Florida Advanced College Algebra

Version Description

In Florida Advanced College Algebra, instructional time will emphasize five areas:

   (1) applying properties of exponents and logarithms using numerical and algebraic expressions;
   (2) extending arithmetic operations with numerical and algebraic expressions to include radical and polynomial expressions;
   (3) solving one-variable linear, absolute value, quadratic, polynomial, exponential, logarithmic, radical and rational equations, and interpreting the viability of solutions in real-world contexts;
   (4) modeling and applying linear, absolute value, quadratic, polynomial, exponential and logarithmic functions to solve mathematical and real-world problems; and
   (5) extending the knowledge of functions through compositions, transformations of parent functions and interpreting key features.

Curricular content for all subjects must integrate critical-thinking, problem-solving, and workforce-literacy skills; communication, reading, and writing skills; mathematics skills; collaboration skills; contextual and applied-learning skills; technology-literacy skills; information and media-literacy skills; and civic-engagement skills.

All clarifications stated, whether general or specific to Florida Advanced College Algebra, are expectations for instruction of that benchmark.

General Notes

Honors and Accelerated Level Course Note: Accelerated courses require a greater demand on students through increased academic rigor. Academic rigor is obtained through the application, analysis, evaluation and creation of complex ideas that are often abstract and multi-faceted. Students are challenged to think and collaborate critically on the content they are learning. Honors level rigor will be achieved by increasing text complexity through text selection, focusing on high-level qualitative measures, and complexity of task. Instruction will be structured to give students a deeper understanding of conceptual themes and organization within and across disciplines. Academic rigor is more than simply assigning to students a greater quantity of work.

For students enrolled in this course, college credit may be earned through completion of the course and a passing score on the Florida Advanced Course Test (FACT).

Florida's Benchmarks for Excellent Student Thinking (B.E.S.T.) Standards: This course includes Florida's B.E.S.T. ELA Expectations (EE) and Mathematical Thinking and Reasoning Standards (MTRs) for students. Florida educators should intentionally embed these standards within the content and their instruction as applicable. For guidance on the implementation of the EEs and MTRs, please visit https://www.cpalms.org/Standards/BEST_Standards.aspx and select the appropriate B.E.S.T. Standards package.

English Language Development ELD Standards Special Notes Section: Teachers are required to provide listening, speaking, reading and writing instruction that allows English language learners (ELL) to communicate information, ideas and concepts for academic success in the content area of Mathematics. For the given level of English language proficiency and with visual, graphic, or interactive support, students will interact with grade level words, expressions, sentences and discourse to process or produce language necessary for academic success. The ELD standard should specify a relevant content area concept or topic of study chosen by curriculum developers and teachers which maximizes an ELL's need for communication and social skills. To access an ELL supporting document which delineates performance definitions and descriptors, please click on the following link: https://cpalmsmediaprod.blob.core.windows.net/uploads/docs/standards/eld/ma.pdf.

General Information

Course Number:	Course Type: Core Academic Course
Course Length: Year (Y)	Course Level: 3
	Grade Level(s): 9, 10, 11, 12
Graduation Requirement: Mathematics	Number of Credits: One (1) credit
Course Path: Section | Grades PreK to 12 Education Courses > Grade Group | Grades 9 to 12 and Adult Education Courses > Subject | Mathematics > SubSubject | Algebra > Abbreviated Title | FL ADV COLL ALG	
Educator Certification: Mathematics (Grades 6-12); Classical Education – Restricted	

Course Standards and Benchmarks

Mathematical Thinking and Reasoning

MA.K12.MTR.1.1 Actively participate in effortful learning both individually and collectively.

Mathematicians who participate in effortful learning both individually and with others:
- Analyze the problem in a way that makes sense given the task.
- Ask questions that will help with solving the task.
- Build perseverance by modifying methods as needed while solving a challenging task.
- Stay engaged and maintain a positive mindset when working to solve tasks.
- Help and support each other when attempting a new method or approach.

