

# Algebra 1 Honors   (#1200320)

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| **Course Section:** Grades PreK to 12 Education Courses  | **Abbreviated Title:** ALG 1 HON  |
| **Honors?** Yes  |  |
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| **Grade Level(s):** 9, 10, 11, 12  | **Grade Level(s) Version:** 9,10,11,12  |
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#### VERSION DESCRIPTION

The fundamental purpose of this course is to formalize and extend the mathematics that students learned in the middle grades. The critical areas, called units, deepen and extend understanding of linear and exponential relationships by contrasting them with each other and by applying linear models to data that exhibit a linear trend, and students engage in methods for analyzing, solving, and using quadratic functions. The Standards for Mathematical Practice apply throughout each course and, together with the content standards, prescribe that students experience mathematics as a coherent, useful, and logical subject that makes use of their ability to make sense of problem situations.

**Unit 1- Relationships Between Quantities and Reasoning with Equations:** By the end of eighth grade, students have learned to solve linear equations in one variable and have applied graphical and algebraic methods to analyze and solve systems of linear equations in two variables. Now, students analyze and explain the process of solving an equation. Students develop fluency writing, interpreting, and translating between various forms of linear equations and inequalities, and using them to solve problems. They master the solution of linear equations and apply related solution techniques and the laws of exponents to the creation and solution of simple exponential equations.

**Unit 2- Linear and Exponential Relationships:** In earlier grades, students define, evaluate, and compare functions, and use them to model relationships between quantities. In this unit, students will learn function notation and develop the concepts of domain and range. They explore many examples of functions, including sequences; they interpret functions given graphically, numerically, symbolically, and verbally, translate between representations, and understand the limitations of various representations. Students build on and informally extend their understanding of integer exponents to consider exponential functions. They compare and contrast linear and exponential functions, distinguishing between additive and multiplicative change. Students explore systems of equations and inequalities, and they find and interpret their solutions. They interpret arithmetic sequences as linear functions and geometric sequences as exponential functions.

**Unit 3- Descriptive Statistics:** This unit builds upon students prior experiences with data, providing students with more formal means of assessing how a model fits data. Students use regression techniques to describe and approximate linear relationships between quantities. They use graphical representations and knowledge of the context to make judgments about the appropriateness of linear models. With linear models, they look at residuals to analyze the goodness of fit.

**Unit 4- Expressions and Equations:** In this unit, students build on their knowledge from unit 2, where they extended the laws of exponents to rational exponents. Students apply this new understanding of number and strengthen their ability to see structure in and create quadratic and exponential expressions. They create and solve equations, inequalities, and systems of equations involving quadratic expressions.

**Unit 5- Quadratic Functions and Modeling:** In this unit, students consider quadratic functions, comparing the key characteristics of quadratic functions to those of linear and exponential functions. They select from among these functions to model phenomena. Students learn to anticipate the graph of a quadratic function by interpreting various forms of quadratic expressions. In particular, they identify the real solutions of a quadratic equation as the zeros of a related quadratic function. Students expand their experience with functions to include more specialized functions absolute value, step, and those that are piece wise-defined.

#### GENERAL NOTES

Fluency Recommendations

**A/G**- Algebra I students become fluent in solving characteristic problems involving the analytic geometry of lines, such as writing down the equation of a line given a point and a slope. Such fluency can support them in solving less routine mathematical problems involving linearity, as well as in modeling linear phenomena (including modeling using systems of linear inequalities in two variables).

**A-APR.1**- Fluency in adding, subtracting, and multiplying polynomials supports students throughout their work in Algebra, as well as in their symbolic work with functions. Manipulation can be more mindful when it is fluent.

**A-SSE.1b**- Fluency in transforming expressions and chunking (seeing parts of an expression as a single object) is essential in factoring, completing the square, and other mindful algebraic calculations.

