



HONORS ALGEBRA II

Approved by KSD Board of Education: March 31, 2025

Course Description:

This class develops fundamental algebraic skills such as: operations, algebraic expressions, and solving equations. Students will create and apply models to situations represented by linear, quadratic, exponential, logarithmic, polynomial, rational, and radical functions. Students will engage with relevant mathematical contexts to make math meaningful.

Grade Level: 10th and 11th Grade (year)

Unit Scope and Sequence

Unit 1: Expressions, Equations, and Inequalities

Unit 2: Introduction to Functions

Unit 3: Linear Functions

Unit 4: Quadratic Functions, Part 1

Unit 5: Systems of Equations

Unit 6: Quadratic Functions, Part 2

Unit 7: Exponential Functions

Unit 8: Logarithmic Functions

Unit 9: Polynomial Functions

Unit 10: Rational Functions

Unit 11: Statistics and Probability

Course Enduring Understandings:

- A function represents a relationship between two quantities where each input has exactly one output.
- By solving algebraic equations and inequalities, students explore how quantities interact and can describe various scenarios, including linear, quadratic, rational, and exponential relationships.

Course Essential Questions:

- How do different types of functions model real-world situations, and what are their key characteristics?
- How can solving equations and inequalities help us understand and describe relationships between variables?

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Unit 1: Expressions, Equations, and Inequalities

In this unit, students will deepen their understanding of algebraic expressions, equations, and inequalities through a variety of operations and problem-solving strategies.

Unit Essential Learning Targets	
<i>Enduring Understandings</i>	<i>Essential Questions</i>
- Algebraic expressions can be simplified and manipulated using properties of operations. - Equations represent relationships between quantities and can be solved using specific strategies. - Interval notation is a concise and precise way to represent the solution to inequalities. - Inequalities represent ranges of values and can be solved and graphed to show the solution set.	- What strategies can be used to solve and graph equations and inequalities? - How do we simplify and manipulate algebraic expressions to reveal their structure and make them easier to work with? - How can inequalities be used to represent and describe ranges of possible solutions?
<i>Students must know:</i>	<i>Students must be able to:</i>
- Absolute Value - Constant - Cube Root - Equation - Evaluate - Expression - Infinite Solutions - Integer - Interval Notation - Rationalize - Real Number - Solve - Solution - Variable - Verify	- Simplify polynomial expressions. - Simplify and perform operations with square and cube roots. - Solve linear, radical, absolute value, and literal equations. - Solve linear and absolute value inequalities. - Use interval notation to represent solutions. - Graph solution sets on a number line. - Apply Pascal's Triangle for binomial expansion.

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Unit 1: Expressions, Equations, and Inequalities

Missouri Learning Standards

Priority Standard:

- **Solve equations and inequalities. Create and solve equations and inequalities, including those that involve absolute value. (A2.REI.A.1)**

Supporting Standard:

- **Extend and use the relationship between rational exponents and radicals. Add, subtract, multiply and divide radical expressions. (A2.NQ.A.3)**

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Unit 2: Introduction to Functions

In this unit, students will explore the fundamental concept of functions, which are central to understanding mathematical relationships and modeling real-world situations. Through a combination of graphing, notation, and transformation, students will develop the skills necessary to analyze, interpret, and work with different types of functions. This unit will provide the foundation for understanding how functions behave, how to represent them graphically, and how to apply them in problem-solving.

Unit Essential Learning Targets	
<i>Enduring Understandings</i>	<i>Essential Questions</i>
• Parent functions are recognizable by their shape, equation, and name. • Function notation is a standard way to represent a relationship's input and output.	• How does a relationship between variables become a function? • How can a function model a real-world situation?
<i>Students must know:</i>	<i>Students must be able to:</i>
• Absolute Value Function • Composite Function • Cube Root Function • Cubic Function • Domain • Function Notation • Horizontal Line Test • Inverse • Linear Function • Step Function • One-to-One Function • Quadratic Function • Range • Relation • Square Root Function • Vertical Line Test	• Analyze relations to determine domain, range, and if they are functions. • Graph the parent functions of linear, quadratic, square root, cube root, absolute value, and cubic functions alone and in piecewise functions. • Recognize and graph vertical and horizontal transformations to functions. • Evaluate function notation and function composition. • Evaluate, set up, and simplify the difference quotient. • Find inverse functions algebraically, graphically, and from a table.

