

Unit 1 Standards:

U1.1 Extend the properties of exponents to rational exponents.

MCC9-12.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.

MCC9-12.N.RN.2 Rewrite expressions involving radicals and rational exponents using the properties of exponents.

U1.2 Use properties of real numbers and rational exponents

MCC9-12.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 $[5^{(1/3)}]^3 = 5^{[(1/3) \times 3]}$ to hold, so $[5^{(1/3)}]^3$ must equal 5.*

MCC9-12.N.RN.2 Rewrite expressions involving radicals and rational exponents using the properties of exponents.

MCC9-12.N.RN.3 Explain why the sum or product of rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational.

U1.3 Perform arithmetic operations with complex numbers

MCC9-12.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.

MCC9-12.N.CN.2 Use the relation $i^2 = -1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.

MCC9-12.N.CN.3 Find the conjugate of a complex number; use conjugates to find quotients of complex numbers.

U1.4 Perform arithmetic operations on polynomials

MCC9-12.A.APR.1 Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.

Unit 2 Standards

U2.1 Use complex numbers in polynomial identities and equations.

MCC9-12.N.CN.7 Solve quadratic equations with real coefficients that have complex solutions. Interpret the structure of expressions.

U2.2 Interpret the structure of expressions

MCC9-12.A.SSE.1 Interpret expressions that represent a quantity in terms of its context. (Focus on quadratic functions; compare with linear and exponential functions studied in Coordinate Algebra.)

MCC9-12.A.SSE.1a Interpret parts of an expression, such as terms, factors, and coefficients. (Focus on quadratic functions; compare with linear and exponential functions studied in Coordinate Algebra.)

MCC9-12.A.SSE.1b Interpret complicated expressions by viewing one or more of their parts as a single entity. (Focus on quadratic functions; compare with linear and exponential functions studied in Coordinate Algebra.)

MCC9-12.A.SSE.2 Use the structure of an expression to identify ways to rewrite it. (Focus on quadratic functions; compare with linear and exponential functions studied in Coordinate Algebra.)

U2.3 Write expressions in equivalent forms to solve problems

MCC9-12.A.SSE.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. (Focus on quadratic functions; compare with linear and exponential functions studied in Coordinate Algebra.)

MCC9-12.A.SSE.3a Factor a quadratic expression to reveal the zeros of the function it defines.

MCC9-12.A.SSE.3b Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.

U2.4 Create equations that describe numbers or relationships

MCC9-12.A.CED.1 Create equations and inequalities in one variable and use them to solve problems. Include equations arising from quadratic functions.

MCC9-12.A.CED.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. (Focus on quadratic functions; compare with linear and exponential functions studied in Coordinate Algebra.)

MCC9-12.A.CED.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. (Focus on quadratic functions; compare with linear and exponential functions studied in Coordinate Algebra.)

U2.5 Solve equations and inequalities in one variable

MCC9-12.A.REI.4 Solve quadratic equations in one variable.

MCC9-12.A.REI.4a Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x - p)^2 = q$ that has the same solutions. Derive the quadratic formula from this form.

MCC9-12.A.REI.4b 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 and write them as $a \pm bi$ for real numbers a and b .

U2.6 Solve systems of equations

MCC9-12.A.REI.7 Solve a simple system consisting of a linear equation and a quadratic equation in two variables, algebraically and graphically. Interpret functions that arise in applications in terms of the context

U2.7 Interpret functions that arise in applications in terms of the context

MCC9-12.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.

MCC9-12.F.IF.5 Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. (Focus on quadratic functions; compare with linear and exponential functions studied in Coordinate Algebra.)

MCC9-12.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. (Focus on quadratic functions; compare with linear and exponential functions studied in Coordinate Algebra.)

U2.8 Analyze functions using different representations

MCC9-12.F.IF.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. (Focus on quadratic functions; compare with linear and exponential functions studied in Coordinate Algebra.)

MCC9-12.F.IF.7a Graph linear and quadratic functions and show intercepts, maxima, and minima.

MCC9-12.F.IF.8 Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function. (Focus on quadratic functions; compare with linear and exponential functions studied in Coordinate Algebra.)

MCC9-12.F.IF.8a Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.

MCC9-12.F.IF.9 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). (Focus on quadratic functions; compare with linear and exponential functions studied in Coordinate Algebra.)

U2.9 Build a function that models a relationship between two quantities

MCC9-12.F.BF.1 Write a function that describes a relationship between two quantities. (Focus on quadratic functions; compare with linear and exponential functions studied in Coordinate Algebra.)

MCC9-12.F.BF.1a Determine an explicit expression, a recursive process, or steps for calculation from a context. (Focus on quadratic functions; compare with linear and exponential functions studied in Coordinate Algebra.)

MCC9-12.F.BF.1b Combine standard function types using arithmetic operations. (Focus on quadratic functions; compare with linear and exponential functions studied in Coordinate Algebra.)

U2.10 Build new functions from existing functions

MCC9-12.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. (Focus on quadratic functions; compare with linear and exponential functions studied in Coordinate Algebra.)

U2.11 Construct and compare linear, quadratic, and exponential models and solve problems

MCC9-12.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. Summarize, represent, and interpret data on two categorical and quantitative variables

U2.12 Summarize, represent, and interpret data on two categorical and quantitative variables

MCC9-12.S.ID.6 Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.

MCC9-12.S.ID.6a 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 quadratic models.

Unit 3 Standards

U3.1 Solve systems of equations

MCC9-12.A.REI.7 Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically.

U3.2 Translate between the geometric description and the equation for a conic section

MCC9-12.G.GPE.1 Derive the equation of a circle of given center and radius using the Pythagorean Theorem; complete the square to find the center and radius of a circle given by an equation.

MCC9-12.G.GPE.2 Derive the equation of a parabola given a focus and directrix.

U3.3 Use coordinates to prove simple geometric theorems algebraically

MCC9-12.G.GPE.4 Use coordinates to prove simple geometric theorems algebraically

Unit 4 Standards

U4.1 Understand independence and conditional probability and use them to interpret data

MCC9-12.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”).

MCC9-12.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.

MCC9-12.S.CP.3 Understand the conditional probability of A given B as $P(A \text{ and } B)/P(B)$, 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.

MCC9-12.S.CP.4 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.

MCC9-12.S.CP.5 Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations.

U4.2 Use the rules of probability to compute probabilities of compound events in a uniform probability model

MCC9-12.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.

MCC9-12.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.

Unit 5 Standards

U5.1 Summarize, represent, and interpret data on a single count or measurement variable

MCC9-12.S.ID.2 Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.

MCC9-12.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.

U5.2 Understand and evaluate random processes underlying statistical experiments

MCC9-12.S.IC.1 Understand statistics as a process for making inferences about population parameters based on a random sample from that population.

MCC9-12.S.IC.2 Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation.

U5.3 Make inferences and justify conclusions from sample surveys, experiments, and observational studies

MCC9-12.S.IC.3 Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.

MCC9-12.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.

MCC9-12.S.IC.5 Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.

MCC9-12.S.IC.6 Evaluate reports based on data.