Mississippi College and Career Readiness Standards for Mathematics Scaffolding Document

Algebra II

ALGEBRA II

Number and Quantity

The Real Number System (N-RN)

Extend the properties of exponents to rational exponents

N-RN.1
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 $5^{1/3}$ to be the cube root of 5 because we want $[5^{1/3}]^3 = 5^{(1/3)\,3}$ to hold, so $[5^{1/3}]^3$ must equal 5.*

Desired Student Performance

A student should know	A student should understand	A student should be able to do
• The meaning and function of exponents. • The meaning of rational expressions.	• How to simplify an exponential expression. • How to simplify radical expressions.	• Identify and attend to structure in writing and using rational exponents. • Recognize a power's corresponding root. • Relate use of rational exponents to properties of integer exponents.

ALGEBRA II

Number and Quantity

The Real Number System (N-RN)

Extend the properties of exponents to rational exponents

N-RN.2
Rewrite expressions involving radicals and rational exponents using the properties of exponents.

Desired Student Performance

A student should know	A student should understand	A student should be able to do
• A single quantity can be represented by various expressions. • Facts about quantities can be expressed by different equations.	• How to simplify a radical expression.	• Rewrite radical expressions using a fractional exponent instead of a radical sign. • Rewrite exponential expressions to reveal quantities of interest that may be useful.

ALGEBRA II

Number and Quantity

Quantities (N-Q)*

Reason quantitatively and use units to solve problems.

N-Q.2 Define appropriate quantities for the purpose of descriptive modeling.*	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• Quantities are contextualized by the use of units.	• How to recognize and identify units. • How to identify relevant quantities in any context or problem-solving task**.**	• Describe solutions using complete quantities (including units). • Attend to precision by the consistent use of units throughout the problem solving process.

ALGEBRA II

Number and Quantity

The Complex Number System (N-CN)

Perform arithmetic operations with complex numbers

N-CN.1
Know there is a complex number *i* such that $i^2 = -1$, and every complex number has the form $a + bi$ with a and b real.

Desired Student Performance

A student should know	A student should understand	A student should be able to do
• Every quadratic equation has complex number solutions. • Complex numbers include imaginary and real numbers. • Some solutions to quadratic equations may be imaginary. • The imaginary unit *i* is a number, not a variable.	• How to solve quadratic equations in the form of $x^2 + k = 0$, where $k > 0$.	• Use a clear and precise vocabulary in defining of the imaginary unit. • Prove and define *i* as the square root of -1.

ALGEBRA II

Number and Quantity

The Complex Number System (N-CN)

Perform arithmetic operations with complex numbers

N-CN.2
Use the relation $i^2 = –1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.

Desired Student Performance

A student should know	A student should understand	A student should be able to do
• Every quadratic equation has complex number solutions. • Complex numbers include imaginary and real numbers. • Some solutions to quadratic equations may be imaginary. • The imaginary unit *i* is a number, not a variable.	• How to solve quadratic equations in the form of $x^2 + k = 0$, where $k > 0$.	• Perform operations with complex numbers. • Use a clear and precise definition of the imaginary unit. • Define *i* as the square root of -1.

ALGEBRA II

Number and Quantity

The Complex Number System (N-CN)

Use complex numbers in polynomial identities and equations

N-CN.7 Solve quadratic equations with real coefficients that have complex solutions.	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• Every quadratic equation has complex number solutions. • Complex numbers include imaginary and real numbers. • Some solutions to quadratic equations may be imaginary. • The imaginary unit *i* is a number, not a variable.	• How to solve quadratic equations in the form of $x^2 + k = 0$, where $k > 0$.	• Perform operations with complex numbers. • Use a clear and precise definition of the imaginary unit. • Define *i* as the square root of -1.

ALGEBRA II

Algebra

Seeing Structure in Expressions (A-SSE)

Interpret the structure of expressions

A-SSE.2
Use the structure of an expression to identify ways to rewrite it. *For example, see $x^4 – y^4$ as $(x^2)^2 – (y^2)^2$, thus recognizing it as a difference of squares that can be factored as $(x^2 – y^2) (x^2 + y^2)$.*

Desired Student Performance

A student should know	A student should understand	A student should be able to do
• Expressions can be factored into simpler expressions. • How to factor expressions is similar to factoring numbers.	• How to factor simple expressions. • Many quadratic trinomials can be factored into the product of two binomials.	• Recognize various forms of factoring. • Find common and binomial factors of quadratic expressions. • Factor special quadratic expressions.

