Algebra 2 Mathematics Item Specifications

Table of Contents

Introduction

In 2014 Missouri legislators passed House Bill 1490, mandating the development of the Missouri Learning Expectations. In April of 2016, these Missouri Learning Expectations were adopted by the State Board of Education. Groups of Missouri educators from across the state collaborated to create the documents necessary to support the implementation of these expectations.

One of the documents developed is the item specification document, which includes all Missouri grade level/course expectations arranged by domains/strands. It defines what could be measured on a variety of assessments. The document serves as the foundation of the assessment development process.

Although teachers may use this document to provide clarity to the expectations, these specifications are intended for summative, benchmark, and large-scale assessment purposes.

Components of the item specifications include:

Expectation Unwrapped breaks down a list of clearly delineated content and skills the students are expected to know and be able to do upon mastery of the Expectation.

Depth of Knowledge (DOK) Ceiling indicates the highest level of cognitive complexity that would typically be assessed on a large scale assessment. The DOK ceiling is not intended to limit the complexity one might reach in classroom instruction.

Item Format indicates the types of items used in large scale assessment. For each expectation, the item format specifies the type best suited for that particular expectation.

Text Types suggests a broad list of text types for both literary and informational expectations. This list is not intended to be all inclusive: other text types may be used in the classroom setting. The expectations were written in grade level bands; for this reason, the progression of the expectations relies upon increasing levels of quantitative and qualitative text complexities.

Content Limits/Assessment Boundaries are parameters that item writers should consider when developing a large scale assessment. For example, some expectations should not be assessed on a large scale assessment but are better suited for local assessment.

Sample stems are examples that address the specific elements of each expectation and address varying DOK levels. The sample stems provided in this document are in no way intended to limit the depth and breadth of possible item stems. The expectation should be assessed in a variety of ways.

High School Algebra 2

Mathematics		A2.NQ.A.1
NQ **A** **1**	**Number and Quantity** **Extend and use the relationship between rational exponents and radicals.** Extend the system of powers and roots to include rational exponents.	

Expectation Unwrapped

The student will apply the rules of exponents to expressions that include rational exponents.

The student will simplify expressions including constants and variables as bases and using rational exponents including those with integer numerators other than one.

DOK Ceiling
2

Item Format
Selected Response
Constructed Response
Technology Enhanced

Sample Stems

State Assessment Content Limits/Boundaries Classroom Work Should Include Extension
Exponent denominators should be limited to natural numbers of ten or less.
Coefficients negative one thousand to one thousand.
No more than three distinct variables.

Calculator Designation
NEUTRAL – a calculator may or may not be available for items

High School Algebra 2

Mathematics		A2.NQ.A.2
NQ A 2	**Number and Quantity** **Extend and use the relationship between rational exponents and radicals.** Create and recognize equivalent expressions involving radical and exponential forms of expressions.	

Expectation Unwrapped

The student will be able to convert from radical form to rational exponent form.

The student will be able to convert from rational exponent form to radical form.

The student will recognize that radical form and rational exponent forms are equivalent.

The student will be able to simplify radical expressions.

The student will be able to simplify expressions with rational exponents.

DOK Ceiling
2

Item Format
Selected Response
Constructed Response
Technology Enhanced

Sample Stems

State Assessment Content Limits/Boundaries Classroom Work Should Include Extension
Denominators should be limited to natural numbers of ten or less.
Coefficients negative one thousand to one thousand.
No more than three distinct variables.
Indices on radicals should not exceed five.

Calculator Designation
NEUTRAL – a calculator may or may not be available for items

High School Algebra 2

Mathematics		A2.NQ.A.3
NQ A 3	**Number and Quantity** **Extend and use the relationship between rational exponents and radicals.** Add, subtract, multiply and divide radical expressions.	

Expectation Unwrapped

The student will able to perform operations with radical expressions, including those that require simplifying prior to combining terms.

The student will use conjugates to simplify rational expressions containing radicals in the denominator.

DOK Ceiling
2

Item Format
Selected Response
Constructed Response
Technology Enhanced

Sample Stems

State Assessment Content Limits/Boundaries Classroom Work Should Include Extension
Expressions should include those that are numeric and algebraic.
Radical indices should be no more than five.
No more than two distinct variables.
Coefficient s between negative six hundred twenty-five and six hundred twenty-five.