#### ****Course Standards****

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| **Name** | **Description** |
| [MAFS.912.N-RN.1.1:](http://www.cpalms.org/Public/PreviewStandard/Preview/5516) | Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents. *For example, we define http://www.cpalms.org/Uploads/Benchmark/5516/img/Capture2.PNG to be the cube root of 5 because we want http://www.cpalms.org/Uploads/Benchmark/5516/img/Capture1.PNG = http://www.cpalms.org/Uploads/Benchmark/5516/img/Capture3.PNG to hold, so http://www.cpalms.org/Uploads/Benchmark/5516/img/Capture1.PNG must equal 5.* |
| [MAFS.912.N-RN.1.2:](http://www.cpalms.org/Public/PreviewStandard/Preview/5517) | Rewrite expressions involving radicals and rational exponents using the properties of exponents. |
| [MAFS.912.N-RN.2.3:](http://www.cpalms.org/Public/PreviewStandard/Preview/5518) | Explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational. |
| [MAFS.912.N-Q.1.1:](http://www.cpalms.org/Public/PreviewStandard/Preview/5519) | 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. |
| [MAFS.912.N-Q.1.2:](http://www.cpalms.org/Public/PreviewStandard/Preview/5520) | Define appropriate quantities for the purpose of descriptive modeling.

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| **Remarks/Examples:****Algebra 1 Content Notes:**Working with quantities and the relationships between them provides grounding for work with expressions, equations, and functions. |

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| [MAFS.912.N-Q.1.3:](http://www.cpalms.org/Public/PreviewStandard/Preview/5521) | Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. |
| [MAFS.912.A-SSE.1.1:](http://www.cpalms.org/Public/PreviewStandard/Preview/5543) | Interpret expressions that represent a quantity in terms of its context. 1. Interpret parts of an expression, such as terms, factors, and coefficients.
2. Interpret complicated expressions by viewing one or more of their parts as a single entity. *For example, interpret http://www.cpalms.org/Uploads/Benchmark/5543/img/Capture1.PNG as the product of P and a factor not depending on P.*
 |
| [MAFS.912.A-SSE.1.2:](http://www.cpalms.org/Public/PreviewStandard/Preview/5544) | 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).* |
| [MAFS.912.A-SSE.2.3:](http://www.cpalms.org/Public/PreviewStandard/Preview/5545) | Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. 1. Factor a quadratic expression to reveal the zeros of the function it defines.
2. Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.
3. Use the properties of exponents to transform expressions for exponential functions. *For example the expression http://www.cpalms.org/Uploads/Benchmark/5545/img/Capture1.PNG can be rewritten as http://www.cpalms.org/Uploads/Benchmark/5545/img/Capture2.PNG ≈ http://www.cpalms.org/Uploads/Benchmark/5545/img/Capture3.PNG to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.*
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| [MAFS.912.A-SSE.2.4:](http://www.cpalms.org/Public/PreviewStandard/Preview/5546) | Derive the formula for the sum of a finite geometric series (when the common ratio is not 1), and use the formula to solve problems. *For example, calculate mortgage payments.* |
| [MAFS.912.A-APR.1.1:](http://www.cpalms.org/Public/PreviewStandard/Preview/5547) | 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.

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| **Remarks/Examples:****Algebra 1 - Fluency Recommendations**Fluency in adding, subtracting, and multiplying polynomials supports students throughout their work in algebra, as well as in their symbolic work with functions. Manipulation can be more mindful when it is fluent.  |