ALGEBRA II

Algebra

Seeing Structure in Expressions (A-SSE)

Write expressions in equivalent forms to solve problems

A-SSE.3c
Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.*

c. Use the properties of exponents to transform expressions for exponential functions. *For example the expression 1.15t can be rewritten as* $[1.15^{1/12}]^{12t} \approx 1.012^{12t}$ *to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.*

Desired Student Performance

A student should know	A student should understand	A student should be able to do
• Exponential growth. • Exponential decay. • Growth and decay factor. • Exponential function models growth or decay of an initial quantity.	• How to create exponential expressions. • How to graph a function (if still needed as a visual aid).	• Rewrite expressions to reveal quantities that may be more useful. • Recognize that exponential function model may be appropriate when finding the solution would require iterative multiplication. • Model in the context of real-world situations, such as compound interest and radioactive decay.

ALGEBRA II

Algebra

Seeing Structure in Expressions (A-SSE)

Write expressions in equivalent forms to solve problems

A-SSE.4
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.**

Desired Student Performance

A student should know	A student should understand	A student should be able to do
• As with arithmetic series, geometric series are also finite • A geometric series is the sum of the terms in a geometric sequence.	• The sum of a finite number of terms can be found using the first term, number of terms, and the common ratio. • A formula can be used to find the sum of a finite geometric series.	• Define geometric series and find their sums • Use the following formula to find the sum of a finite series: $S_n = a_1(1-r^n)/1-r$

ALGEBRA II

Algebra

Arithmetic with Polynomials and Rational Expressions (A-APR)

Understand the relationship between zeros and factors of polynomials

A-APR.2
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 $p(x)$.

Desired Student Performance

A student should know	A student should understand	A student should be able to do
• Synthetic division simplifies the long division process. • Algorithms are instructions in solving problems and identify algorithms used in previous courses. • Factors of polynomials are similar to factors of whole numbers.	• How to write the coefficients of polynomials in standard form. • How to divide whole numbers using long division. • How to factor whole numbers and polynomials.	• Know and apply the Remainder Theorem. • Divide polynomials. • Use both long division and synthetic division to divide polynomials. • Attend to precision. • Recognize similar structure in both division processes. • Recognize when a specific division process may not be possible.

ALGEBRA II

Algebra

Arithmetic with Polynomials and Rational Expressions (A-APR)

Understand the relationship between zeros and factors of polynomials

A-APR.3
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.

Desired Student Performance

A student should know	A student should understand	A student should be able to do
• Knowing the zeros of a polynomial function can give information about its graph. • Zeros of a quadratic function are equivalent to the *x-intercepts* and solutions of the related quadratic equation set to zero.	• Finding *x*- and *y-intercepts.* • Solving quadratic equations by factoring and by graphing. • Zeros of a quadratic function $y=ax^2+bx+c$ can be found by solving the related equation $0=ax^2+bx+c$. • Applying the Zero-Product Property. • Applying the Factor Theorem.	• Write a polynomial function from its zeros. • Analyze the factored form of polynomials. • Use appropriate tools strategically to graph the function defined by the polynomial. • Represent the polynomial in a factored form, tables, and graphs.

ALGEBRA II

Algebra

Arithmetic with Polynomials and Rational Expressions (A-APR)

Use polynomial identities to solve problems

A-APR.4 Prove polynomial identities and use them to describe numerical relationships. *For example, the polynomial identity* $(x^2 + y^2)^2 = (x^2 – y^2)^2 + (2xy)^2$ *can be used to generate Pythagorean triples.*	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• Number theory. • Consecutive numbers.	• How to factor polynomials.	• Use polynomial identities to write expressions in different forms. • Determine if an expression is even or odd by its characteristics. • Identify patterns.

ALGEBRA II

Algebra

Arithmetic with Polynomials and Rational Expressions (A-APR)

Rewrite rational expressions

A-APR.6 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.	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• Factors of polynomials are similar to factors of whole numbers.	• How to divide whole numbers. • How to divide polynomials using long division. • How to divide polynomials using synthetic division.	• Use appropriate tools strategically, including technology. • Attend to precision in checking the factors of the expressions. • Factor rational expressions. • Rewrite rational expressions using inspection or long division. • Determine how different forms of an expression reveal useful information.

ALGEBRA II

Algebra

Creating Equations (A-CED)*

Create equations that describe numbers or relationships

	Desired Student Performance		
A-CED.1 Create equations and inequalities in one variable and use them to solve problems. *Include equations arising from linear and quadratic functions, and simple rational and exponential functions.**	**A student should know** • Properties of Equality (Reflexive, Symmetric, Transitive, Substitution, Addition, Subtraction, Multiplication, and Division). • Properties of Inequality (Transitive, Addition, Subtraction, Multiplication, and Division). • Inverse Operations. • Variables represent unknown quantities. • Absolute value.	**A student should understand** • How to apply the Properties of Equality. • How to isolate variables. • How to apply the order of operations. • How to use the equal sign to represent balance or equivalence. • How to use signs of inequalities to represent a domain of solutions. • How to represent operations symbolically.	**A student should be able to do** • Represent real-world problems algebraically, and reason abstractly and quantitatively in solving them. • Find unknown quantities by relating them to known quantities.