Clarifications:
Teachers who encourage students to participate actively in effortful learning both individually and with others:
- Cultivate a community of growth mindset learners.
- Foster perseverance in students by choosing tasks that are challenging.
- Develop students' ability to analyze and problem solve.
- Recognize students' effort when solving challenging problems.

MA.K12.MTR.2.1 Demonstrate understanding by representing problems in multiple ways.

Mathematicians who demonstrate understanding by representing problems in multiple ways:
- Build understanding through modeling and using manipulatives.
- Represent solutions to problems in multiple ways using objects, drawings, tables, graphs and equations.
- Progress from modeling problems with objects and drawings to using algorithms and equations.
- Express connections between concepts and representations.
- Choose a representation based on the given context or purpose.

Clarifications:
Teachers who encourage students to demonstrate understanding by representing problems in multiple ways:
- Help students make connections between concepts and representations.
- Provide opportunities for students to use manipulatives when investigating concepts.
- Guide students from concrete to pictorial to abstract representations as understanding progresses.
- Show students that various representations can have different purposes and can be useful in different situations.

MA.K12.MTR.3.1 Complete tasks with mathematical fluency.

Mathematicians who complete tasks with mathematical fluency:
- Select efficient and appropriate methods for solving problems within the given context.
- Maintain flexibility and accuracy while performing procedures and mental calculations.
- Complete tasks accurately and with confidence.
- Adapt procedures to apply them to a new context.
- Use feedback to improve efficiency when performing calculations.

Clarifications:
Teachers who encourage students to complete tasks with mathematical fluency:
- Provide students with the flexibility to solve problems by selecting a procedure that allows them to solve efficiently and accurately.
- Offer multiple opportunities for students to practice efficient and generalizable methods.
- Provide opportunities for students to reflect on the method they used and determine if a more efficient method could have been used.

MA.K12.MTR.4.1 Engage in discussions that reflect on the mathematical thinking of self and others.

Mathematicians who engage in discussions that reflect on the mathematical thinking of self and others:
- Communicate mathematical ideas, vocabulary and methods effectively.
- Analyze the mathematical thinking of others.
- Compare the efficiency of a method to those expressed by others.
- Recognize errors and suggest how to correctly solve the task.
- Justify results by explaining methods and processes.
- Construct possible arguments based on evidence.

Clarifications:
Teachers who encourage students to engage in discussions that reflect on the mathematical thinking of self and others:
- Establish a culture in which students ask questions of the teacher and their peers, and error is an opportunity for learning.
- Create opportunities for students to discuss their thinking with peers.
- Select, sequence and present student work to advance and deepen understanding of correct and increasingly efficient methods.
- Develop students' ability to justify methods and compare their responses to the responses of their peers.

MA.K12.MTR.5.1 Use patterns and structure to help understand and connect mathematical concepts.

Mathematicians who use patterns and structure to help understand and connect mathematical concepts:
- Focus on relevant details within a problem.
- Create plans and procedures to logically order events, steps or ideas to solve problems.
- Decompose a complex problem into manageable parts.
- Relate previously learned concepts to new concepts.
- Look for similarities among problems.
- Connect solutions of problems to more complicated large-scale situations.

Clarifications:
Teachers who encourage students to use patterns and structure to help understand and connect mathematical concepts:
- Help students recognize the patterns in the world around them and connect these patterns to mathematical concepts.
- Support students to develop generalizations based on the similarities found among problems.
- Provide opportunities for students to create plans and procedures to solve problems.
- Develop students' ability to construct relationships between their current understanding and more sophisticated ways of thinking.

MA.K12.MTR.6.1 Assess the reasonableness of solutions.

Mathematicians who assess the reasonableness of solutions:
- Estimate to discover possible solutions.
- Use benchmark quantities to determine if a solution makes sense.
- Check calculations when solving problems.
- Verify possible solutions by explaining the methods used.
- Evaluate results based on the given context.

Clarifications:
Teachers who encourage students to assess the reasonableness of solutions:
- Have students estimate or predict solutions prior to solving.
- Prompt students to continually ask, "Does this solution make sense? How do you know?"
- Reinforce that students check their work as they progress within and after a task.
- Strengthen students' ability to verify solutions through justifications.