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| [MAFS.912.A-APR.2.2:](http://www.cpalms.org/Public/PreviewStandard/Preview/5548) | Know and apply the Remainder Theorem: For a polynomial p(x) and a number a, the remainder on division by x – a is p(a), so p(a) = 0 if and only if (x – a) is a factor of p(x). |
| [MAFS.912.A-APR.2.3:](http://www.cpalms.org/Public/PreviewStandard/Preview/5549) | Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomial. |
| [MAFS.912.A-APR.3.4:](http://www.cpalms.org/Public/PreviewStandard/Preview/5550) | Prove polynomial identities and use them to describe numerical relationships. For example, the polynomial identity (x² + y²)² = (x² – y²)² + (2xy)² can be used to generate Pythagorean triples. |
| [MAFS.912.A-APR.4.6:](http://www.cpalms.org/Public/PreviewStandard/Preview/5552) | Rewrite simple rational expressions in different forms; write a(x)/b(x) in the form q(x) + r(x)/b(x), where a(x), b(x), q(x), and r(x) are polynomials with the degree of r(x) less than the degree of b(x), using inspection, long division, or, for the more complicated examples, a computer algebra system. |
| [MAFS.912.A-CED.1.1:](http://www.cpalms.org/Public/PreviewStandard/Preview/5554) | Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational, absolute, and exponential functions. |
| [MAFS.912.A-CED.1.2:](http://www.cpalms.org/Public/PreviewStandard/Preview/5555) | Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. |
| [MAFS.912.A-CED.1.3:](http://www.cpalms.org/Public/PreviewStandard/Preview/5556) | Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context. *For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.* |
| [MAFS.912.A-CED.1.4:](http://www.cpalms.org/Public/PreviewStandard/Preview/5557) | 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.* |
| [MAFS.912.A-REI.1.1:](http://www.cpalms.org/Public/PreviewStandard/Preview/5558) | Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.  |
| [MAFS.912.A-REI.1.2:](http://www.cpalms.org/Public/PreviewStandard/Preview/5559) | Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise. |
| [MAFS.912.A-REI.2.3:](http://www.cpalms.org/Public/PreviewStandard/Preview/5560) | Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.  |
| [MAFS.912.A-REI.2.4:](http://www.cpalms.org/Public/PreviewStandard/Preview/5561) | Solve quadratic equations in one variable. 1. Use the method of completing the square to transform any quadratic equation in x into an equation of the form (x – p)² = q that has the same solutions. Derive the quadratic formula from this form.
2. Solve quadratic equations by inspection (e.g., for x² = 49), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as *a ± bi* for real numbers a and b.
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| [MAFS.912.A-REI.3.5:](http://www.cpalms.org/Public/PreviewStandard/Preview/5562) | Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions. |
| [MAFS.912.A-REI.3.6:](http://www.cpalms.org/Public/PreviewStandard/Preview/5563) | Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables. |
| [MAFS.912.A-REI.3.7:](http://www.cpalms.org/Public/PreviewStandard/Preview/5564) | Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically. *For example, find the points of intersection between the line y = –3x and the circle x² + y² = 3.* |
| [MAFS.912.A-REI.4.10:](http://www.cpalms.org/Public/PreviewStandard/Preview/5567) | 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). |
| [MAFS.912.A-REI.4.11:](http://www.cpalms.org/Public/PreviewStandard/Preview/5568) | Explain why the x-coordinates of the points where the graphs of the equations y = f(x) and y = g(x) intersect are the solutions of the equation f(x) = g(x); find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where f(x) and/or g(x) are linear, polynomial, rational, absolute value, exponential, and logarithmic functions. |
| [MAFS.912.A-REI.4.12:](http://www.cpalms.org/Public/PreviewStandard/Preview/5569) | Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes. |
| [MAFS.912.F-IF.1.1:](http://www.cpalms.org/Public/PreviewStandard/Preview/5570) | 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). |
| [MAFS.912.F-IF.1.2:](http://www.cpalms.org/Public/PreviewStandard/Preview/5571) | Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context. |
| [MAFS.912.F-IF.1.3:](http://www.cpalms.org/Public/PreviewStandard/Preview/5572) | Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. For example, the Fibonacci sequence is defined recursively by f(0) = f(1) = 1, f(n+1) = f(n) + f(n-1) for n ≥ 1. |
| [MAFS.912.F-IF.2.4:](http://www.cpalms.org/Public/PreviewStandard/Preview/5573) | 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.* |
| [MAFS.912.F-IF.2.5:](http://www.cpalms.org/Public/PreviewStandard/Preview/5574) | 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.* |
| [MAFS.912.F-IF.2.6:](http://www.cpalms.org/Public/PreviewStandard/Preview/5575) | 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. |
| [MAFS.912.F-IF.3.7:](http://www.cpalms.org/Public/PreviewStandard/Preview/5576) | Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.1. Graph linear and quadratic functions and show intercepts, maxima, and minima.
2. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.
3. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.
4. Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior.
5. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude, and using phase shift.
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| [MAFS.912.F-IF.3.8:](http://www.cpalms.org/Public/PreviewStandard/Preview/5577) | Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function. 1. Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.
2. Use the properties of exponents to interpret expressions for exponential functions. *For example, identify percent rate of change in functions such as y = http://www.cpalms.org/Uploads/Benchmark/5577/img/Capture.PNG, y = http://www.cpalms.org/Uploads/Benchmark/5577/img/Capture1.PNG, y = http://www.cpalms.org/Uploads/Benchmark/5577/img/Capture4.PNG, y = http://www.cpalms.org/Uploads/Benchmark/5577/img/Capture3.PNG, and classify them as representing exponential growth or decay.*
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| [MAFS.912.F-IF.3.9:](http://www.cpalms.org/Public/PreviewStandard/Preview/5578) | 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.* |
| [MAFS.912.F-BF.1.1:](http://www.cpalms.org/Public/PreviewStandard/Preview/5579) | Write a function that describes a relationship between two quantities. 1. Determine an explicit expression, a recursive process, or steps for calculation from a context.
2. Combine standard function types using arithmetic operations. *For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model.*
3. Compose functions. *For example, if T(y) is the temperature in the atmosphere as a function of height, and h(t) is the height of a weather balloon as a function of time, then T(h(t)) is the temperature at the location of the weather balloon as a function of time.*
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| [MAFS.912.F-BF.1.2:](http://www.cpalms.org/Public/PreviewStandard/Preview/5580) | Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms. |
| [MAFS.912.F-BF.2.3:](http://www.cpalms.org/Public/PreviewStandard/Preview/5581) | Identify the effect on the graph of replacing f(x) by f(x) + k, k f(x), f(kx), and f(x + k) for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. *Include recognizing even and odd functions from their graphs and algebraic expressions for them.* |
| [MAFS.912.F-BF.2.4:](http://www.cpalms.org/Public/PreviewStandard/Preview/5582) | Find inverse functions. 1. Solve an equation of the form f(x) = c for a simple function f that has an inverse and write an expression for the inverse. *For example, f(x) =2 x³ or f(x) = (x+1)/(x–1) for x ≠ 1.*
2. Verify by composition that one function is the inverse of another.
3. Read values of an inverse function from a graph or a table, given that the function has an inverse.
4. Produce an invertible function from a non-invertible function by restricting the domain.
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| [MAFS.912.F-LE.1.1:](http://www.cpalms.org/Public/PreviewStandard/Preview/5584) | Distinguish between situations that can be modeled with linear functions and with exponential functions. 1. Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals.
2. Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.
3. Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.
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| [MAFS.912.F-LE.1.2:](http://www.cpalms.org/Public/PreviewStandard/Preview/5585) | Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table). |
| [MAFS.912.F-LE.1.3:](http://www.cpalms.org/Public/PreviewStandard/Preview/5586) | Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function. |
| [MAFS.912.F-LE.2.5:](http://www.cpalms.org/Public/PreviewStandard/Preview/5588) | Interpret the parameters in a linear or exponential function in terms of a context. |
| [MAFS.912.S-ID.1.1:](http://www.cpalms.org/Public/PreviewStandard/Preview/5641) | Represent data with plots on the real number line (dot plots, histograms, and box plots).