ALGEBRA II

Algebra

Creating Equations (A-CED)*

Create equations that describe numbers or relationships

A-CED.2
Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. *[Note this standard appears in previous courses with a slight variation in the standard language.]*

Desired Student Performance

A student should know	A student should understand	A student should be able to do
• Solve equations for specific variables. • Solve one-variable equations. • Solve one-variable equations with variables on both sides. • Interpret graphs and write equations for linear relations. • Justify relationship between graph, table, equation, and situation. • Graph linear equations on a coordinate axes with labels and scales.	• Build equations from mathematical situations. • Solve a two-variable equation. • Explain and illustrate how a change in one variable results in a change in another variable and apply to the relationships between independent and dependent variables. • Graph and analyze linear and exponential functions. • Use algebraic and graphical methods to solve systems of equations (both two and three variable) in mathematical and real-world situations.	• Identify the quantities in a mathematical problem or real-world situation that should be represented by distinct variables and describe what quantities the variable represents. This should include situations needing more than two variables such as comparing the calories, protein and fat in food. • Determine appropriate units for the labels and scale of a graph depicting the relationship between equations created in two or more variables. • Graph one or more created equations on axes with appropriate labels and scales. • Write equations from given graph, table or situation.

ALGEBRA II

Algebra

Creating Equations (A-CED)*

Create equations that describe numbers or relationships

A-CED.3
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. *

Desired Student Performance

A student should know	A student should understand	A student should be able to do
• Build equations from a mathematical or real-world situation. • Solve multi-step equations and inequalities in one-variable. • Solve and graph equations and inequalities of two variables. • Solve and graph systems of equations and inequalities. • Determine when equations are true sometimes, always or never.	• Define constraints and determine their necessity in modeling real-world situations. • Constraints are necessary to balance a mathematical model with real-world context. • When a modeling context involves constraints. • Interpret solutions as viable or nonviable options in a modeling context. • When a problem should be represented by an equation, inequality, systems of equations and/or inequalities. • Represent constraints by equations or inequalities, and by systems of equations and/or inequalities.	• Use the graphing method to solve or estimate the solutions of complex equations and inequalities. • Explain the meaning of solutions to equations and inequalities using the context of the problem. • Eliminate algebraic solutions that do not make sense in the context of the problem. • Recognize how certain input and output values may or may not be reasonable. • Select an appropriate domain for a single-variable in a modeling context. • Develop necessary constraint using linear equations and linear inequalities.

ALGEBRA II

Algebra

Reasoning with Equations and Inequalities (A-REI)

Understand solving equations as a process of reasoning and explain the reasoning

A-REI.1 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.	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• Properties of Equality (Reflexive, Symmetric, Transitive, Substitution, Addition, Subtraction, Multiplication, and Division). • Inverse Operations. • Variables represent unknown quantities.	• How to apply the Properties of Equality. • How to isolate variables. • How to apply the order of operations. • How to use the equal sign to represent balance or equivalence.	• Justify their solution method. • Reason abstractly and quantitatively. • Find unknown quantities by relating them to known quantities.

ALGEBRA II

Algebra

Reasoning with Equations and Inequalities (A-REI)

Understand solving equations as a process of reasoning and explain the reasoning

A-REI.2 Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• The function of exponents and radicals. • Properties of Equality (Reflexive, Symmetric, Transitive, Substitution, Addition, Subtraction, Multiplication, and Division). • Inverse Operations. • Variables represent unknown quantities.	• How to apply the Properties of Equality. • How to isolate variables. • How to use the equal sign to represent balance or equivalence.	• Solve square root and other radical equations • Justify the solution method. • Reason abstractly and quantitatively. • Find unknown quantities by relating them to known quantities. • Use mathematical properties and structures to create equivalent expressions.

ALGEBRA II

Algebra

Reasoning with Equations and Inequalities (A-REI)

Solve equations and inequalities in one variable

A-REI.4b Solve quadratic equations in one variable.	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
b. Solve quadratic equations by inspection (e.g., for $x^2 = 49$), 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.	• The function of exponents and radicals. • Properties of Equality (Multiplication and Division). • Inverse Operations. • Variables represent unknown quantities.	• How to apply the Properties of Equality. • How to isolate variables. • How to use the equal sign to represent balance or equivalence.	• Rewrite functions by completing the square. • Look for and express regularity in repeated reasoning and derive possible shortcuts as solving equations. • Use mathematical properties and structures to create equivalent expressions.