MA.K12.MTR.7.1 Apply mathematics to real-world contexts.

Mathematicians who apply mathematics to real-world contexts:
- Connect mathematical concepts to everyday experiences.
- Use models and methods to understand, represent and solve problems.
- Perform investigations to gather data or determine if a method is appropriate.
- Redesign models and methods to improve accuracy or efficiency.

Clarifications:
Teachers who encourage students to apply mathematics to real-world contexts:
- Provide opportunities for students to create models, both concrete and abstract, and perform investigations.
- Challenge students to question the accuracy of their models and methods.
- Support students as they validate conclusions by comparing them to the given situation.
- Indicate how various concepts can be applied to other disciplines.

ELA Expectations

ELA.K12.EE.1.1 Cite evidence to explain and justify reasoning.

ELA.K12.EE.2.1 Read and comprehend grade-level complex texts proficiently.

ELA.K12.EE.3.1 Make inferences to support comprehension.

ELA.K12.EE.4.1 Use appropriate collaborative techniques and active listening skills when engaging in discussions in a variety of situations.

ELA.K12.EE.5.1 Use the accepted rules governing a specific format to create quality work.

> ***ELA.K12.EE.6.1 Use appropriate voice and tone when speaking or writing.***

English Language Development

> ***ELD.K12.ELL.MA Language of Mathematics***

ELD.K12.ELL.MA.1	English language learners communicate information, ideas and concepts necessary for academic success in the content area of Mathematics.

Number Sense and Operations

> ***MA.912.NSO.1 Generate equivalent expressions and perform operations with expressions involving exponents, radicals or logarithms.***

MA.912.NSO.1.1	Extend previous understanding of the Laws of Exponents to include rational exponents. Apply the Laws of Exponents to evaluate numerical expressions and generate equivalent numerical expressions involving rational exponents.

Benchmark Clarifications:
Clarification 1: Instruction includes the use of technology when appropriate.
Clarification 2: Refer to the K-12 Formulas (Appendix E) for the Laws of Exponents.
Clarification 3: Instruction includes converting between expressions involving rational exponents and expressions involving radicals.
Clarification 4: Within the Mathematics for Data and Financial Literacy course, it is not the expectation to generate equivalent numerical expressions.

MA.912.NSO.1.2	Generate equivalent algebraic expressions using the properties of exponents.

Example: The expression 1.5^{3t+2} is equivalent to the expression $2.25(1.5)^{3t}$ which is equivalent to $2.25(3.375)^{t}$.

MA.912.NSO.1.3	Generate equivalent algebraic expressions involving radicals or rational exponents using the properties of exponents.

Benchmark Clarifications:
Clarification 1: Within the Algebra 2 course, radicands are limited to monomial algebraic expressions.

MA.912.NSO.1.4 | Apply previous understanding of operations with rational numbers to add, subtract, multiply and divide numerical radicals.

Algebra 1 Example: The expression $\frac{\sqrt{136}}{\sqrt{2}}$ is equivalent to $\sqrt{\frac{136}{2}}$ which is equivalent to $\sqrt{68}$ which is equivalent to $2\sqrt{17}$.

Benchmark Clarifications:
Clarification 1: Within the Algebra 2 course, radicands are limited to monomial algebraic expressions.

MA.912.NSO.1.5 | Add, subtract, multiply and divide algebraic expressions involving radicals.

Benchmark Clarifications:
Clarification 1: Within the Algebra 2 course, radicands are limited to monomial algebraic expressions.

MA.912.NSO.1.6 | Given a numerical logarithmic expression, evaluate and generate equivalent numerical expressions using the properties of logarithms or exponents.

Benchmark Clarifications:
Clarification 1: Within the Mathematics for Data and Financial Literacy Honors course, problem types focus on money and business.

MA.912.NSO.1.7 | Given an algebraic logarithmic expression, generate an equivalent algebraic expression using the properties of logarithms or exponents.