Calculator Designation
NEUTRAL – a calculator may or may not be available for items

High School Algebra 2

Mathematics		A2.NQ.A.4
NQ A 4	**Number and Quantity** **Extend and use the relationship between rational exponents and radicals.** Solve equations involving rational exponents and/or radicals and identify situations where extraneous solutions may result.	

Expectation Unwrapped

The student will solve equations involving rational exponents.

The student will solve equations involving radical expressions.

The student will check for and identify extraneous solutions.

DOK Ceiling
2

Item Format
Selected Response
Constructed Response
Technology Enhanced

Sample Stems

State Assessment Content Limits/Boundaries Classroom Work Should Include Extension
Resulting polynomials to solve should not exceed degree two.
Equations can contain one or two radicals.
Expressions with rational exponents should be set equal to a constant.

Calculator Designation
NEUTRAL – a calculator may or may not be available for items

High School Algebra 2

Mathematics		A2.NQ.B.5
NQ B 5	**Number and Quantity** **Use complex numbers.** Represent complex numbers.	

Expectation Unwrapped

The student will be able to write all numbers in the form $a + bi$.

The student will be able to identify that a and b are real numbers and i is defined as the square root of -1.

DOK Ceiling
2

Item Format
Selected Response
Constructed Response
Technology Enhanced

Sample Stems

State Assessment Content Limits/Boundaries Classroom Work Should Include Extension
Items requiring $a + bi$ would include items like $(2 + 2i)/4$ which should be written as $1/2 + 1/2i$.

Calculator Designation
NEUTRAL – a calculator may or may not be available for items

High School Algebra 2

Mathematics		A2.NQ.B.6
NQ **B** **6**	**Number and Quantity** **Use complex numbers.** Add, subtract, multiply and divide complex numbers.	

Expectation Unwrapped

The student will add and subtract complex numbers with answers given in $a + bi$ form.

The student will multiply complex numbers with answers given in $a + bi$ form.

The student will divide complex numbers with answers given in $a + bi$ form, using conjugates to rationalize the denominator.

DOK Ceiling
2

Item Format
Selected Response
Constructed Response
Technology Enhanced

Sample Stems

State Assessment Content Limits/Boundaries Classroom Work Should Include Extension
While simplified answers may have fractional a and/or b values, given problems should use integer values for a and b.
When multiplying and dividing, limit *a* and *b* to values between negative twelve and twelve.
Items requiring $a + bi$ would include items like $(2 + 2i)/4$ which should be written as $1/2 + 1/2i$.

Calculator Designation
NEUTRAL – a calculator may or may not be available for items

High School Algebra 2

Mathematics		A2.NQ.B.7
NQ B 7	**Number and Quantity** **Use complex numbers.** Know and apply the Fundamental Theorem of Algebra.	

Expectation Unwrapped

The student will recognize that the degree of a polynomial determines the number of solutions. (real + imaginary)

The student will understand that complex solutions always occur in pairs.

The student will understand that factors repeated *n* times have a multiplicity of *n*.

DOK Ceiling
2

Item Format
Selected Response
Constructed Response
Technology Enhanced

Sample Stems

State Assessment Content Limits/Boundaries Classroom Work Should Include Extension
Polynomial equations should contain integer coefficients.
Degree of five or less on given polynomial.

Calculator Designation
NEUTRAL – a calculator may or may not be available for items

High School Algebra 2

Mathematics		A2.SSE.A.1
SSE **A** **1**	**Seeing Structure in Expressions** **Define and use logarithms** Develop the definition of logarithms based on properties of exponents.	

Expectation Unwrapped

The student will develop the definition of logarithms $\log_b y = x$ if and only if $b^x = y$, based on properties of exponents.

The student will be able to convert equations from exponential to logarithmic form.

The student will be able to convert equations from logarithmic to exponential form.

DOK Ceiling
2

Item Format
Selected Response
Constructed Response
Technology Enhanced

Sample Stems

State Assessment Content Limits/Boundaries Classroom Work Should Include Extension
Bases should be greater than zero.

Calculator Designation
NEUTRAL – a calculator may or may not be available for items

High School Algebra 2

Mathematics		A2.SSE.A.2
SSE A 2	**Seeing Structure in Expressions** **Define and use logarithms** Use the inverse relationship between exponents and logarithms to solve exponential and logarithmic equations.	

Expectation Unwrapped

The student will use the inverse relationship between exponents and logarithms to solve simple exponential equations.