ALGEBRA II

Algebra

Reasoning with Equations and Inequalities (A-REI)

Solve systems of equations

	Desired Student Performance		
A-REI.6 Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.	**A student should know** • Variables represent unknown quantities. • Properties of Equality (Reflexive, Symmetric, Transitive, Substitution, Addition, Subtraction, Multiplication, and Division). • Inverse Operations.	**A student should understand** • How to graph on a coordinate plane. • How to apply the Properties of Equality. • How to isolate variables. • How to use the equal sign to represent balance or equivalence.	**A student should be able to do** • Solve linear systems using graphs and tables. • Solve linear systems algebraically. • Recognize the point of intersection of the graphs as the solution of the system. • Identify one solution, infinitely many solutions, or no solution for the system. • Use appropriate tools strategically.

ALGEBRA II

Algebra

Reasoning with Equations and Inequalities (A-REI)

Solve systems of equations

A-REI.7 Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically.	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• A quadratic function is a stretch, compression, reflection, and/or translation of $y=x^2$.	• How to solve systems of linear equations.	• Solve and graph systems of linear and quadratic equations. • Identify one solution, two solutions, or no solution for the system. • Use appropriate tools strategically.

ALGEBRA II

Algebra

Reasoning with Equations and Inequalities (A-REI)

Represent and solve equations and inequalities graphically

A-REI.11 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.*	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• Variables represent unknown quantities. • Properties of Equality (Reflexive, Symmetric, Transitive, Substitution, Addition, Subtraction, Multiplication, and Division). • Inverse Operations.	• How to solve systems of linear equations. • How to graph on a coordinate plane. • How to apply the Properties of Equality. • How to isolate variables. • How to use the equal sign to represent balance or equivalence.	• Defend their reasoning in the context of real-world problems. • Construct viable arguments to defend their responses. • Use appropriate tools strategically.

ALGEBRA II

Functions

Interpreting Functions (F-IF)

Understand the concept of a function and use function notation

F-IF.3 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.*	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• The set of integers includes the whole numbers and their opposites. • How to define domain.	• How to continue or complete a given sequence by listing additional terms. • How to develop a rule to yield sequence values.	• Recognize sequences as functions. • Describe/model a sequence using function notation. • Recognize a recursive function as a function that calls upon itself to produce new terms within the sequence.

ALGEBRA II

Functions

Interpreting Functions (F-IF)

Interpret functions that arise in applications in terms of the context

F-IF.4
For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. *Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.**

Desired Student Performance

A student should know	A student should understand	A student should be able to do
• A function can be used to model the relationship between two quantities. • Key features may be identified using various representations such as graphs and tables. • The end behavior of a graph may be used to determine the domain of the function.	• How to identify all intercepts. • How to create a table of values and sketch a graph, when given a function. • Functions with degree other than 1 may contain relative maximum or relative minimums. • How to identify symmetries in graphs.	• Given key features, sketch an appropriate graph • Determine increasing and decreasing intervals. • Identify relative maximums and minimums. • Recognize periodicity (when applicable) in graphs. • Model a periodical function using the form $f(x + P) = f(x)$ where the period (P) is a non-zero constant.

ALGEBRA II

Functions

Interpreting Functions (F-IF)

Interpret functions that arise in applications in terms of the context

	Desired Student Performance		
F-IF.6 Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.*	**A student should know** • How to recognize that the rate of change can be calculated at various points along any curve.	**A student should understand** • How to calculate the average rate of change by finding the slope of a secant line of the curve.	**A student should be able to do** • Compare the rate of change associated with different intervals along the curve.

ALGEBRA II

Functions

Interpreting Functions (F-IF)

Analyze functions using different representations

F-IF.7c and F-IF.7e
Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.*

c. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.

e. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.

Desired Student Performance

A student should know	A student should understand	A student should be able to do
• A function can be used to model the relationship between two quantities. • The end behavior of a graph. • Definition and examples of polynomials. • Standard Form of a Polynomial Function. • Factoring polynomials. • Zero Product Property. • The Factor Theorem. • Relative maximum. • Relative minimum.	• End behavior and turning points can be determined from the degree of the polynomial. • A polynomial function of odd degree has an even number of turning points. • A polynomial function of even degree has an odd number of turning points. • How to set linear factors to zero to find the zeros.	• Determine the end behavior of polynomial function given its algebraic form. • Use the graph of a polynomial function to construct its algebraic form. • Describe the relationship between the linear factors and the zeros of a polynomial. • Identify relative maximums and minimums. • Find linear factors and graph *x-intercepts.* • Determine the degree of a polynomial. • Use appropriate tools strategically.

