • Residual plot • Scatter plot • Slope • Slope-intercept form • Solutions • Table of Values • Y-intercept

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Key Standards Addressed Connections to Common Core/NC Essential Standards	**Where This Unit Fits** Connections to prior and future learning
8.F.2 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). *For example, given a linear function represented by a table of values and a linear function represented by an algebraic expression, determine which function has the greater rate of change.* **8.F.3** Interpret the equation y = mx + b as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. *For example, the function $A = s^2$ giving the area of a square as a function of its side length is not linear because its graph contains the points (1,1), (2,4), and (3, 9) which are not on a straight line.* **8.F.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.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.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. **8.SP.3** Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept. *For example, in a linear model for a biology experiment, interpret a slope of 1.5 cm/hr as meaning that an additional hour of sunlight each day is associated with an additional 1.5 cm in mature plant height.*	**Coming into this unit, students should have a strong foundation in:** • Operations with integers • Solving one variable equations • Plotting points on a coordinate plane • Estimating rate of change • Identifying key features of a function from a graph **This unit builds to the following future skills and concepts:** • Solving quadratic & exponential equations • Solving systems of equations and inequalities through graphing, substitution and elimination • Graphing and analyzing more complex functions (including inverse, step, exponential, absolute value, trigonometric and logarithmic functions) • Using regression lines to predict linear, quadratic and exponential models

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NC.M1.A-SSE.1 Interpret expressions that represent a quantity in terms of its context. a. Identify and interpret parts of a **linear**, exponential, or quadratic expression, including terms, factors, coefficients, and exponents. b. Interpret a **linear**, exponential, or quadratic expression made of multiple parts as a combination of entities to give meaning to an expression. **NC.M1.A-CED.2** Create and graph equations in two variables to represent **linear**, exponential, and quadratic relationships between two quantities. **NC.M1.A-REI.10** Understand that the graph of a two-variable equation represents the set of all solutions to the equation. **NC.M1.A-REI.11** Build an understanding of why the x-coordinate of the points where the graphs of two **linear**, exponential, and/or quadratic equations $y=(x)$ and $y=(x)$ intersect are the solutions of the equation $(x) = g(x)$ and approximate solutions using graphing technology or successive approximations with a table of values. **NC.M1.F-IF.2** Use function notation to evaluate **linear**, quadratic, and exponential functions for inputs in their domains, and interpret statements that use function notation in terms of a context. **NC.MI.F-IF.3** Recognize that recursively and explicitly defined sequences are functions whose domain is a subset of the integers, the terms of an **arithmetic sequence are a subset of the range of a linear function**, and the terms of a geometric sequence are a subset of the range of an exponential function. **NC.M1.F-IF.4** Interpret key features of graphs, tables, and verbal descriptions in context to describe functions that arise in applications relating two quantities, including: intercepts; intervals where the function is increasing, decreasing, positive, or negative; and maximums and minimums. **NC.M1.F-IF.5** Interpret a function in terms of the context by relating its domain and range to its graph and, where applicable, to the quantitative relationship it describes.	

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NC.M1.F-IF.6 Calculate and interpret the average rate of change over a specified interval for a function presented numerically, graphically, and/or symbolically. **NC.M1.F-IF.7** Analyze linear, exponential, and quadratic functions by generating different representations, by hand in simple cases and using technology for more complicated cases, to show key features, including: domain and range; rate of change; intercepts; intervals where the function is increasing, decreasing, positive or negative; maximums and minimums; and end behavior. **NC.M1.F-IF.9** Compare key features of two functions (linear, quadratic, or exponential) each with a different representation (symbolically, graphically, numerically in tables, or by verbal descriptions). **NC.M1.F-BF.1** Write a function that describes a relationship between two quantities. a. Build linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two ordered pairs (include reading these from a table. b. Build a function that models a relationship between two quantities by combining linear, exponential, or quadratic functions with addition and subtraction or two linear functions with multiplication. **NC.M1.F-BF.2** Translate between the explicit and recursive forms of arithmetic and geometric sequences and use both to model situations. **NC.M1.F-LE.5** Interpret the parameters *a* and *b* in a **linear function *f(x)= ax + b*** or an exponential function $g(x)=ab^x$ in terms of a context. **NC.M1.F-LE.1** Identify situations that can be modeled with **linear** and exponential functions, and justify the most appropriate model for a situation based on the rate of change over equal intervals. **NC.M1.S-ID.6** Represent data on two quantitative variables on a scatter plot, and describe how the variables are related. a. Fit a least squares regression line to linear data using technology. Use the fitted function to solve problems. b. Assess the fit of a linear function by analyzing residuals.	

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NC.M1.S-ID.7 Interpret in context the rate of change and the intercept of a linear model. Use the linear model to interpolate and extrapolate predicted values. Assess the validity of a predicted value. **NC.M1.S-ID.8** Analyze patterns and describe relationships between two variables in context. Using technology, determine the correlation coefficient of bivariate data and interpret it as a measure of the strength and direction of a linear relationship. Use a scatter plot, correlation coefficient, and a residual plot to determine the appropriateness of using a linear function to model a relationship between two variables. **NC.M1.S-ID.9** Distinguish between association and causation.	
Additional Resources Materials to support understanding and enrichment	**"Learning Checks"** Questions Parents Can Use to Assess Understanding
•Teaching videos made by Wake County teachers •Linear equations (overview) •Graphing linear equations (practice) •Writing linear equations from graphs (practice) •Arithmetic sequences (overview) •Linear regression (overview) •Writing arithmetic sequences (practice) •Linear equations (formative assessment) •Association and causation overview (video) •Line of best fit overview (video) •Linear regression (practice)	• Why is the concept of "linear function" important in mathematics? • How are the key features identified, described, and interpreted from different representations of linear functions? • Why is a constant rate of change a key characteristic of a linear function? • How is a constant rate of change revealed in different representations of a linear function (graph, table, equation, and verbal forms)? • How does association differ or relate to causation? • What are appropriate methods to use when looking for patterns of association? • When is it appropriate to use a linear model to describe the relationship between two quantities?

*** Please note**, the unit guides are a work in progress. If you have feedback or suggestions on improvement, please feel free to contact wakemiddle@wcpss.net.