Unit #9 Linear Modeling

Content Area: **Math**
Course(s):
Time Period:
Length: **8 weeks**
Status: **Published**

State Mandated Topics Addressed in this Unit

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N/A	N/A

Linear Modeling

Learning Objectives

- Objective 1 - Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.
- Objective 10 - Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.
- Objective 11 - For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.★
- Objective 12 - Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.★
- Objective 13 - Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.★
- Objective 14 - Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.★ Graph linear and quadratic functions and show intercepts, maxima, and minima.
- Objective 15 - Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.
- Objective 16 - Distinguish between situations that can be modeled with linear functions and with exponential functions. Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.
- Objective 17 - Interpret the parameters in a linear or exponential function in terms of a context.
- Objective 18 - Prove the slope criteria for parallel and perpendicular lines and use them to solve

geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point).

- Objective 19 - Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
- Objective 2 - Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
- Objective 20 - Define appropriate quantities for the purpose of descriptive modeling.
- Objective 21 - Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
- Objective 22 - Represent data with plots on the real number line (dot plots, histograms, and box plots).
- Objective 23 - Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.
- Objective 24 - Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).
- Objective 25 - Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate areas under the normal curve.
- Objective 26 - Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data.
- Objective 27 - Represent data on two quantitative variables on a scatter plot and describe how the variables are related. Fit a function to the data (including with the use of technology); use functions fitted to data to solve problems in the context of the data. Use given functions or choose a function suggested by the context. Emphasize linear and exponential models.
- Objective 28 - Represent data on two quantitative variables on a scatter plot, and describe how the variables are related. Informally assess the fit of a function by plotting and analyzing residuals, including with the use of technology.
- Objective 29 - Represent data on two quantitative variables on a scatter plot, and describe how the variables are related. Fit a linear function for a scatter plot that suggests a linear association.
- Objective 3 - Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context. For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.
- Objective 30 - Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.
- Objective 31 - Compute (using technology) and interpret the correlation coefficient of a linear fit.
- Objective 32 - Distinguish between correlation and causation.
- Objective 33 - Determine the constant rate of the proportional relationship with the corresponding units.
- Objective 34 - evaluate functions by replacing the values of "x"
- Objective 4 - Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For example, rearrange Ohm's law V = IR to highlight resistance R.
- Objective 5 - Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).
- Objective 6 - Interpret expressions that represent a quantity in terms of its context. Interpret parts of an expression, such as terms, factors, and coefficients.
- Objective 7 - Interpret expressions that represent a quantity in terms of its context. Interpret complicated expressions by viewing one or more of their parts as a single entity.

- Objective 8 - Use the structure of an expression to identify ways to rewrite it. For example, see x4 – y4 as (x2) 2 – (y2) 2 , thus recognizing it as a difference of squares that can be factored as (x2 – y2)(x2 + y2).
- Objective 9 - Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then f(x) denotes the output of f corresponding to the input x. The graph of f is the graph of the equation y = f(x).