ALGEBRA II

Functions

Interpreting Functions (F-IF)

Analyze functions using different representations

F-IF.8b
Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.

b. Use the properties of exponents to interpret expressions for exponential functions. *For example, identify percent rate of change in functions such as* $y = (1.02)^t$, $y = (0.97)^t$, $y = (1.01)^{12t}$, $y = (1.2)^{t/10}$, *and classify them as representing exponential growth and decay.*

Desired Student Performance

A student should know	A student should understand	A student should be able to do
• The effects of a, k, and h to functions. • Properties of exponents.	• How to graph a function in the form $y = ab^x$. • The effects of the factor a in $y = ab^x$ to stretch, compress, or reflect the parent graph.	• Identify the function $y = ab^x$, where a>0 and b>1 as exponential growth. • Identify the function $y = ab^x$, where a>0 and b<1 as exponential decay. • Look for and make use of structure.

ALGEBRA II

Functions

Interpreting Functions (F-IF)

Analyze functions using different representations

F-IF.9
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.*

Desired Student Performance

A student should know	A student should understand	A student should be able to do
• A function can be used to model the relationship between two quantities. • The end behavior of a graph. • Relative maximum. • Relative minimum.	• How to calculate slope. • How to read a function's graph or table. • How to write functions algebraically various ways (point slope form, standard form).	• Identify key features of a function. • Create a viable argument comparing two functions.

ALGEBRA II

Functions

Building Functions (F-BF)

Build a function that models a relationship between two quantities

F-BF.1a and F-FB.1b Write a function that describes a relationship between two quantities.* a. Determine an explicit expression, a recursive process, or steps for calculation from a context. b. 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.*	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• A function can be used to model the relationship between two quantities. • The effects of a, k, and h to functions. • Direct variation. • Constant of variation. • Exponential decay. • Exponential growth.	• How to find slope. • How to write functions algebraically in various forms.	• Identify key features of a function. • Write functions algebraically various ways (point slope form, standard form). • Use a real-world context to create a function. • Relate each term of the function to the next term.

ALGEBRA II

Functions

Building Functions (F-BF)

Build a function that models a relationship between two quantities

F-BF.2 Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.*	**Desired Student Performance**		
	A student should know	A student should understand	**A student should be able to do**
	• How to identify an arithmetic or geometric pattern.	• How to write functions algebraically in various ways.	• Create arithmetic and geometric sequences from real-world contexts. • Reason abstractly and quantitatively and relate the forms to one another. • Relate each term of the function to the next term.

ALGEBRA II

Functions

Building Functions (F-BF)

Build new functions from existing functions

F-BF.3 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.*	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• The effects of a, k, and h to functions.	• How to interpret the graph of a function. • How to determine if a function is even or odd based on its graph or algebraic form.	• Use appropriate tools strategically to manipulate and explain graphs of functions.

ALGEBRA II

Functions

Building Functions (F-BF)

Build new functions from existing functions

F-BF.4a Find inverse functions. a. 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, $f(x) = 2x^3$ or $f(x) = (x+1)/(x-1)$ for $x \neq 1$.*	**Desired Student Performance**		
	A student should know • How to define inverse. • The range of the relation is the domain of the inverse. • The domain of the relation is the range of the inverse.	**A student should understand** • How to create and solve equations. • If a function maps *a* to *b*, then its inverse maps *b* to *a*.	**A student should be able to do** • Define and identify inverse relations and functions. • Create an inverse function.

ALGEBRA II

Functions

Linear, Quadratic, and Exponential Models (F-LE)

Construct and compare linear, quadratic, and exponential models and solve problems

F-LE.2 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).*	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• How to create a function given data or a contextual description. • Arithmetic and geometric sequences. • Linear functions. • Exponential functions.	• How to interpret a function's graph or table. • How to create equations. • The effects of an exponent and its graphical representation.	• Create linear and exponential functions based on a real-world context.

ALGEBRA II

Functions

Linear, Quadratic, and Exponential Models (F-LE)

Construct and compare linear, quadratic, and exponential models and solve problems

F-LE.3
Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.*

Desired Student Performance

A student should know	A student should understand	A student should be able to do
• Simplify expressions involving rational numbers and coefficients. • Generate data by evaluation expressions for different values of a variable and organize the data. • Justify conjectures and patterns using numerical expressions. • Translate verbal phrases into mathematical expressions. • Generalize patterns using words and algebraic methods. • Recognize patterns of linear functions.	• How and why you can use exponential functions in real world applications. • Use tables to generate graphs of exponential functions. • Recognize and interpret characteristics of graphs of exponential functions. • Analyze and compare patterns of growth in tables, graphs, and mathematical situations to determine whether a linear or exponential function matches it. • If the rate of change is constant or changing as it pertains to a graph, table, or function. • Recognize the family of function model for each sequence.	• Explain and justify why a quantity increasing exponentially will eventually exceed a quantity increasing linearly. • Build an exponential function given a geometric sequence, graph, a description of a relationship, or a table of input-output pairs. • Identify whether a relationship is linear or exponential given a graph or numeric representation. • Graph exponential functions and recognize important properties of exponential graphs. • Describe the differences between rates of change of a linear function vs. an exponential function.