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Unit 2: Introduction to Functions

Missouri Learning Standards

Priority Standard

- **Use and interpret functions. Identify and interpret key characteristics of functions represented graphically, with tables and with algebraic symbolism to solve problems. (A2.IF.A.1)**
- **Create new functions from existing functions. Create new functions by applying the four arithmetic operations and composition of functions (modifying the domain and range as necessary). (A2.BF.A.1)**
- **Create new functions from existing functions. Describe the effects of transformations algebraically and graphically, creating vertical and horizontal translations, vertical and horizontal reflections and dilations (expansions/compressions) for linear, quadratic, cubic, square and cube root, absolute value, exponential and logarithmic functions. (A2.BF.A.3)**

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Unit 3: Linear Functions

In this unit, students will explore linear relationships and develop a deep understanding of how to represent and solve linear equations and inequalities in multiple forms. Emphasizing both algebraic manipulation and graphical interpretation, this unit covers a range of important skills that will allow students to solve real-world problems, model linear relationships, and analyze systems of equations.

Unit Essential Learning Targets	
<i>Enduring Understandings</i>	<i>Essential Questions</i>
• A linear relationship has a constant rate of change (slope). • The characteristics of linear equations and inequalities and their representations are useful in solving real-world problems.	• How can we represent values using variables? • How can a real-world situation be translated into an algebraic equation? • What strategies can be used to solve and graph equations and inequalities? • How can we use a system of equations to solve a real-world situation? • What does the number of solutions of a system of linear equations represent? • Which method is most efficient when solving a system of linear equations? • How can systems of equations be used to represent situations and solve problems?
<i>Students must know:</i>	<i>Students must be able to:</i>
• Constant Function • Horizontal Line • Linear Inequality • Parallel • Perpendicular • Point-Slope Form • Slope • Slope-Intercept Form • Standard Form • Undefined • Vertical Line • x-intercept • y-intercept	• Write and graph linear equations and inequalities in slope-intercept, point-slope, and standard form. • Write equations given 2 points, parallel lines, or perpendicular lines. • Evaluate slope in various forms. • Graph piecewise functions using linear pieces. • Apply linear functions to real life models. • Evaluate piecewise functions.

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Unit 3: Linear Functions

Missouri Learning Standards

Priority Standards

- Solve general systems of equations and inequalities. Create and solve systems of equations that may include non-linear equations and inequalities. (A2.REI.B.3)
- Solve equations and inequalities. Create and solve equations and inequalities, including those that involve absolute value. (A2.REI.A.1)
- Use and interpret functions. Identify and interpret key characteristics of functions represented graphically, with tables and with algebraic symbolism to solve problems. (A2.IF.A.1)

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Unit 4: Quadratic Functions, Part 1

In this unit, students will focus on understanding and working with quadratic functions. They will learn how to factor quadratic expressions, graph parabolas, and manipulate quadratic equations in different forms. Key skills in factoring, graphing, and analyzing quadratic functions will be developed, providing the foundation for solving more advanced problems in algebra and beyond.

Unit Essential Learning Targets	
<i>Enduring Understandings</i>	<i>Essential Questions</i>
- Quadratic equations can be factored and solved using multiple methods. - The graph of a quadratic function is a parabola, and its key features determine the behavior of the function. - Quadratic functions model real-world situations, and their graphs help visualize solutions.	- How can factoring quadratics help us solve equations and find the roots of a function? - What are the key features of a quadratic function, and how do they influence the graph of the function? - How do different forms of a quadratic function (standard form, vertex form) reveal different properties of the function? - How can we apply factoring and graphing of quadratic functions to solve real-world problems?
<i>Students must know:</i>	<i>Students must be able to:</i>
- Axis of Symmetry - Complete the Square - Decreasing - Difference of Squares - Factoring - Increasing - Maximum - Minimum - Perfect Square Trinomial - Standard Form - Vertex Form - Vertex - y-intercept - x-intercepts - Zeros	- Factor quadratics using real numbers. - Factor higher degree polynomials with GCF or grouping. - Graph quadratics in vertex, and standard form. - Convert between vertex and standard form by completing the square. - Factor the sum and difference of cubes. - Analyze quadratic graphs. - Use the quadratic formula and completing the square to solve a quadratic equation. - Apply quadratic functions to real world situations. - Write quadratic equations from key features.