Benchmark Clarifications:
Clarification 1: Within the Mathematics for Data and Financial Literacy Honors course, problem types focus on money and business.

MA.912.NSO.2 Represent and perform operations with expressions within the complex number system.

MA.912.NSO.2.1 | Extend previous understanding of the real number system to include the complex number system. Add, subtract, multiply and divide complex numbers.

Algebraic Reasoning

> ### *MA.912.AR.1 Interpret and rewrite algebraic expressions and equations in equivalent forms.*

MA.912.AR.1.2 Rearrange equations or formulas to isolate a quantity of interest.

> *Algebra 1 Example:* The Ideal Gas Law $PV = nRT$ can be rearranged as $T = \frac{PV}{nR}$ to isolate temperature as the quantity of interest.
>
> *Example:* Given the Compound Interest formula $A = P\left(1 + \frac{r}{n}\right)^{nt}$, solve for P.
>
> *Mathematics for Data and Financial Literacy Honors Example:* Given the Compound Interest formula $A = P\left(1 + \frac{r}{n}\right)^{nt}$, solve for t.

Benchmark Clarifications:
Clarification 1: Instruction includes using formulas for temperature, perimeter, area and volume; using equations for linear (standard, slope-intercept and point-slope forms) and quadratic (standard, factored and vertex forms) functions.
Clarification 2: Within the Mathematics for Data and Financial Literacy course, problem types focus on money and business.

MA.912.AR.1.3 Add, subtract and multiply polynomial expressions with rational number coefficients.

Benchmark Clarifications:
Clarification 1: Instruction includes an understanding that when any of these operations are performed with polynomials the result is also a polynomial.
Clarification 2: Within the Algebra 1 course, polynomial expressions are limited to 3 or fewer terms.

MA.912.AR.1.7 Rewrite a polynomial expression as a product of polynomials over the real number system.

> *Example:* The expression $4x^3y - 3x^2y^4$ is equivalent to the factored form $x^2y(4x - 3y^3)$.
>
> *Example:* The expression $16x^2 - 9y^2$ is equivalent to the factored form $(4x - 3y)(4x + 3y)$.

Benchmark Clarifications:
Clarification 1: Within the Algebra 1 course, polynomial expressions are limited to 4 or fewer terms with integer coefficients.

> ### *MA.912.AR.2 Write, solve and graph linear equations, functions and inequalities in one and two variables.*

MA.912.AR.2.1 Given a real-world context, write and solve one-variable multi-step linear equations.

| MA.912.AR.2.2 | Write a linear two-variable equation to represent relationships between quantities from a graph, a written description or a table of values within a mathematical or real-world context. |

Benchmark Clarifications:
Clarification 1: Instruction includes the use of standard form, slope-intercept form and point-slope form, and the conversion between these forms.

| MA.912.AR.2.3 | Write a linear two-variable equation for a line that is parallel or perpendicular to a given line and goes through a given point. |

Benchmark Clarifications:
Clarification 1: Instruction focuses on recognizing that perpendicular lines have slopes that when multiplied result in -1 and that parallel lines have slopes that are the same.
Clarification 2: Instruction includes representing a line with a pair of points on the coordinate plane or with an equation.
Clarification 3: Problems include cases where one variable has a coefficient of zero.

| MA.912.AR.2.4 | Given a table, equation or written description of a linear function, graph that function, and determine and interpret its key features. |

Benchmark Clarifications:
Clarification 1: Key features are limited to domain, range, intercepts and rate of change.
Clarification 2: Instruction includes the use of standard form, slope-intercept form and point-slope form.
Clarification 3: Instruction includes cases where one variable has a coefficient of zero.
Clarification 4: Instruction includes representing the domain and range with inequality notation, interval notation or set-builder notation.
Clarification 5: Within the Algebra 1 course, notations for domain and range are limited to inequality and set-builder notations.

| MA.912.AR.2.5 | Solve and graph mathematical and real-world problems that are modeled with linear functions. Interpret key features and determine constraints in terms of the context. |

Algebra 1 Example: Lizzy's mother uses the function $C(p) = 450 + 7.75p$, where $C(p)$ represents the total cost of a rental space and p is the number of people attending, to help budget Lizzy's 16th birthday party. Lizzy's mom wants to spend no more than $850 for the party. Graph the function in terms of the context.

