Unit 2: Linear Functions

Content Area: **Mathematics**
Course(s):
Time Period: **Marking Period 1**
Length: **9 Weeks**
Status: **Published**

Summary of Linear Functions

The concept of a function is foundational in secondary and advanced mathematics. Students will learn that a function is a special type of mathematical relationship in which the value of one variable depends on the value of another variable. Students will learn about independent and dependent variables, domain and range, and the four ways in which a function may be represented. In this unit, students apply their understanding of linear functions to elementary bivariate data analysis by creating scatter plots and lines of best fit to create mathematical models of data sets. Different types of functions are presented in this course, with emphasis on linear, exponential, and quadratic functions (in that order). Given that linear functions are the least complicated type, they are studied first. The fundamental concepts presented in this unit will support students in learning about the other types of functions in successive units. The end of this unit also introduces students to a two-way contingency table as a means of organizing data about multiple variables.

Revised Date: July 2024

NJ Standards for Linear Functions Unit

In accordance with New Jersey's Chapter 32 Diversity and Inclusion Law, this unit includes instructional materials that highlight and promote diversity, including equality when solving various linear equations given real world applications.

ELA.K-12.1	Developing Responsibility for Learning: Cultivating independence, self-reflection, and responsibility for one's own learning.
MATH.9-12.S.ID.B.5	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.
MATH.9-12.S.ID.B.6	Represent data on two quantitative variables on a scatter plot and describe how the variables are related.
MATH.9-12.S.ID.B.6.c	Fit a linear function for a scatter plot that suggests a linear association.
MATH.9-12.F.BF.B.4	Find inverse functions.
MATH.9-12.S.ID.C.7	Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.
MATH.9-12.A.CED	Creating Equations
SCI.K-2.ETS1.B	Developing Possible Solutions
MATH.9-12.S.ID.C.8	Compute (using technology) and interpret the correlation coefficient of a linear fit.
MATH.9-12.S.ID.C.9	Distinguish between correlation and causation.
MATH.9-12.F.IF	Interpreting Functions

MATH.9-12.F.IF.A.1	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 $y = f(x)$.
MATH.9-12.F.IF.A.2	Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.
MATH.9-12.A.REI	Reasoning with Equations and Inequalities
MATH.9-12.F.IF.A.3	Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers.
MATH.9-12.A.REI.B	Solve equations and inequalities in one variable
MATH.9-12.F.IF.B.4	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.
MATH.9-12.F.IF.B.5	Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.
MATH.9-12.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.
MATH.9-12.A.REI.C	Solve systems of equations
MATH.9-12.A.REI.D	Represent and solve equations and inequalities graphically
MATH.9-12.A.SSE.A	Interpret the structure of expressions
MATH.9-12.F.LE.A	Construct and compare linear and exponential models and solve problems
MATH.9-12.A.SSE.B	Write expressions in equivalent forms to solve problems
CS.K-12.3	Recognizing and Defining Computational Problems
WRK.K-12.P.5	Utilize critical thinking to make sense of problems and persevere in solving them.
WRK.K-12.P.8	Use technology to enhance productivity increase collaboration and communicate effectively.

Essential Questions for Linear Functions

- What is the meaning of a domain and range for a given function?
- What real-life relationships can be mathematically modeled by linear functions?
- What is an arithmetic sequence, and how can be it expressed algebraically as a linear function?
- What is a scatter plot, and how does one create a line of best fit to analyze real-life bivariate data sets?
- What are absolute value and piecewise functions, and how can they be used to support one's understanding of quadratic functions?
- How does one determine the average rate of change for a piecewise function over an interval?
- How does one graph a system of linear inequalities and identify a solution set?
- What is a two-way contingency table and how does one interpret the values it contains?

Enduring Understandings for Linear Functions

- Functions constitute a special type of relationship in mathematics, and they have independent and dependent variables.