ALGEBRA II

Functions

Linear, Quadratic, and Exponential Models (F-LE)

Construct and compare linear, quadratic, and exponential models and solve problems

F-LE.4
For exponential models, express as a logarithm the solution to $ab^{ct} = d$ where a, c, and d are numbers and the base b is 2, 10, or e; evaluate the logarithm using technology.*

Desired Student Performance

A student should know	A student should understand	A student should be able to do
• Exponential equations. • Logarithmic equations. • Change of Base formula.	• An exponential function is one with the general form $y=ab^x$, $a \neq 0$, with $b>0$, and $b\neq1$. • The exponential function $y=b^x$ and the logarithmic function $y=\log_b x$ are inverse functions.	• Relate an exponential model to its logarithmic form for real- world contexts. • Use appropriate tools strategically.

ALGEBRA II

Functions

Linear, Quadratic, and Exponential Models (F-LE)

Interpret expressions for functions in terms of the situation they model

	Desired Student Performance		
F-LE.5 Interpret the parameters in a linear or exponential function in terms of a context.*	**A student should know** • Linear functions • Exponential functions.	**A student should understand** • How to solve and graph functions. • Linear functions in point-slope form, slope-intercept form, and standard form. • Exponential functions in the form $y=ab^x$.	**A student should be able to do** • Reason abstractly and quantitatively to interpret the meaning of parameters in a real-world context.

ALGEBRA II

Functions

Trigonometric (F-TF)

Extend the domain of trigonometric functions using the unit circle

	Desired Student Performance		
F-TF.1 Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle.	**A student should know** • Radian measure has no associated unit of measure. • Right triangle trigonometry.	**A student should understand** • Radian measure is the ratio of arc length and the radius of a circle.	**A student should be able to do** • Create a reference triangle on a unit circle using right triangle trigonometry.

ALGEBRA II

Functions

Trigonometric (F-TF)

Extend the domain of trigonometric functions using the unit circle

F-TF.2 Explain how the unit circle in the coordinate plane enables the extension of trigonometric functions to all real numbers, interpreted as radian measures of angles traversed counterclockwise around the unit circle.	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• Unit circles are circles that have a center at the origin of a coordinate plane. • Terminating sides of angles.	• Simplicity of unit circles that have a radius of 1.	• Find any of the six trigonometric functions for any angle within any quadrant of the unit circle.

ALGEBRA II

Geometry

Expressing Geometric Properties with Equations (G-GPE)

Translate between the geometric description and the equation for a conic section

G-GPE.2 Derive the equation of a parabola given a focus and directrix.	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• How to recognize a parabola as conic sections, formed by the intersection of a cone and a plane parallel to a side of the cone. • How to distinguish between vertical and horizontal parabolas. • How to define and identify the focus of a parabola, directix, and focal length. • Each point on a parabola is equidistance from both the focus and directix.	• How to apply the vertex equation for a parabola.	• Use the focus and directix of a parabola to create its equation. • Attend to precision of vocabulary such as focus and directix used with parabolas.

ALGEBRA II

Statistics and Probability*

Interpreting Categorical and Quantitative Data (S-ID)

Summarize, represent, and interpret data on a single count or measurement variable

	Desired Student Performance		
S-ID.4 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.*	**A student should know** • How to define and give characteristics of mean, variance, standard deviation, and normal distribution. • How to define discrete and continuous probability distribution.	**A student should understand** • How to calculate mean, variance, and standard deviation. • Give examples of discrete and continuous probability distributions in real-world contexts.	**A student should be able to do** • Use appropriate tools strategically. • Apply standard deviation to create a normal distribution that models a real world scenario. • Interpret data given in a graphic display.

ALGEBRA II

Statistics and Probability*

Interpreting Categorical and Quantitative Data (S-ID)

Summarize, represent, and interpret data on two categorical and quantitative variables

	Desired Student Performance		
S-ID.6a Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.* a. 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, quadratic, and exponential models.*	**A student should know** • Quantitative variables. • Line of best fit. • Trend line.	**A student should understand** • How to display data on a scatter plot. • How to recognize types of correlation (weak or strong, negative or positive, or no correlation).	**A student should be able to do** • Create a scatter plot to display a data set. • Match data with its graphical representation. • Describe the correlation between two variables. • Make inferences about the problem in context based on its function and data.