Benchmark Clarifications:
Clarification 1: Key features are limited to domain, range, intercepts and rate of change.
Clarification 2: Instruction includes the use of standard form, slope-intercept form and point-slope form.
Clarification 3: Instruction includes representing the domain, range and constraints with inequality notation, interval notation or set-builder notation.
Clarification 4: Within the Algebra 1 course, notations for domain and range are limited to inequality and set-builder.
Clarification 5: Within the Mathematics for Data and Financial Literacy course, problem types focus on money and business.

MA.912.AR.2.6	Given a mathematical or real-world context, write and solve one-variable linear inequalities, including compound inequalities. Represent solutions algebraically or graphically.

Algebra 1 Example: The compound inequality $2x \leq 5x + 1 < 4$ is equivalent to $-1 \leq 3x$ and $5x < 3$, which is equivalent to $\frac{-1}{3} \leq x < \frac{3}{5}$.

MA.912.AR.3 Write, solve and graph quadratic equations, functions and inequalities in one and two variables.

MA.912.AR.3.1	Given a mathematical or real-world context, write and solve one-variable quadratic equations over the real number system.

Benchmark Clarifications:
Clarification 1: Within the Algebra 1 course, instruction includes the concept of non-real answers, without determining non-real solutions.
Clarification 2: Within this benchmark, the expectation is to solve by factoring techniques, taking square roots, the quadratic formula and completing the square.

MA.912.AR.3.4	Write a quadratic function to represent the relationship between two quantities from a graph, a written description or a table of values within a mathematical or real-world context.

Algebra 1 Example: Given the table of values below from a quadratic function, write an equation of that function.

x	-2	-1	0	1	2
$f(x)$	2	-1	-2	-1	2

Benchmark Clarifications:
Clarification 1: Within the Algebra 1 course, a graph, written description or table of values must include the vertex and two points that are equidistant from the vertex.
Clarification 2: Instruction includes the use of standard form, factored form and vertex form.
Clarification 3: Within the Algebra 2 course, one of the given points must be the vertex or an x-intercept.

MA.912.AR.3.5	Given the x-intercepts and another point on the graph of a quadratic function, write the equation for the function.

MA.912.AR.3.6	Given an expression or equation representing a quadratic function, determine the vertex and zeros and interpret them in terms of a real-world context.

| MA.912.AR.3.7 | Given a table, equation or written description of a quadratic function, graph that function, and determine and interpret its key features. |

Benchmark Clarifications:
Clarification 1: Key features are limited to domain; range; intercepts; intervals where the function is increasing, decreasing, positive or negative; end behavior; vertex; and symmetry.
Clarification 2: Instruction includes the use of standard form, factored form and vertex form, and sketching a graph using the zeros and vertex.
Clarification 3: Instruction includes representing the domain and range with inequality notation, interval notation or set-builder notation.
Clarification 4: Within the Algebra 1 course, notations for domain and range are limited to inequality and set-builder.

| MA.912.AR.3.8 | Solve and graph mathematical and real-world problems that are modeled with quadratic functions. Interpret key features and determine constraints in terms of the context. |

> *Algebra 1 Example:* The value of a classic car produced in 1972 can be modeled by the function $V(t) = 19.25t^2 - 440t + 3500$, where t is the number of years since 1972. In what year does the car's value start to increase?