Essential Skills

- Essential Skill 1 - Understand polynomials are closed under addition, subtraction, and multiplication
- Essential Skill 10 - Interpret expressions in terms of context.
- Essential Skill 11 - Interpret parts of an expression in context, such as terms, factors, and coefficients.
- Essential Skill 12 - Interpret complicated expressions by viewing its parts as a single entity.
- Essential Skill 13 - Factor expressions.
- Essential Skill 14 - Identify structure to rewrite expressions.
- Essential Skill 15 - Rewrite using difference of squares.
- Essential Skill 16 - Rewrite expressions using difference of cubes.
- Essential Skill 17 - Rewrite expressions using sum of cubes.
- Essential Skill 18 - Understand that a function has one member of the domain assigned to exactly one element of the range.
- Essential Skill 19 - F(x) denotes the output of f corresponding to the input of x.
- Essential Skill 2 - Create equation that represents relationships between quantities.
- Essential Skill 20 - The graph of f is the graph of y=f(x)
- Essential Skill 21 - Use function notation to evaluation functions for inputs in their domain.
- Essential Skill 22 - Interpret statements that use function notations in terms of context.
- Essential Skill 23 - Sketch a graph using the key features of a function.
- Essential Skill 24 - Interpret key features from a graph or a table of values.
- Essential Skill 25 - Relate the domain of a function its graph.
- Essential Skill 26 - Relate the domain of a function to the quantitative relationship that it describes.
- Essential Skill 27 - Calculate the average rate of change of a function from a graph or a function on an interval.
- Essential Skill 28 - Interpret the average rate of change.
- Essential Skill 29 - Estimate the average rate of change from a graph.
- Essential Skill 3 - Graph equations on axes with labels and scales.
- Essential Skill 30 - Graph linear and quadratic functions showing key features including intercepts, maxima and minima.
- Essential Skill 31 - Compare properties of two functions represented differently (algebraically, graphically, numerically, verbally).
- Essential Skill 32 - Distinguish between situations that can be modeled with linear functions and with exponential functions.
- Essential Skill 33 - Recognize situations where one quantity changes at a constant rate relative to another.

- Essential Skill 34 - Interpret the parameters of a linear or exponential functions in context
- Essential Skill 35 - Prove the slopes for parallel and perpendicular lines.
- Essential Skill 36 - Use the slopes of parallel and perpendicular lines to solve geometric problems.
- Essential Skill 37 - Apply scales to graphs, origin of graph and data displays.
- Essential Skill 38 - Use units to make sense of solutions.
- Essential Skill 39 - Apply scales to multi-step problems and formulas.
- Essential Skill 4 - Represent solutions of equations, inequalities, and systems to real-world applications.
- Essential Skill 40 - Interpret units in formulas.
- Essential Skill 41 - Choose units in formulas.
- Essential Skill 42 - Define quantities for descriptive modeling problems. (Incorporate appropriate units).
- Essential Skill 43 - Choose limits on measurements when reporting quantities.
- Essential Skill 44 - Choose the level of accuracy.
- Essential Skill 45 - Represent data with plots on the real number line.
- Essential Skill 46 - Use statistics appropriate to the shape of a data distribution.
- Essential Skill 47 - Compare the center(mean/median) and spread (interquartile range, standard deviation) of two (or more) different data sets.
- Essential Skill 48 - Interpret differences in shape, center, and spread in data sets, accounting for the effects of outliers
- Essential Skill 49 - Use mean and standard deviation of data set to fit a normal distribution and estimate population percentages.
- Essential Skill 5 - Interpret solutions as viable based on the constraints of the application.
- Essential Skill 50 - Recognize when appropriate to use mean and Standard deviation for data sets.
- Essential Skill 51 - Use Calculators, spreadsheets and tables to estimate area under the normal curve.
- Essential Skill 52 - Summarize data in a two-way frequency table.
- Essential Skill 53 - Interpret the relative frequencies including joint, marginal and conditional relative frequencies.
- Essential Skill 54 - Recognize possible trends and associations in the data.
- Essential Skill 55 - Represent data on two quantitative variables on a scatter plot.
- Essential Skill 56 - Describe how variables are related.
- Essential Skill 57 - Fit a function to the data.
- Essential Skill 58 - Use functions fitted to the data to solve problems.
- Essential Skill 59 - Use given functions or choose a function based on the context with an emphasis on linear and exponential models.
- Essential Skill 6 - Rearrange formulas to highlight a quantity of interest.
- Essential Skill 60 - Represent data on two quantitative variables on a scatter plot.
- Essential Skill 61 - Describe how variables are related.
- Essential Skill 62 - Informally assess the fit of a function through plotting and analyzing residuals.
- Essential Skill 63 - Represent two quantitative variables on a scatter plot. Describe how the variables are related.
- Essential Skill 64 - Fit a linear function for a scatterplot with a linear association.