ALGEBRA II

Statistics and Probability*

Making Inferences and Justifying Conclusions (S-IC)

Understand and evaluate random processes underlying statistical experiments

S-IC.1 Understand statistics as a process for making inferences about population parameters based on a random sample from that population.*	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• How to define a population. • How to define a sample. • How to define a representative sample. • How to define a random sample.	• Given a scenario, how to identify the population and sample. • How to determine if a sample is representative of the population.	• Determine the population given details of the experiment. • Design a collection process to create a representative sample. • Explain the importance and usefulness of representative samples when making inferences about populations. • Apply to a real-world context.

ALGEBRA II

Statistics and Probability*

Making Inferences and Justifying Conclusions (S-IC)

Understand and evaluate random processes underlying statistical experiments

S-IC.2	**Desired Student Performance**		
Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation. *For example, a model says a spinning coin falls heads up with probability 0.5. Would a result of 5 tails in a row cause you to question the model?**	**A student should know** • The probability of a chance event is a number between 0 and 1 that expresses the likelihood of the event occurring. • Recognize that experimental probability and theoretical (expected) probability may yield different results.	**A student should understand** • How to use a frequency table or graph to display a population distribution.	**A student should be able to do** • Justify discrepancies in results concerning experimental probability versus theoretical (expected) probability. • Discuss how/when experimental probability approaches the theoretical (expected) probability. • Make sense of a real-world context to justify discrepancies in experimental and theoretical probability. • Use sample data to make, justify, and critique inferences and conclusions about the corresponding population.

ALGEBRA II

Statistics and Probability*

Making Inferences and Justifying Conclusions (S-IC)

Make inferences and justify conclusions from sample surveys, experiments, and observational studies

	Desired Student Performance		
S-IC.3 Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.*	**A student should know** • How to define sample survey, experiment, and observational study.	**A student should understand** • How to identify if a scenario describes a sample survey, experiment, or observational study. • How to determine the major difference between sample survey, experiment, and observational study. • List the strengths and weaknesses of each.	**A student should be able to do** • Determine whether a sample survey, experiment, or observational study is appropriate for a given circumstance. • Explain when and why each would be appropriate. • Modify scenarios to create an appropriate circumstance for sample survey, experiment, or observational study.

ALGEBRA II

Statistics and Probability*

Making Inferences and Justifying Conclusions (S-IC)

Make inferences and justify conclusions from sample surveys, experiments, and observational studies

	Desired Student Performance		
S-IC.4 Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling.*	**A student should know** • Sampling types and methods (convenience, self-selected, systematic, and random sampling). • Bias and influence.	**A student should understand** • How to recognize and create proportional relationships. • How to find margin of error. • How to calculate confidence interval.	**A student should be able to do** • Apply data from a sample to its population by relating parts to the whole and creating proportional models. • Identify bias. • Calculate and justify margin of error via simulation models of real-world contexts.

ALGEBRA II

Statistics and Probability*

Making Inferences and Justifying Conclusions (S-IC)

Make inferences and justify conclusions from sample surveys, experiments, and observational studies

	Desired Student Performance		
S-IC.5 Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.*	**A student should know** • Sampling types and methods (convenience, self-selected, systematic, and random sampling). • Z-score.	**A student should understand** • How to calculate Z-score. • How to use proportions to compare data.	**A student should be able to do** • Compare data to its population by relating parts to the whole and creating proportional models. • Recreate the event with various parameters to gather more data. • Create a viable argument to justify if differences in parameters are significant.

ALGEBRA II

Statistics and Probability*

Making Inferences and Justifying Conclusions (S-IC)

Make inferences and justify conclusions from sample surveys, experiments, and observational studies

S-IC.6 Evaluate reports based on data.*	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• Measures of central tendencies and their uses. • Measures of variation. • How to interpret a box-and-whiskers plot.	• How to calculate measures of central tendency. • How to calculate measures of variation.	• Attend to precision in use of explicit statistical vocabulary. • Decide if specified models are consistent with results from the given data-generating processes.

ALGEBRA II

Statistics and Probability*

Conditional Probability and the Rules of Probability (S-CP)

Understand independence and conditional probability and use them to interpret data

S-CP.1 Describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events ("or," "and," "not").*	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• Conditional probability • Contingency, or two-way frequency, tables. • Addition Rule of Probability. • Independent and dependent events.	• The formula to find conditional probability— For any two events *A* and *B* with $P(A) \neq P(B|A)$= $\frac{P(A \text{ and } B)}{P(A)}$.	• Recognize, determine, and use conditional probability in contextual problems. • Apply the Addition Rule of Probability and interprets answers in context.