Benchmark Clarifications:
Clarification 1: Key features are limited to domain; range; intercepts; intervals where the function is increasing, decreasing, positive or negative; end behavior; vertex; and symmetry.
Clarification 2: Instruction includes the use of standard form, factored form and vertex form.
Clarification 3: Instruction includes representing the domain, range and constraints with inequality notation, interval notation or set-builder notation.
Clarification 4: Within the Algebra 1 course, notations for domain and range are limited to inequality and set-builder.

| **MA.912.AR.4 Write, solve and graph absolute value equations, functions and inequalities in one and two variables.** |

| MA.912.AR.4.1 | Given a mathematical or real-world context, write and solve one-variable absolute value equations. |

| MA.912.AR.4.2 | Given a mathematical or real-world context, write and solve one-variable absolute value inequalities. Represent solutions algebraically or graphically. |

| MA.912.AR.4.3 | Given a table, equation or written description of an absolute value function, graph that function and determine its key features. |

Benchmark Clarifications:
Clarification 1: Key features are limited to domain; range; intercepts; intervals where the function is increasing, decreasing, positive or negative; vertex; end behavior and symmetry.
Clarification 2: Instruction includes representing the domain and range with inequality notation, interval notation or set-builder notation.
Clarification 3: Within the Algebra 1 course, notations for domain and range are limited to inequality and set-builder.

| MA.912.AR.4.4 | Solve and graph mathematical and real-world problems that are modeled with absolute value functions. Interpret key features and determine constraints in terms of the context. |

Benchmark Clarifications:
Clarification 1: Key features are limited to domain; range; intercepts; intervals where the function is increasing, decreasing, positive or negative; vertex; end behavior and symmetry.
Clarification 2: Instruction includes representing the domain, range and constraints with inequality notation, interval notation or set-builder notation.

MA.912.AR.5 Write, solve and graph exponential and logarithmic equations and functions in one and two variables.

| MA.912.AR.5.1 | Solve one-variable exponential equations using the properties of exponents. |
| MA.912.AR.5.2 | Solve one-variable equations involving logarithms or exponential expressions. Interpret solutions as viable in terms of the context and identify any extraneous solutions. |

| MA.912.AR.5.3 | Given a mathematical or real-world context, classify an exponential function as representing growth or decay. |

Benchmark Clarifications:
Clarification 1: Within the Algebra 1 course, exponential functions are limited to the forms $f(x) = ab^x$, where b is a whole number greater than 1 or a unit fraction, or $f(x) = a(1 \pm r)^x$, where $0 < r < 1$.

MA.912.AR.5.4	Write an exponential function to represent a relationship between two quantities from a graph, a written description or a table of values within a mathematical or real-world context.

Benchmark Clarifications:
Clarification 1: Within the Algebra 1 course, exponential functions are limited to the forms $f(x) = ab^x$, where b is a whole number greater than 1 or a unit fraction, or $f(x) = a(1 \pm r)^x$, where $0 < r < 1$.
Clarification 2: Within the Algebra 1 course, tables are limited to having successive nonnegative integer inputs so that the function may be determined by finding ratios between successive outputs.

MA.912.AR.5.6	Given a table, equation or written description of an exponential function, graph that function and determine its key features.

Benchmark Clarifications:
Clarification 1: Key features are limited to domain; range; intercepts; intervals where the function is increasing, decreasing, positive or negative; constant percent rate of change; end behavior and asymptotes.
Clarification 2: Instruction includes representing the domain and range with inequality notation, interval notation or set-builder notation.
Clarification 3: Within the Algebra 1 course, notations for domain and range are limited to inequality and set-builder.
Clarification 4: Within the Algebra 1 course, exponential functions are limited to the forms $f(x) = ab^x$, where b is a whole number greater than 1 or a unit fraction or $f(x) = a(1 \pm r)^x$, where $0 < r < 1$.

MA.912.AR.5.7	Solve and graph mathematical and real-world problems that are modeled with exponential functions. Interpret key features and determine constraints in terms of the context.
	Example: The graph of the function $f(t) = e^{5t+2}$ can be transformed into the straight line $y = 5t + 2$ by taking the natural logarithm of the function's outputs.