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Unit 4: Quadratic Functions, Part 1

Missouri Learning Standards

Priority Standards

- **Use and interpret functions. Identify and interpret key characteristics of functions represented graphically, with tables and with algebraic symbolism to solve problems. (A2.IF.A.1)**
- **Create new functions from existing functions. Create new functions by applying the four arithmetic operations and composition of functions (modifying the domain and range as necessary). (A2.BF.A.1)**
- **Create new functions from existing functions. Describe the effects of transformations algebraically and graphically, creating vertical and horizontal translations, vertical and horizontal reflections and dilations (expansions/compressions) for linear, quadratic, cubic, square and cube root, absolute value, exponential and logarithmic functions. (A2.BF.A.3)**

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Unit 5: Systems of Equations

In this unit, students will solve systems of equations, including substitution, elimination, and graphing. They will learn to solve both linear and nonlinear systems, apply these methods to real-world problems, and interpret solutions graphically. Additionally, students will study systems of inequalities, graphing feasible regions, and using systems to model constraints in real-life scenarios.

Unit Essential Learning Targets	
<i>Enduring Understandings</i>	<i>Essential Questions</i>
- The methods for solving systems of equations (substitution, elimination, graphing) can be applied to both linear and nonlinear systems. - Systems of inequalities can be used to represent constraints in real-world scenarios, and graphing these systems gives insight into feasible solutions.	- How can we use systems of equations to solve real-world problems? - What are the different methods to solve systems of equations, and when is it appropriate to use each method? - How do systems of inequalities help us model real-world situations?
<i>Students must know:</i>	<i>Students must be able to:</i>
- System of Equations - Solution of a System - Substitution Method - Elimination Method - Graphing Method - Consistent System - Inconsistent System - Dependent System - Independent System - System of Inequalities - Feasible Region	- Solve systems using substitution, elimination, and graphing methods. - Identify and interpret the solution of a system as a point of intersection on a graph. - Determine when systems have one solution, no solution, or infinitely many solutions. - Solve systems that include linear and nonlinear equations. - Graph the solutions of systems of linear equations. - Graph systems of inequalities and shade the feasible region correctly. - Determine when to use a solid line vs. a dashed line based on the inequality symbol. - Shade the correct region of the graph to represent the solution set. - Apply the rules for "$\leq$" and "$\geq$" (solid line) versus "<" and ">" (dashed line). - Interpret the meaning of the feasible region in the context of real-world problems. - Model real-world situations using systems of equations and inequalities. - Solve real-world problems involving systems of equations, such as mixture problems, investment problems, and problems involving motion or rates. - Analyze whether solutions to systems of equations are practical or meaningful in a given context. - Understand the implications of no solution or infinitely many solutions in real-world scenarios.

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Unit 5: Systems of Equations

Missouri Learning Standards

Priority Standard:

- **A2.REI.B.3: Solve general systems of equations and inequalities. Create and solve systems of equations that may include non-linear equations and inequalities.**

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Unit 6: Quadratic Functions, Part 2

In this unit, students will build on their knowledge of quadratic functions to explore more advanced concepts, including solving quadratic equations with complex solutions. The unit will cover factoring, solving, and graphing quadratic functions in various forms, and it will introduce students to the concept of complex numbers and how they relate to quadratic equations that don't have real solutions. By the end of this unit, students will understand how to solve quadratic equations using a variety of methods and interpret the results, whether they are real or complex.

