New York State Testing Program

Next Generation Mathematics Test

Performance Level Descriptions

Algebra I

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THE STATE EDUCATION DEPARTMENT / THE UNIVERSITY OF THE STATE OF NEW YORK /
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Algebra I Performance Level Descriptions

Performance level descriptions (PLDs) help communicate to students, families, educators, and the public the specific knowledge and skills expected of students when they demonstrate proficiency of a learning standard. The PLDs serve several purposes in classroom instruction and assessment. They are the foundation of rich discussion around what students need to do to perform at higher levels and to explain the progression of learning within a subject area. PLDs are also crucial in explaining student performance on the NYS assessments since they make a connection between the scale score, the performance level, and specific knowledge and skills typically demonstrated at that level.

Policy Definitions of Performance Levels

For each subject area, students perform along a continuum of the knowledge and skills necessary to meet the demands of the Learning Standards for Mathematics. There are students who meet the expectations of the standards with distinction, students who fully meet the expectations, students who minimally meet the expectations, students who partially meet the expectations, and students who do not demonstrate sufficient knowledge or skills required for any performance level. New York State assessments are designed to classify student performance into one of five levels based on the knowledge and skills the student has demonstrated.

These performance levels for the Mathematics Regents Examinations are defined as:

NYS Level 5

Students performing at this level meet the expectations of the Mathematics Learning Standards **with distinction** for Algebra I.

NYS Level 4

Students performing at this level **fully meet** the expectations of the Mathematics Learning Standards for Algebra I. They are likely prepared to succeed in the next level of coursework.

NYS Level 3

Students performing at this level **minimally meet** the expectations of the Mathematics Learning Standards for Algebra I. They meet the content area requirements for a Regents diploma but may need additional support to succeed in the next level of coursework.

NYS Level 2

Students performing at this level **partially meet** the expectations of the Mathematics Learning Standards for Algebra I. Students with disabilities performing at this level meet content area requirements for a local diploma but may need additional support to succeed in the next level of coursework.

NYS Level 1

Students performing at this level demonstrate knowledge, skills, and practices embodied by the Mathematics Learning Standards for Algebra I below that of Level 2.

How were the PLDs developed?

Following best practice for the development of PLDs, the number of performance levels and their definitions were specified prior to the articulation of the full descriptions. The New York State Education Department convened a group of NYS mathematics educators to develop the initial draft PLDs for Algebra I. In developing PLDs, participants considered policy definitions of the performance level and the knowledge and skill expectations for each grade level in the Learning Standards. Once they established the appropriate knowledge and skills from a particular standard for NYS Level 4 (fully meet), panelists worked together to parse the knowledge and skills across the other performance levels in such a way that the progression of the knowledge and skills was clearly seen moving from Level 2 to Level 5. This process was repeated for all of the standards within the course. The draft PLDs then went through additional rounds of review and edits from a number of NYS-certified educators, content specialists, and assessment experts under NYSED supervision.

How can the PLDs be used by Educators and in Instruction?

The PLDs should be used as a guidance document to show the overall continuum of learning of the knowledge and skills from the Learning Standards. NYSED encourages the use of the PLDs for a variety of purposes, including differentiating instruction to maximize individual student outcomes, creating formative classroom assessments and rubrics to help identify target performance levels for individual or groups of students, and tracking student growth along the proficiency continuum as described by the PLDs. The knowledge and skills shown in the PLDs describe typical performance and progression, however the order in which students will demonstrate the knowledge and skills within and between performance levels may be staggered (i.e. a student who predominantly demonstrates Level 3 knowledge and skills may simultaneously demonstrate certain knowledge and skills indicative of Level 4).

How are the PLDs used in Assessment?