Benchmark Clarifications:
Clarification 1: Key features are limited to domain; range; intercepts; intervals where the function is increasing, decreasing, positive or negative; constant percent rate of change; end behavior and asymptotes.
Clarification 2: Instruction includes representing the domain, range and constraints with inequality notation, interval notation or set-builder notation.
Clarification 3: Instruction includes understanding that when the logarithm of the dependent variable is taken and graphed, the exponential function will be transformed into a linear function.
Clarification 4: Within the Mathematics for Data and Financial Literacy course, problem types focus on money and business.

MA.912.AR.5.8	Given a table, equation or written description of a logarithmic function, graph that function and determine its key features.

Benchmark Clarifications:
Clarification 1: Key features are limited to domain; range; intercepts; intervals where the function is increasing, decreasing, positive or negative; end behavior; and asymptotes.
Clarification 2: Instruction includes representing the domain and range with inequality notation, interval notation or set-builder notation.

MA.912.AR.5.9	Solve and graph mathematical and real-world problems that are modeled with logarithmic functions. Interpret key features and determine constraints in terms of the context.

Benchmark Clarifications:
Clarification 1: Key features are limited to domain; range; intercepts; intervals where the function is increasing, decreasing, positive or negative; end behavior; and asymptotes.
Clarification 2: Instruction includes representing the domain, range and constraints with inequality notation, interval notation or set-builder notation.

MA.912.AR.6 Solve and graph polynomial equations and functions in one and two variables.

MA.912.AR.6.1	Given a mathematical or real-world context, when suitable factorization is possible, solve one-variable polynomial equations of degree 3 or higher over the real and complex number systems.

MA.912.AR.6.4	Given a table, equation or written description of a polynomial function of degree 3 or higher, graph that function and determine its key features.

Benchmark Clarifications:
Clarification 1: Key features are limited to domain; range; intercepts; intervals where the function is increasing, decreasing, positive or negative; relative maximums and minimums; symmetry; and end behavior.
Clarification 2: Instruction includes representing the domain and range with inequality notation, interval notation or set-builder notation.

MA.912.AR.6.5	Sketch a rough graph of a polynomial function of degree 3 or higher using zeros, multiplicity and knowledge of end behavior.

MA.912.AR.7 Solve and graph radical equations and functions in one and two variables.

MA.912.AR.7.1	Solve one-variable radical equations. Interpret solutions as viable in terms of context and identify any extraneous solutions.

MA.912.AR.8 Solve and graph rational equations and functions in one and two variables.

MA.912.AR.8.1 Write and solve one-variable rational equations. Interpret solutions as viable in terms of the context and identify any extraneous solutions.

Benchmark Clarifications:
Clarification 1: Within the Algebra 2 course, numerators and denominators are limited to linear and quadratic expressions.

MA.912.AR.9 Write and solve a system of two- and three-variable equations and inequalities that describe quantities or relationships.

MA.912.AR.9.1 Given a mathematical or real-world context, write and solve a system of two-variable linear equations algebraically or graphically.

Benchmark Clarifications:
Clarification 1: Within this benchmark, the expectation is to solve systems using elimination, substitution and graphing.
Clarification 2: Within the Algebra 1 course, the system is limited to two equations.

MA.912.AR.9.4 Graph the solution set of a system of two-variable linear inequalities.

Benchmark Clarifications:
Clarification 1: Instruction includes cases where one variable has a coefficient of zero.
Clarification 2: Within the Algebra 1 course, the system is limited to two inequalities.

MA.912.AR.9.5 Graph the solution set of a system of two-variable inequalities.

Benchmark Clarifications:
Clarification 1: Within the Algebra 2 course, two-variable inequalities are limited to linear and quadratic.

MA.912.AR.9.6 Given a real-world context, represent constraints as systems of linear equations or inequalities. Interpret solutions to problems as viable or non-viable options.

Benchmark Clarifications:
Clarification 1: Instruction focuses on analyzing a given function that models a real-world situation and writing constraints that are represented as linear equations or linear inequalities.

Functions

> ### MA.912.F.1 Understand, compare and analyze properties of functions.

MA.912.F.1.1	Given an equation or graph that defines a function, determine the function type. Given an input-output table, determine a function type that could represent it.