Unit Essential Learning Targets	
<i>Enduring Understandings</i>	<i>Essential Questions</i>
• All quadratic equations have solutions, either real or complex. • Operations of complex numbers always simplify to real or complex expressions. • All quadratic expressions can be factored.	• How does understanding how to find the vertex of a quadratic function help in making decisions in real-life applications? • Which method is most efficient when solving a quadratic equation? • How is a quadratic function used to model a situation? • When are complex solutions applicable to quadratic equations? • How do we model quadratic functions with complex roots? • How can we represent complex expressions in simplest form?
<i>Students must know:</i>	<i>Students must be able to:</i>
• Quadratic Function • Standard Form • Vertex Form • Parabola • Discriminant • Imaginary Number • Complex Number • Real Number • Solutions • Axis of Symmetry • Vertex • y-intercept • x-intercept • Quadratic Formula • Completing the Square • Sum and Difference of Squares • Imaginary Unit • Conjugates	• Simplify expressions including complex numbers. • Solve quadratics equations. • Graph quadratic functions. • Model quadratic situations and apply that model to a new situation.

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Unit 6: Quadratic Functions, Part 2

Missouri Learning Standards

Priority Standards:

- Solve equations and inequalities. Create and solve equations and inequalities, including those that involve absolute value. (A2.REI.A.1)
- Use and interpret functions. Identify and interpret key characteristics of functions represented graphically, with tables and with algebraic symbolism to solve problems. (A2.IF.A.1)
- Create new functions from existing functions. Create new functions by applying the four arithmetic operations and composition of functions (modifying the domain and range as necessary). (A2.BF.A.1)
- Create new functions from existing functions. Describe the effects of transformations algebraically and graphically, creating vertical and horizontal translations, vertical and horizontal reflections and dilations (expansions/compressions) for linear, quadratic, cubic, square and cube root, absolute value, exponential and logarithmic functions. (A2.BF.A.3)
- Use functions to model real-world problems. Create functions and use them to solve applications of quadratic and exponential function model problems. (A2.FM.A.1)

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Unit 7: Exponential Functions

In this unit, students will explore the properties and applications of exponential functions, focusing on simplifying expressions, solving equations, and modeling real-world situations. They will develop a deep understanding of how to apply exponent rules, solve exponential equations with common bases and rational exponents, and graph exponential functions. Students will also learn how exponential functions can model growth and decay in various contexts, such as population growth and interest rates.

Unit Essential Learning Targets	
<i>Enduring Understandings</i>	<i>Essential Questions</i>
- Real world situations can be represented by exponential graphs. - Integer exponents can be used to represent a series of multiplications. - A radical expression can be written using rational exponents. - The structure of an exponential function can determine a strategy used to find solutions.	- How can we solve exponential equations by rewriting them with common bases, and what strategies help us find solutions? - How is an exponential function used to model a situation? - How can we simplify expressions involving exponents and radicals, and why are the exponent rules important for solving algebraic problems? - What role does the number e play in exponential growth and decay, and why is it significant in natural phenomena and mathematics? - How does an asymptote help us understand the behavior of exponential functions as they approach certain values?
<i>Students must know:</i>	<i>Students must be able to:</i>
- Asymptote - Base - Domain - Exponent - Exponential Decay - Exponential Form - Exponential Function - Exponential Growth - Horizontal Asymptote	- Simplify expressions by applying exponent rules. - Solve exponential equations with common bases. - Solve equations with rational exponents. - Model exponential situations and apply that model to a new situation. - Graph exponential functions. - Do all of the above without a calculator. - Factor and solve equations using rational exponents.

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Unit 7: Exponential Functions

Missouri Learning Standards

Priority Standards:

- **Solve equations and inequalities. Create and solve equations and inequalities, including those that involve absolute value. (A2.REI.A.1)**
- **Use and interpret functions. Identify and interpret key characteristics of functions represented graphically, with tables and with algebraic symbolism to solve problems. (A2.IF.A.1)**
- **Create new functions from existing functions. Describe the effects of transformations algebraically and graphically, creating vertical and horizontal translations, vertical and horizontal reflections and dilations (expansions/compressions) for linear, quadratic, cubic, square and cube root, absolute value, exponential and logarithmic functions. (A2.BF.A.3)**
- **Use functions to model real-world problems. Create functions and use them to solve applications of quadratic and exponential function model problems. (A2.FM.A.1)**

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Unit 8: Logarithmic Functions

In this unit, students will focus on understanding and working with logarithmic functions. They will learn to simplify logarithmic expressions using logarithmic properties, solve logarithmic and exponential equations, and graph logarithmic functions. The unit will emphasize the relationship between logarithms and exponents, showing how logarithms serve as the inverse of exponential functions.