PLDs are essential in setting performance standards (i.e., "cut scores") for New York State assessments. Standard setting panelists use PLDs to determine the expectations for students to demonstrate the knowledge and skills necessary to just barely attain a Level 3, Level 4, or Level 5 on the assessment. These knowledge and skills drive discussions that influence the panelists as they recommend the cut scores on the assessment. PLDs are also used in question development. Question writers are assigned to write questions that draw on the specific knowledge and skills from a PLD. This ensures that each test has questions that distinguish performance all along the continuum. Teachers can use the PLDs in the same manner when developing both formative and summative classroom assessments. Tasks that require students to demonstrate knowledge and skills from the PLDs can be tied back to the performance level with which the PLD is associated, providing the teacher with feedback about the students' progress as well as a wealth of other skills that the student is likely able to demonstrate (or can aspire to in the case of the next-highest PLD).

Note: Certain level 5 PLD's will be denoted with a star, indicating the knowledge and skills represented will not be targeted by questions on the NYS Algebra I Regents Examination.

	Performance Level 5	Performance Level 4	Performance Level 3	Performance Level 2
Use Properties of rational and irrational numbers. **N-RN.B**	*Perform operations on radicals that include variables in the radicand.[1]	Perform operations on rational and irrational numbers of unlike radicals which require more than one simplification. Rationalize numerical denominators of irrational fractions.	Perform operations on rational and irrational numbers including like and unlike radicals which require only one simplification.	Perform operations on radicals which do *not* require simplification of the radicand. (Addition and subtraction may include a variable in front of the radical.)
	Explain why sums or products are rational or irrational including giving concrete examples.	Explain why sums or products of given numbers are rational or irrational.	Categorize the sums or products of rational and/or irrational numbers as rational or irrational.	Identify rational and irrational numbers.
Reason quantitatively and use units to solve problems. **N-Q.A**	Explain how altering the units would affect the degree of accuracy of the solutions.	Convert units of measure using multiple steps. Choose and/or interpret the appropriate unit and scale in formulas, graphs, and data displays. Apply the given units of a multi-step real world problem to determine an appropriate solution pathway.	Identify the correct steps necessary to convert units of measure. Determine an appropriate unit of measure given a real-world situation.	Convert accurately between two units of measure (does not include rates).
	Justify the accuracy of units and/or limitations on measurements used in reporting quantities when solving problems.	Determine an appropriate level of accuracy on measurements in context when reporting quantities, (if units are tenths and hundredths, then the appropriate level is tenth).		

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	Performance Level 5	Performance Level 4	Performance Level 3	Performance Level 2
Interpret the structure of expressions. A-SSE.A		Simplify expressions, including combining like terms, using the distributive property or other operations on polynomials.	Arrange a polynomial expression in standard form. Identify the terms of a polynomial: coefficients, degree, leading coefficient, and constant term.	Arrange a trinomial in standard form.
	Explain how an equivalent but different form of an expression reveals different information about the context it models.	Interpret parts of an expression in terms of quantities they represent within a context, including cases that involve rewriting the expressions.	Write an appropriate expression within the context of a real-world problem.	Translate a verbal expression into a mathematical expression.
	*Factor a polynomial whose leading coefficient is other than 1 (there is no GCF).[1]	Rewrite polynomials in equivalent forms using a combination of methods to factor completely.	Determine equivalent expressions by applying factoring strategies that include a GCF with a variable, the difference of perfect squares, or trinomials in the form of $ax^2 + bx + c$ whose leading coefficient is 1.	Identify and factor out a numerical GCF.
Write expressions in equivalent forms to reveal their characteristics. A-SSE.B	Explain how equivalent but different forms of exponential expressions, (* including fractional exponents[1]), reveal different characteristics about the function they define.	Rewrite equivalent monomial expressions using more than one law of exponents. Rewrite expressions using the laws of exponents to create equivalent polynomials.	Write equivalent monomials or polynomials that include coefficients that are *not* equal to one using one law of exponents.	Write equivalent monomials with coefficients equal to one using laws of exponents.