- It is necessary to know and understand the domain and range for a given function.
- Linear functions extend one's understanding of linear graphs, knowing that the y-intercept and slope of a line have particular implications when functions are contextualized in real-life scenarios.
- Systems of linear inequalities can be graphed on the coordinate plan and the overlapping region represents the solution set.
- Scatter plots of bivariate data sets may be modeled by lines of best fit, and interpreted for levels of correlation.
- Transformations on the piecewise-defined absolute value function serve as a useful guide towards understanding transformations on quadratic functions.
- Arithmetic sequences can be written as linear functions, and they have both explicit and recursive formulas.
- Two-way tables are a helpful way to organize data about multiple variables.

Objectives for Linear Functions

- How to identify the domain and range of a function, especially in real-life context.
- How to create a linear function to model a real-life scenario.
- How to graph linear functions.
- How to graph systems of linear inequalities on the coordinate plane.
- How to perform transformations with absolute value functions.
- How to create a scatter plot and a line of best fit.
- How to identify the common difference for arithmetic sequences and use the given information to explicitly express an arithmetic sequence as a linear function.
- How to interpret two-way contingency tables.

Objectives for Linear Functions

- Writing, evaluating, and graphing linear functions.
- Graphing inequalities with two variables on the coordinate plane.
- Identifying key features of a linear function, including the significance of the y-intercept and the slope of a line as the rate of change between its independent and dependent variables.
- Creating a mathematical model for a real-life relationship as a linear function.
- Interpreting linear functions in context.
- Determining the average rate of change for a piecewise function, over a stated interval.
- Creating a mathematical model for bivariate data sets, using lines of best fit for scatterplots.
- Performing transformations on the graphs of absolute value functions.
- Identifying correlation between variables in a two-way contingency table.

Learning Plan for Linear Functions

1-2 Weeks: Instructor leads class in evaluating and graphing linear functions. Students learn how to bridge the gap between an equation and its graph by constructing a table of values. Emphasis is given to algebraically calculating the slope and intercepts for a linear function. Word problems are consistently used to develop

students' skills with translating and modeling. Discussions about domain and range are integrated into classroom exercises when working with word problems in real-life context.

1 Week: Students practice graphing systems of inequalities on the coordinate plane. Word problems are used to provide context and students learn how to interpret their solutions in relation to the real-life scenario contained within the word problem.

1-2 Weeks: Students work with a variety of arithmetic sequences – organizing the values into tables and constructing graphs to represent the sequences. Students make important connections between a table of values and the process of constructing linear graphs.

2 Weeks: Absolute value functions are introduced as the prototypical piecewise function. Include average rate of change. Students work with many examples of absolute value functions – evaluating and graphing, and learn to make natural connections between algebraic modifications and the corresponding changes to graphical appearances. Students learn how to identify the vertex of an absolute value function, as well as vertical and horizontal shifts, and vertical and horizontal stretching.

2 Weeks: Students are given data sets, learn how to plot the data points with appropriate scales on the axes, and draw lines of best fit. Students use their knowledge of linear functions to create mathematical models, interpret, predict and interpolate values based on their linear models.

1 Week: Two-way tables are presented to students as a means of organizing data with multiple variables. This topic is included on standardized testing, as such, it is important that students are exposed to the topic and learn how to interpret this type of informational table and look for the presence of correlation among variables.

1 Week: Review all topics and assess. Practice test questions, IXL assessment, student portfolio assignment.

Evidence/Performance Tasks for Linear Functions

During this unit, students will be administered many formative written assessments as entrance and exit tickets, along with homework assignments to be completed outside of class time. Short exercises in class will be frequently given as opportunities to practice drawing graphs of linear functions. The instructor will gauge student comprehension based on their written answers along with their participation in class discussions. IXL shall be used throughout this unit to assess and provide immediate feedback to students with their efforts and keep track of their progress with an individualized SmartScore on the website. A final summative assessment is given on paper for students to demonstrate their understanding of linear functions.

Materials

Core Instructional materials: Lecture notes and classroom activities designed by instructors.

Core Book List including Algebra 1, Pearson Publishing

Supplemental instructional materials: IXL

Suggested Strategies for Modification

Possible accommodations/modification for Algebra 1