Unit Essential Learning Targets	
<i>Enduring Understandings</i>	<i>Essential Questions</i>
• Real world situations can be represented by logarithmic graphs. • A logarithm is an exponent. • A logarithmic equation can be written in exponential form. • The structure of a logarithmic function can determine a strategy used to find solutions .	• How do we solve exponential equations with any bases? • When is it appropriate to use an exponential or logarithmic function to model a situation? • How do we simplify an expression with logarithmic terms? • How is a natural log different from a common log?
<i>Students must know:</i>	<i>Students must be able to:</i>
• Asymptote • e • Logarithm • Natural Logarithm	• Simplify expressions by applying logarithmic properties or laws. • Solve logarithmic equations. • Solve exponential equations with different bases. • Model exponential and logarithmic situations and apply that model to a new situation. • Graph logarithmic functions.

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Unit 8: Logarithmic Functions

Missouri Learning Standards

Priority Standards

- **Define and use logarithms. Understand why logarithmic scales are used, and use them to solve problems. (A2.SSE.A.4)**
- **Solve equations and inequalities. Create and solve equations and inequalities, including those that involve absolute value. (A2.REI.A.1)**
- **Use and interpret functions. Identify and interpret key characteristics of functions represented graphically, with tables and with algebraic symbolism to solve problems. (A2.IF.A.1)**
- **Create new functions from existing functions. Describe the effects of transformations algebraically and graphically, creating vertical and horizontal translations, vertical and horizontal reflections and dilations (expansions/compressions) for linear, quadratic, cubic, square and cube root, absolute value, exponential and logarithmic functions. (A2.BF.A.3)**

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Unit 9: Polynomial Functions

In this unit, students will study polynomial functions, learning to factor, solve, graph, and analyze polynomials. They will begin by mastering the techniques for factoring polynomials, both with and without division, and then move on to solving polynomial equations that yield real and complex roots. Students will also explore the characteristics of polynomial functions, including how to graph them and analyze their key features, such as intercepts, turning points, and end behavior.

Unit Essential Learning Targets	
<i>Enduring Understandings</i>	<i>Essential Questions</i>
• All polynomial equations have solutions, either real or complex. • The fundamental theorem of algebra determines the number of solutions. • The degree of a polynomial determines its shape and end behavior.	• How does the fundamental theorem of algebra relate to x-intercepts? • How can end behavior and intercepts be used to model a polynomial function? • What is the relationship between factors, x-intercepts, and solutions?
<i>Students must know:</i>	<i>Students must be able to:</i>
• Complex • Degree • End Behavior • Extrema • Long Division • Maximum • Minimum • Polynomial • Roots • Synthetic Division • Zeros	• Factor polynomial expressions with or without division. • Solve polynomial equations with real and complex roots. • Graph and analyze polynomial functions. • Create polynomial functions. • Use the rational root theorem and synthetic division to find all roots.

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Unit 9: Polynomial Functions

Missouri Learning Standards

Priority Standards:

- Use complex numbers. Know and apply the Fundamental Theorem of Algebra. (A2.NQ.B.7)
- Solve equations and inequalities. Create and solve equations and inequalities, including those that involve absolute value. (A2.REI.A.1)
- Perform operations on polynomials and rational expressions. Understand the Remainder Theorem and use it to solve problems. (A2.APR.A.2)
- Use and interpret functions. Identify and interpret key characteristics of functions represented graphically, with tables and with algebraic symbolism to solve problems. (A2.IF.A.1)
- Create new functions from existing functions. Describe the effects of transformations algebraically and graphically, creating vertical and horizontal translations, vertical and horizontal reflections and dilations (expansions/compressions) for linear, quadratic, cubic, square and cube root, absolute value, exponential and logarithmic functions. (A2.BF.A.3)
- Use functions to model real-world problems. Create functions and use them to solve applications of quadratic and exponential function model problems. (A2.FM.A.1)