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	Performance Level 5	Performance Level 4	Performance Level 3	Performance Level 2
Perform arithmetic operations on polynomials. A-APR.A	Perform at least two operations on polynomial expressions with fractional coefficients.	Perform at least two operations (addition, subtraction, and multiplication) on polynomial expressions which may include multiplying a trinomial by a binomial or a trinomial by a trinomial.	Perform an operation (addition, subtraction, and multiplication) on polynomial expressions that may include a fractional coefficient. Perform multiplication on two binomials.	Perform an operation, including addition or subtraction on polynomial expressions with integral coefficients.
Understand the relationship between zeros and factors of polynomials. A-APR.B	Create a possible factorization of a polynomial function based upon known zeros. *Explain how the zero(s) of a function relates to a graph.[1]	Determine the zeros of polynomial functions by using different methods of factorization. Explain the relationship between a function and its zeros.	Identify the zeros of quadratic and cubic functions when written in factored form.	Identify the zeros of a quadratic function using a method other than factorization (graphically, use of a table, or technology).
Create equations that describe numbers or relationships A-CED.A		Create a one variable equation or inequality to represent a real-world context, which requires more than two steps. Create an exponential function that describes a relationship between two quantities given a real-world context. Create equations and inequalities in two variables to represent a real-world context.	Create a one variable equation or inequality to represent a real-world context, which requires one or two steps.	Create an equation or inequality in one variable given a verbal description.

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	Performance Level 5	Performance Level 4	Performance Level 3	Performance Level 2
	Explain how the solution(s) to equations and inequalities represent what is viable or not viable within the modeling context.	Create and solve a multiple step equation or inequality in one variable to represent a real-world context and/or interpret the solutions. Create and solve a quadratic or exponential equation in one variable given the context of the problem and/or interpret the solutions. Create and solve systems of equations or inequalities in two variables to represent a real-world context and/or interpret the solutions.	Create and solve a one or two step equation or inequality in one variable to represent a real-world context.	Identify a solution to the context of a problem using a method other than algebraic.
		Rewrite a formula or identify an equivalent expression that involves taking the square root and/or subscripts.	Rewrite a formula using more than two steps to solve for a given variable.	Rewrite formulas using two steps to solve for a given variable.
Understand solving equations as a process of reasoning and explain the reasoning. **A-REI.A**	Construct a viable argument to justify a quadratic solution method.	State and/or explain more than one step when solving a linear or quadratic equation.	State one property in the algebraic solution of a single variable equation using precise mathematical vocabulary.	
Solve equations and inequalities in one variable. **A-REI.B**	Solve literal equations involving factoring.	Solve multi-step linear equations and inequalities in one variable where the coefficients and constants are rational numbers. Solve literal equations.	Solve multi-step linear equations and inequalities in one variable where the coefficients are rational numbers, and the constants are integers.	Solve two step equations and inequalities in one variable where the coefficients are rational numbers, and the constants are integers. Graph the solution of an inequality on a number line.

	Performance Level 5	Performance Level 4	Performance Level 3	Performance Level 2
	*Rewrite a quadratic equation into the form $(x-p)^2=q$ by using the method of completing the square. The quadratic's leading coefficient is other than 1 and the coefficient of the linear term may be odd or even.[1]	Rewrite the quadratic equation in the form $ax^2+bx+c=0$ into the form $(x-p)^2=q$ by using the method of completing the square. The quadratic's leading coefficient must be 1 and the coefficient of the linear term must be even (after factoring out a possible GCF).	Rewrite an equation in the form $x^2+bx=n$ into the form $(x-p)^2=q$ by completing the square, where *b* is even.	Determine the value of *c* given the trinomial ax^2+bx+c, where $a=1$ and *b* is even, to create a perfect square trinomial.
	*Solve a quadratic by factoring whose leading coefficient is other than 1 (there is no GCF).[1] Construct a viable argument to justify the advantage of using one method over another. Determine if a quadratic equation has no real solution using the discriminant. Predict, without solving, when a quadratic equation will have no real solutions and explain using algebraic or graphical evidence.	Solve quadratic equations by factoring or graphing. Solve quadratic equations by completing the square or the quadratic formula. This may include simplifying radicals. Determine the number of the solutions to a quadratic equation algebraically.	Determine the solutions to a quadratic equation that is set equal to zero using the difference of two perfect squares. Determine the solutions to a quadratic equation that is given in factored form or in the form, $(x-p)^2=q$. Determine the number of solutions to a quadratic equation from a given graph.	Solve quadratic equations by inspection or by taking square roots.