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| **Remarks/Examples:**In grades 6 – 8, students describe center and spread in a data distribution. Here they choose a summary statistic appropriate to the characteristics of the data distribution, such as the shape of the distribution or the existence of extreme data points. |

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| [MAFS.912.S-ID.1.2:](http://www.cpalms.org/Public/PreviewStandard/Preview/5642) | 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.

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| **Remarks/Examples:**In grades 6 – 8, students describe center and spread in a data distribution. Here they choose a summary statistic appropriate to the characteristics of the data distribution, such as the shape of the distribution or the existence of extreme data points. |

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| [MAFS.912.S-ID.1.3:](http://www.cpalms.org/Public/PreviewStandard/Preview/5643) | Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).

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| **Remarks/Examples:**In grades 6 – 8, students describe center and spread in a data distribution. Here they choose a summary statistic appropriate to the characteristics of the data distribution, such as the shape of the distribution or the existence of extreme data points. |

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| [MAFS.912.S-ID.1.4:](http://www.cpalms.org/Public/PreviewStandard/Preview/5644) | 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. |
| [MAFS.912.S-ID.2.5:](http://www.cpalms.org/Public/PreviewStandard/Preview/5645) | 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. |
| [MAFS.912.S-ID.2.6:](http://www.cpalms.org/Public/PreviewStandard/Preview/5646) | Represent data on two quantitative variables on a scatter plot, and describe how the variables are related. 1. Fit a function to the data; 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.*
2. Informally assess the fit of a function by plotting and analyzing residuals.
3. Fit a linear function for a scatter plot that suggests a linear association.

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| **Remarks/Examples:**Students take a more sophisticated look at using a linear function to model the relationship between two numerical variables. In addition to fitting a line to data, students assess how well the model fits by analyzing residuals. |

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| [MAFS.912.S-ID.3.7:](http://www.cpalms.org/Public/PreviewStandard/Preview/5647) | Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data. |
| [MAFS.912.S-ID.3.8:](http://www.cpalms.org/Public/PreviewStandard/Preview/5648) | Compute (using technology) and interpret the correlation coefficient of a linear fit. |
| [MAFS.912.S-ID.3.9:](http://www.cpalms.org/Public/PreviewStandard/Preview/5649) | Distinguish between correlation and causation. |