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Unit 10: Rational Functions

In this unit, students will explore rational functions, which are ratios of two polynomials. They will learn to perform operations on rational expressions, including addition, subtraction, multiplication, and division. Students will also focus on graphing and analyzing rational functions, identifying key features such as asymptotes, holes, and intercepts. The unit will emphasize solving rational equations and checking for extraneous solutions, ensuring students understand how to apply algebraic methods accurately. Finally, students will learn how to create rational functions from given conditions, applying their knowledge to model real-world situations.

Unit Essential Learning Targets	
Enduring Understandings	Essential Questions
- Solving rational equations involves clearing denominators and checking for extraneous solutions. - Operations on rational expressions require careful attention to domain restrictions. - Intercepts and asymptotes provide key information for graphing rational functions. - Rational functions model real-world relationships. - Discontinuities can occur in rational functions. - Asymptotes define the behavior of rational functions	- Under what conditions can a rational function cross its asymptotes, and how does this affect the graph? - How can we distinguish between an asymptote and a point of discontinuity, and why is it important to recognize the difference? - What strategies can we use to identify extraneous solutions when solving rational equations, and why must we check for them? - How can the locations of intercepts and asymptotes help us construct and analyze the graph of a rational function?
Students must know:	Students must be able to:
- Asymptote - Point of Discontinuity - Domain Restriction	- Perform operations on rational expressions. - Graph and analyze rational functions. - Create rational functions. - Solve rational equations and check for extraneous solutions. - Find points of discontinuity and slant asymptotes for rational functions.

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Unit 10: Rational Functions

Missouri Learning Standards

Priority Standards:

- **Solve equations and inequalities. Create and solve equations and inequalities, including those that involve absolute value. (A2.REI.A.1)**
- **Use and interpret functions. Identify and interpret key characteristics of functions represented graphically, with tables and with algebraic symbolism to solve problems. (A2.IF.A.1)**
- **Create new functions from existing functions. Describe the effects of transformations algebraically and graphically, creating vertical and horizontal translations, vertical and horizontal reflections and dilations (expansions/compressions) for linear, quadratic, cubic, square and cube root, absolute value, exponential and logarithmic functions. (A2.BF.A.3)**

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Unit 11: Statistics and Probability

In this unit, students will explore fundamental concepts in data analysis and statistics, focusing on how data can be used to estimate population parameters and interpret real-world data. The unit will cover methods for calculating and understanding the margin of error in statistical estimates, as well as how to analyze and interpret data sets that follow a normal distribution. Through hands-on activities and problem-solving, students will learn how to draw conclusions about populations based on sample data, and how to assess the reliability of those conclusions.

Unit Essential Learning Targets	
<i>Enduring Understandings</i>	<i>Essential Questions</i>
• Statistical analysis provides tools for making informed decisions based on data. • Data sampling allows for estimation of population parameters. • Margin of error reflects the uncertainty of estimates. • Normal distributions follow predictable patterns.	• How can we analyze data to draw conclusions about a population? • What is the significance of the normal distribution in statistics?
<i>Students must know:</i>	<i>Students must be able to:</i>
• Sample • Population • Margin of Error • Normal Distribution • Probability	• Use data to estimate population parameters and understand margin of error. • Analyze and interpret normally distributed data sets. • Use permutations and combinations to find outcomes and probabilities. • Use the binomial theorem for binomial expansion. • Use probability techniques to solve problems.

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Unit 11: Statistics and Probability

Missouri Learning Standards

Priority Standards:

- **Make inferences and justify conclusions. Determine whether a specified model is consistent with a given data set. (A2.DS.A.2)**
- **Make inferences and justify conclusions. Use data from a sample to estimate characteristics of the population and recognize the meaning of the margin of error in these estimates. (A2.DS.A.4)**
- **Fit a data set to a normal distribution. Know and use the characteristics of normally distributed data sets; predict what percentage of the data will be above or below a given value that is a multiple of standard deviations above or below the mean. (A2.DS.B.8)**