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Solve systems of equations. **A-REI.C**	Explain a method of choice when solving systems of linear equations. Determine approximate solutions using technology.	Solve systems of linear equations in two variables either algebraically or graphically. Equations have rational coefficients and/or constants.	Solve systems of linear equations in two variables either algebraically or graphically. Equations have integral coefficients and constants. Determine the number of solutions for linear system of equations. (One solution, many solutions, or no solution.)	Solve systems of linear equations algebraically (when one equation is solved for a variable) or graphically (when the equations are solved for y). Identify a correct step in the process of using substitution to solve a system of equations. Determine the number of solutions given the graphs of a linear system of equations. (One solution, many solutions, or no solution.)
	Solve a linear-quadratic system of equations graphically and approximate the solutions using technology.	Solve a linear-quadratic system of equations in two variables algebraically.	Solve a linear-quadratic system of equations in two variables, with integral solutions, graphically. Determine the number of solutions of a linear-quadratic system. (One solution, two solutions, or no solution.)	Justify that a given set of coordinates is a solution to a linear-quadratic system of equations.
Represent and solve equations and inequalities graphically. **A-REI.D**	Determine if a point does *not* fall on a line, given a set of points when the equation is *not* given.	Determine either the *x* or *y* coordinate of a point on the parabola when given the equation of the parabola. Write the equation for a line when given two points on the line. Determine if the graph of an equation in two variables is the set of all solutions in the coordinate plane where the numbers are rational values.	Determine either the *x* or *y* coordinate of a point on the line when given the equation of the line. Write the equation for a line when given the slope and a point on the line. Write the equation of a line when given its graph.	Determine if a point is on a line or parabola when given its equation. Write the equation of a line when given the slope and *y* intercept. Determine if the graph of an equation in two variables is the set of all solutions in the coordinate plane where the numbers are integral values.

	Performance Level 5	Performance Level 4	Performance Level 3	Performance Level 2
	Explain why the solution of two equations in two variables occur at the point of intersection of their graphs. Determine non-integral solutions to $f(x) = g(x)$ using technology.	Interpret the meaning of the intersection of the graphs of *y=f(x)* and *y=g(x)* in terms of a context. Graph *f(x)* and *g(x)* and state all values of *x* for which $f(x) = g(x)$. This may include quadratic, absolute value, exponential, and step (piecewise) functions.	Graph the linear functions *f(x)* and *g(x)* and state the value of *x* for which $f(x) = g(x)$.	State all values of *x* for which $f(x) = g(x)$ when given the graphs of *f(x)* and *g(x)*.
	Explain what a point in the solution set means in the context of the problem. Explain why there are multiple solutions to a system of inequalities.	Write an inequality given its graph. Graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.	Justify that a point lies in the solution set of a system of inequalities. Graph the solutions to one linear inequality in two variables as a half- plane.	Justify that a point lies in the solution set of a given inequality. Identify a point in the solution set given the graph of a system of inequalities.
Understand the concept of a function and use function notation. F-IF.A		Explain 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. State the domain and/or range of a given function using set builder notation, interval notion, inequalities, or a verbal description.	Identify if a relation is a function when given a linear, exponential, quadratic, or square root equation.	Identify if a relation is a function given a graph, table, coordinates, mapping, or a verbal description.
	Determine the input for a given output when the equation is expressed in function notation.	Evaluate multiple functions for inputs in their domains when given the equations in function notation. Interpret statements that use function notation in terms of a context.	Evaluate a function when given function notation, for inputs in its domain. Express inputs and outputs using function notation.	Evaluate functions for inputs in their domains using a table or graph.