ALGEBRA II

Statistics and Probability*

Conditional Probability and the Rules of Probability (S-CP)

Understand independence and conditional probability and use them to interpret data

S-CP.2 Understand that two events *A* and *B* are independent if the probability of *A* and *B* occurring together is the product of their probabilities, and use this characterization to determine if they are independent.*	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• How to define and identify examples of dependent and independent events.	• How to find the probability of a single event. • The probability of events A and B: $P(A \text{ and } B) = P(A) \bullet P(B)$.	• Determine if two real-world events are independent of one another. • Give examples of real-world independent events and determine the probability of them both happening.

ALGEBRA II

Statistics and Probability*

Conditional Probability and the Rules of Probability (S-CP)

Understand independence and conditional probability and use them to interpret data

S-CP.3 Understand the conditional probability of *A* given *B* as *P*(*A* and *B*)/*P*(*B*), and interpret independence of *A* and *B* as saying that the conditional probability of *A* given *B* is the same as the probability of *A*, and the conditional probability of *B* given *A* is the same as the probability of *B*.*	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• Conditional Probability.	• How to calculate probability of compound events— The probability of events A and B: *P*(*A* and *B*) = *P*(*A*)•*P*(*B*).	• Communicate dependency of one event to another in calculating its probability. • Identify conditional probability in real-world contexts.

ALGEBRA II

Statistics and Probability*

Conditional Probability and the Rules of Probability (S-CP)

Understand independence and conditional probability and use them to interpret data

S-CP.4	**Desired Student Performance**		
Construct and interpret two-way frequency tables of data when two categories are associated with each object being classified. Use the two-way table as a sample space to decide if events are independent and to approximate conditional probabilities. *For example, collect data from a random sample of students in your school on their favorite subject among math, science, and English. Estimate the probability that a randomly selected student from your school will favor science given that the student is in tenth grade. Do the same for other subjects and compare the results.**	**A student should know** • Conditional probability. • Contingency, or two-way frequency, table. • Addition Rule of Probability. • Independent and dependent events.	**A student should understand** • How to calculate conditional probability— For any two events *A* and *B* with $P(A) \neq P(B|A)=\frac{P(A \text{ and } B)}{P(A)}$.	**A student should be able to do** • Create and interpret contingency tables based on real-world contexts. • Create a viable argument as to whether two events are independent or dependent.

ALGEBRA II

Statistics and Probability*

Conditional Probability and the Rules of Probability (S-CP)

Understand independence and conditional probability and use them to interpret data

S-CP.5 Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations. *For example, compare the chance of having lung cancer if you are a smoker with the chance of being a smoker if you have lung cancer.**	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• Conditional probability. • Independent and dependent events.	• How to calculate conditional probability— For any two events *A* and *B* with $P(A) \neq 0$, $P(B|A) = \frac{P(A \text{ and } B)}{P(A)}$.	• Determine if conditional probability exist in real-world context examples. • Create a viable argument as to whether two events are independent or dependent.

ALGEBRA II

Statistics and Probability*

Conditional Probability and the Rules of Probability (S-CP)

Use the rules of probability to compute probabilities of compound events in a uniform probability model

S-CP.6 Find the conditional probability of *A* given *B* as the fraction of *B*'s outcomes that also belong to *A*, and interpret the answer in terms of the model.*	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• Conditional probability. • Contingency, or two-way frequency, table. • Addition Rule of Probability. • Independent and dependent events.	• How to calculate conditional probability— For any two events *A* and *B* with $P(A) \neq P(B|A) = \frac{P(A \text{ and } B)}{P(A)}$.	• Interpret contingency tables based on real-world contexts to find the conditional probability. • Relate and explain the answer back to the real-world context of the problem.

ALGEBRA II

Statistics and Probability*

Conditional Probability and the Rules of Probability (S-CP)

Use the rules of probability to compute probabilities of compound events in a uniform probability model

S-CP.7 Apply the Addition Rule, $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$, and interpret the answer in terms of the model.*	**Desired Student Performance**		
	A student should know	**A student should understand**	**A student should be able to do**
	• Dependent events. • Independent events. • Mutually exclusive events.	• The probability of events A and B: $P(A \text{ and } B) = P(A) \bullet P(B)$. • The probability of event A or B: $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$. • The probability of event A or B if the two are mutually exclusive events: $P(A \text{ or } B) = P(A) + P(B)$.	• Identify dependent, independent, and mutually exclusive events in a real-world context. • Identify events and apply the Addition Rule in real-world context.