- Essential Skill 65 - Interpret the slope (rate of change) of a linear model.
- Essential Skill 66 - Compute the correlation coefficient of a linear fit.
- Essential Skill 67 - Interpret the correlation coefficient of a linear fit.
- Essential Skill 68 - Distinguish between correlation and causation.
- Essential Skill 7 - Understand that the graph of an equation in two variables is the set of all of its solutions plotted in the coordinate plane
- Essential Skill 8 - Understand that the solution set to an equation in two variables often forms a curve (which could be a line).
- Essential Skill 9 - Interpret parts of expressions including terms, factors, and coefficients.
- Recognize and describe the domain and range of a function

Standards

MA.7.RP.A.2a	Decide whether two quantities are in a proportional relationship, e.g., by testing for equivalent ratios in a table or graphing on a coordinate plane and observing whether the graph is a straight line through the origin.
MA.7.RP.A.2b	Identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships.
MA.F-IF.B.6	Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.
MA.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.
MA.8.F.A.1	Understand that a function is a rule that assigns to each input exactly one output. The graph of a function is the set of ordered pairs consisting of an input and the corresponding output.
MA.8.F.A.2	Compare properties (e.g. rate of change, intercepts, domain and range) of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).
MA.8.F.A.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.

Instructional Tasks/Activities

- Baseball Activity
- Bingo
- Jeopardy
- Ladder Activity
- Manipulative Activities as needed
- Zombie Grudge Match

Assessment Procedure

- Classroom Total Participation Technique

- Classwork
- DBQ
- Essay
- Exit Ticket/Entrance Ticket/Do Now
- Identify the Error Problems
- Journal / Student Reflection
- Kahoot
- Other named in lesson
- Peer Review
- Performance
- Problem Correction
- Project
- Quiz
- Rubric
- Teacher Collected Data
- Test
- Worksheet

Recommended Technology Activities

- Appropriate Content Specific Online Resource
- Appropriate Content Specific Online Resource
- Gimkit
- GoGuardian
- Google Classroom
- Google Docs
- Google Slides
- Google Slides
- Kahoot
- MagicSchool AI
- Other- Specified in Lesson
- Quiziz
- Screencastify

Accommodations & Modifications & Differentiation

Accommodations and Modifications should be used to meet individual needs. Their IEP and 504 plans should be used in addition to the following suggestions.

Gifted and Talented

- Compare & Contrast
- Conferencing
- Debates
- Jigsaw
- Peer Partner Learning
- Problem Solving
- Structured Controversy
- Think, Pair, Share
- Tutorial Groups

Instruction/Materials

- alter format of materials (type/highlight, etc.)
- color code materials
- eliminate answers
- extended time
- extended time
- large print
- modified quiz
- modified test
- Modify Assignments as Needed
- Modify/Repeat/Model directions
- necessary assignments only
- Other (specify in plans)
- other- named in lesson
- provide assistance and cues for transitions
- provide daily assignment list
- read class materials orally
- reduce work load
- shorten assignments
- study guide/outline
- utilize multi-sensory modes to reinforce instruction

Environment

- alter physical room environment

- assign peer tutors/work buddies/note takers
- assign preferential seating
- individualized instruction/small group
- modify student schedule (Describe)
- other- please specify in plans
- provide desktop list/formula

Honors Modifications

Resources

- https://deltamath.com/
- https://education.ti.com/en/timathnspired/us/algebra-1
- www.Khanacademy.com
- www.mathforum.com

Special Education Pull out Essential Skills

- 1) The artist will be able to understand the concept of slope as a rate of change.
- 2) The artist will be able to discover the connection between slope and parallel/perpendicular lines.
- 3) The artist will be able to understand, apply, and manipulate the various formulas for linear equations.
- 4) The artist will be able to graph linear equations.