	Performance Level 5	Performance Level 4	Performance Level 3	Performance Level 2
	*Write a sequence in a recursive form.[1] Write an explicit equation in subscript notation given two terms and the type of sequence. Determine a specific term of a sequence given the type of sequence and two terms in the sequence that includes variables. Explain why sequences are functions whose domain is a subset of integers. Explain if a function is continuous or discrete in a real-world context.	Identify the common difference or ratio for sequences that include variables. Write an explicit equation in subscript notation for a given sequence. Determine a specific term of a sequence given the type of sequence and at least two terms in the sequence. Determine the n*th* term for a given sequence using the explicit formula.	Identify the common difference for an arithmetic sequence. Identify the common ratio for a geometric sequence. Determine a specific term of a sequence given a term in the sequence and the common difference or ratio.	Identify and continue patterns of geometric sequences. Identify if a given sequence is arithmetic, geometric, or neither.
Interpret functions that arise in applications in terms of the context. **F-IF.B**	Determine non-integral key features of a function by using technology.	Interpret key features of functions (including absolute value, square root, and piecewise), from a verbal description, equation, or graph of the relationship. Describe key features of functions (including absolute value, square root, and piecewise.) Describe an interval (set of numbers) using set builder notation, interval notation, or inequalities.	Interpret key features of functions (including linear, quadratic, and exponential), from an equation, graph, or table of values in the context of the problem. The domain of the exponent is limited to positive integral values. Describe the key features of functions in the context of the problem (including linear, quadratic, and exponential).	Describe the *x* and *y* intercepts in the context of the problem given its graph.

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	Determine the domain of a function from its equation. Explain why a domain is appropriate given the real-world context.	Determine the appropriate domain for a function in context.	Determine the domain of a function from its graph.	Determine the domain of a function from its table.
	Calculate, interpret, and compare the average rate of change of two or more functions over a specified interval. Calculate the average rate of change over a specified interval when the equation is written in function form.	Interpret the average rate of change of a function over a specified interval in context, which may include stating the appropriate units. Express the average rate of change of a function over a specified interval using set builder notation, interval notation, or inequalities.	Calculate multiple average rates of change of a function over specified intervals from a table or graph.	Calculate the average rate of change of a function over a specified interval from a table or graph.
Analyze functions using different representations. F-IF.C	*Graph exponential equations, including the asymptotes.[1] Identify key features of a graph by hand or by using technology where the values are not integers.	Graph square root, absolute value, and piecewise functions by hand or by using technology where appropriate. Graph functions over a given domain.	Graph quadratic and exponential functions by hand or by using technology where appropriate. Identify key features of a graph where the values are integers.	Graph linear functions by hand or by using technology where appropriate.
	*Determine the vertex of a quadratic function by using the process of completing the square.[1]	Write a quadratic function in different but equivalent forms to reveal and/or explain different characteristics of the function. Algebraically determine the vertex, maxima, or minima of a quadratic function. Determine the zeros of a quadratic function using factorization. Algebraically determine the zeros of a quadratic function using the quadratic formula.	Write a linear function in different but equivalent forms to reveal and/or explain different characteristics of the function. Determine the equation for the axis of symmetry of a quadratic function using a formula. Determine the zeros of a function written in factored form.	Write a linear function in different but equivalent forms to reveal different characteristics of the function. State the equation for the axis of symmetry of a quadratic function when given its graph.

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	Compare key features of more than two functions represented in different ways which must include a verbal description. Transform and/or graph functions to justify an interpretation of the key features.	Compare key features of more than two functions represented in at least three different ways.	Compare key features of two or more functions represented in at least two different ways (graphically, algebraically, or numerically in tables).	Compare key features of two functions each represented graphically.
Build a function that models a relationship between two quantities. **F-BF.A**	Write a quadratic function that describes a relationship between two quantities given a real-world context. Write an explicit geometric function when given two non-consecutive terms, neither of which are the initial term. Write an explicit geometric or arithmetic function when the terms include variables. Generate the nth term of a given sequence where n is greater than 25.	Write an exponential function that describes a relationship between two quantities given a real-world context. Write an explicit geometric function using subscript notation given the initial term and a common ratio or two consecutive terms. Write an explicit arithmetic function when given two non-consecutive terms, neither of which are the initial term.	Write a linear function that describes a relationship between two quantities given a real-world context. Write a linear function that describes a relationship between two quantities given a table. Write a geometric sequence when given the initial term and common ratio or two consecutive terms. Write an explicit arithmetic function using subscript notation given the initial term and a common difference or two consecutive terms.	Write a linear function that describes a relationship between two quantities given a graphical representation. Write an arithmetic sequence when given the initial term and common difference or two consecutive terms.