Benchmark Clarifications:
Clarification 1: Within the Algebra 1 course, functions represented as tables are limited to linear, quadratic and exponential.
Clarification 2: Within the Algebra 1 course, functions represented as equations or graphs are limited to vertical or horizontal translations or reflections over the x-axis of the following parent functions:
$f(x) = x, f(x) = x^2, f(x) = x^3, f(x) = \sqrt{x}, f(x) = \sqrt[3]{x}, f(x) = |x|, f(x) = 2^x$ and $f(x) = \left(\frac{1}{2}\right)^x$.

MA.912.F.1.2	Given a function represented in function notation, evaluate the function for an input in its domain. For a real-world context, interpret the output.

> *Algebra 1 Example:* The function $f(x) = \frac{x}{7} - 8$ models Alicia's position in miles relative to a water stand x minutes into a marathon. Evaluate and interpret for a quarter of an hour into the race.

Benchmark Clarifications:
Clarification 1: Problems include simple functions in two-variables, such as $f(x, y) = 3x - 2y$.
Clarification 2: Within the Algebra 1 course, functions are limited to one-variable such as $f(x) = 3x$.

MA.912.F.1.3	Calculate and interpret the average rate of change of a real-world situation represented graphically, algebraically or in a table over a specified interval.

Benchmark Clarifications:
Clarification 1: Instruction includes making the connection to determining the slope of a particular line segment.

MA.912.F.1.9	Determine whether a function is even, odd or neither when represented algebraically, graphically or in a table.

> ### MA.912.F.2 Identify and describe the effects of transformations on functions. Create new functions given transformations.

MA.912.F.2.1	Identify the effect on the graph or table of a given function after replacing $f(x)$ by $f(x) + k, kf(x), f(kx)$ and $f(x + k)$ for specific values of k.

Benchmark Clarifications:
Clarification 1: Within the Algebra 1 course, functions are limited to linear, quadratic and absolute value.
Clarification 2: Instruction focuses on including positive and negative values for k.

MA.912.F.2.2	Identify the effect on the graph of a given function of two or more transformations defined by adding a real number to the x- or y-values or multiplying the x- or y-values by a real number.

MA.912.F.2.3	Given the graph or table of $f(x)$ and the graph or table of $f(x) + k, kf(x)$, $f(kx)$ and $f(x + k)$, state the type of transformation and find the value of the real number k.

Benchmark Clarifications:
Clarification 1: Within the Algebra 1 course, functions are limited to linear, quadratic and absolute value.

MA.912.F.2.4	Given the graph or table of values of two or more transformations of a function, state the type of transformation and find the values of the real number that defines the transformation.

MA.912.F.2.5	Given a table, equation or graph that represents a function, create a corresponding table, equation or graph of the transformed function defined by adding a real number to the x- or y-values or multiplying the x- or y-values by a real number.

MA.912.F.3 Create new functions from existing functions.

MA.912.F.3.4	Represent the composition of two functions algebraically or in a table. Determine the domain and range of the composite function.

MA.912.F.3.5	Solve mathematical and real-world problems involving composite functions.

MA.912.F.3.6	Determine whether an inverse function exists by analyzing tables, graphs and equations.

MA.912.F.3.7	Represent the inverse of a function algebraically, graphically or in a table. Use composition of functions to verify that one function is the inverse of the other.

Benchmark Clarifications:
Clarification 1: Instruction includes the understanding that a logarithmic function is the inverse of an exponential function.

Data Analysis and Probability

MA.912.DP.2 Solve problems involving univariate and bivariate numerical data.

MA.912.DP.2.4 Fit a linear function to bivariate numerical data that suggests a linear association and interpret the slope and y-intercept of the model. Use the model to solve real-world problems in terms of the context of the data.

Benchmark Clarifications:
Clarification 1: Instruction includes fitting a linear function both informally and formally with the use of technology.
Clarification 2: Problems include making a prediction or extrapolation, inside and outside the range of the data, based on the equation of the line of fit.