	Performance Level 5	Performance Level 4	Performance Level 3	Performance Level 2
Build new functions from existing functions. **F-BF.B**	Explain the specific effect on the graph when replacing *f(x)* by $af(x+b)+c$ for values of *a*, *b*, and *c*. Generalize that the effect of a constant, *k*, is the same across different function families.	Explain the specific effect k has on the graph of *f(x)* when replacing *f(x)* with graphs of multiple transformations. Graph the image of *f(x)* after multiple transformations. Write a new function given a function *f(x)* and a verbal description or graph of multiple transformations.	Explain the specific effect *k* has on the graph of *f(x)* given $f(x)+k$, $f(x+k)$, or $kf(x)$. Determine the value of *k* given the graphs *f(x)* and the graph after one transformation. Graph a new function given *f(x)* and a value of *k* for one transformation. Write a new function given a function *f(x)* and a verbal description or graph of one transformation.	Explore the general effect (shift up, down, right, left, wider, or narrower) of *k* given the graph of *f(x)* for $f(x)+k$, $kf(x)$, or $f(x+k)$ by using technology.
Construct and compare linear, quadratic, and exponential models and solve problems. **F-LE.A**	Explain why situations can be modeled either linearly or exponentially as depicted in real-world situations.	Justify/explain why a function is linear or exponential. Describe an exponential pattern of change in a real-world situation. Describe the rate of change depicted in a real-world situation where a quantity grows or decays at a constant percent rate per unit interval.	Identify a situation as linear or exponential given equations, graphs, tables, and/or verbal descriptions. Describe a linear pattern of change in a real-world situation. Describe the rate of change depicted in a real-world situation where a quantity grows or decays at a constant rate per unit interval.	Identify the type of function given a situation represented by a graph, table, and/or verbal description.
	Write an exponential function, *f(x)*, given a graph.	Write an exponential function, *f(x)*, given a verbal description (growth and decay) or from a table of values.	Write a linear function, *f(x)*, given a verbal description or from a table of values.	Write a linear function, *f(x)*, given a graph.

	Performance Level 5	Performance Level 4	Performance Level 3	Performance Level 2
	Explain, by using student generated graphs and tables, that a quantity increasing exponentially eventually exceeds a quantity increasing linearly or quadratically or as a polynomial function.	Justify that exponential rates of growth eventually exceed the rates of growth modeled by linear and quadratic functions when given graphs and/or tables of multiple functions. State the interval where the linear function grows faster than the exponential function.	Justify that a quantity increasing exponentially eventually exceeds a quantity increasing linearly given equations, graphs and/or tables.	State a value that will demonstrate when a quantity increasing exponentially will exceed a quantity increasing linearly given a graph.
Interpret expressions for functions in terms of the situation they model. **F-LE.B**	Interpret changes in parameters based on the comparison of multiple functions in terms of a real-world context. Rewrite exponential equations in different forms in terms of a real-world context. Compare exponential functions in a variety of contexts.	Identify that exponential relationships have a percentage rate of change in terms of a real-world context. Interpret the meanings of the initial value, rate, and/or exponent of an exponential function in terms of a real-world context. Interpret the meaning of $f(x) = a(b)^x$ in a variety of contexts. Identify an appropriate value of *b* to model growth or decay. Write exponential functions that are described by the parameters in the context of the problem.	Identify the slope and/or y-intercept in a linear function in terms of a real-world context. Interpret the meanings of the initial value and/or rate of a linear function in terms of a real-world context. Interpret the meaning of $f(x) = mx + b$ in a variety of contexts. Identify an appropriate value for *m* to model increase or decrease. Write linear functions that are described by the parameters in the context of the problem.	Identify that linear relationships have a constant rate of change. Rewrite a linear equation in $y = mx + b$ form to best describe the parameters.

	Performance Level 5	Performance Level 4	Performance Level 3	Performance Level 2
Summarize, represent, and interpret data on a single count or measurement variable. **S-ID.A**	Choose, justify, and represent the most appropriate graphical representation of a set of data. Represent data by constructing a cumulative frequency histogram using correct labels and intervals.	Represent data by constructing a box plot on a student generated scaled number line. Represent data by constructing a histogram using correct labels and intervals.	Determine the five number summary of a data set. Construct a box plot on a given scaled number line. Represent data by constructing dot plots. Interpret data given a histogram, a dot plot, and/or a box plot.	Identify whether a given graph is a histogram, dot plot, or box plot.
	Interpret the sample standard deviation to describe the variability of a data set, or to compare two sets of data that are approximately symmetric.	Calculate and/or compare the sample standard deviation of two or more different data sets.	Calculate and/or compare quartile 1, quartile 3, and the interquartile range of data sets.	Calculate and/or compare the mean, median and/or range of data sets.
	Solve real-world problems by interpreting graphical representations or statistical values drawn from two or more different data sets. Decide when to include the outliers as part of the data set or to remove them for purposes of descriptive modeling.	Interpret the spread of the data using range (when the data is not skewed), inter-quartile range, and/or sample standard deviation. Explain which is the most appropriate measure of center and spread to describe a distribution that is symmetric (mean) or skewed(median). Interpret differences in shape, center and spread in the context of the data sets using either sample standard deviation or interquartile range (if there are outliers).	Calculate the inter-quartile range of a set of data. Determine if the data set has an approximately normal distribution or is skewed (left or right). Identify and interpret the effect of outliers on the mean and/or median on data sets, and how it affects the distribution of the data (normal or skewed).	Calculate the range of a set of data. Identify outliers of a given data set.

	Performance Level 5	Performance Level 4	Performance Level 3	Performance Level 2
Summarize, represent, and interpret data on two categorical and quantitative variables. S-ID.B	Calculate and compare two or more conditional relative frequencies.	Complete a two-way frequency table. Interpret marginal, joint, and conditional relative frequencies of data displayed in a two-way table in terms of a context of the data and/or use them to predict outcomes.	Calculate marginal, joint, and conditional relative frequencies (expressed as probability and/or percentages) of data displayed in a two-way table in terms of a context of the data. Describe the associations and trends in the data given a completed two-way table.	Identify quantitative differences of categorical data given a two-way frequency table.
	*Fit a non-linear function to the data by using technology.[1] Use the linear model to extrapolate or interpolate values. *Explain, in context, the meaning of the line of best fit that models quadratic and exponential data.[1]	Fit a linear function to real world data. Sketch the line of best fit given the scatter plot and use this line to predict values. Explain, in context, the meaning of the line of best fit that models linear data.	Fit a linear function to the data by using technology and state the regression equation for line of best fit. Create a scatter plot from two quantitative variables. Given only a scenario, describe the relationship between two variables. Make a prediction given a scatterplot.	Given a scenario and a scatterplot, describe the relationship between two variables (positive, negative or no relationship). Sketch the line of best fit given the scatter plot.

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Interpret linear models. **S-ID.C**	Compare the slope and *y*-intercept of two linear models in context.	Interpret the slope and the *y*-intercept of a linear model in the context of the data.	Interpret the slope or *y*-intercept of a linear model in the context of the data.	State the slope and the *y*-intercept of a linear model.
	Explain that the correlation coefficient describes a statistical relationship and can be used to judge the fit but does *not* indicate a cause-and-effect relationship.	Interpret the strength of the correlation coefficient for the line of best fit in the context of the problem.	Use technology to state the regression equation and/or the correlation coefficient for the line of best fit. Indicate if the relationship is strong or weak.	State if a relationship is strong ($r \leq -0.8$ and $r \geq 0.8$) or weak ($-0.2 \leq r \leq 0.2$) given a correlation coefficient.
	Generate and explain examples of relationships that are correlated and causal or correlated but not causal.	Distinguish between correlation and causation for multiple relationships. Explain the difference between correlation and causation for a given example.	Distinguish between correlation and causation for two relationships. Explain the difference between correlation and causation.	Explain why a given relationship represents correlation. Indicate if a relationship is a positive or negative correlation.