The student will use the inverse relationship between exponents and logarithms to solve simple logarithmic equations.

DOK Ceiling

2

Item Format

Selected Response
Constructed Response
Technology Enhanced

Sample Stems

$4\log(2x+4)=8$
$10^2=2x+4$

State Assessment Content Limits/Boundaries Classroom Work Should Include Extension

The expressions used as exponents should not exceed linear.
The expression used in logarithms should not exceed linear $c\log_n(ax+b)=m$, where *n* or *m* are integers and *c* is a constant.

Calculator Designation

YES – a calculator will be available for items

High School Algebra 2

Mathematics		A2.SSE.A.3
SSE **A** **3**	**Seeing Structure in Expressions** **Define and use logarithms** Use properties of logarithms to solve equations or find equivalent expressions.	

Expectation Unwrapped

The student will expand expressions using properties of logarithms.

The student will condense expressions using properties of logarithms.

The student will solve equations using properties of logarithms.

DOK Ceiling
2

Item Format
Selected Response
Constructed Response
Technology Enhanced

Sample Stems

State Assessment Content Limits/Boundaries Classroom Work Should Include Extension
Base is greater than zero.
No more than three distinct variables in expanding and condensing problems.
Equations should be have no more than two terms on one side of the equation and one term on the other side.
Equations should have the same base throughout.

Calculator Designation
NEUTRAL – a calculator may or may not be available for items

High School Algebra 2

Mathematics		A2.SSE.A.4
SSE **A** **4**	**Seeing Structure in Expressions** **Define and use logarithms** Understand why logarithmic scales are used, and use them to solve problems.	

Expectation Unwrapped

The student will demonstrate an understanding of applications of the logarithmic scale and apply it in problem solving. For example: pH scale, Richter scale, sound intensity, light intensity and the musical scale.

Students will demonstrate an understanding of how logarithmic scales are used to compare quantities.

DOK Ceiling
3

Item Format
Selected Response
Constructed Response
Technology Enhanced

Sample Stems

State Assessment Content Limits/Boundaries Classroom Work Should Include Extension
Base is greater than zero.
When giving formulas, all variables should be defined.

Calculator Designation
YES – a calculator will be available for items

High School Algebra 2

Mathematics		A2.REI.A.1
REI **A** **1**	**Reasoning with Equations and Inequalities** **Solve equations and inequalities.** Create and solve equations and inequalities, including those that involve absolute value.	

Expectation Unwrapped

The student will solve exponential equations that do not require logarithms.

The student will write an equation or inequality to model a context.

The student will create equations that may include but is not limited to: linear, quadratic, cubic, exponential, step, and absolute value.

The student will solve equations that may include but is not limited to: linear, quadratic, cubic, exponential, and absolute value.

The student will create equations that may include but is not limited to: linear, quadratic, cubic, exponential, step, and absolute value.

The student will solve inequalities that may include but is not limited to: linear, quadratic, cubic, exponential, and absolute value.

The student may use algebraic and/or graphical methods to solve these problems.

DOK Ceiling

2

Item Format

Selected Response
Constructed Response
Technology Enhanced

Sample Stems

Given the solutions -6, 8, write an absolute value equation that will yield these solutions.

Sample answer: |x-1| = 7

Solve $8^{x+6} = 16^{2x+4}$

Write an absolute value inequality that yields the solution $4 \leq x \leq 12$

State Assessment Content Limits/Boundaries Classroom Work Should Include Extension

Absolute value equations and inequalities should be limited to variables to the first power. (e.g., -5|x-4|+2 = -20)
Inequalities will be limited to linear, quadratic and absolute value functions.

Calculator Designation

NEUTRAL – a calculator may or may not be available for items

High School Algebra 2

Mathematics		A2.REI.A.2
REI **A** **2**	**Reasoning with Equations and Inequalities** **Solve equations and inequalities.** Solve rational equations where numerators and denominators are polynomials and where extraneous solutions may result.	

Expectation Unwrapped

The student will solve rational equations by various methods, including instances when the numerator and denominator are polynomials.

The student will check solutions and identify those that are extraneous.

DOK Ceiling
2

Item Format
Selected Response
Constructed Response
Technology Enhanced

Sample Stems

State Assessment Content Limits/Boundaries Classroom Work Should Include Extension
Higher degree polynomials should be factorable. Do not exceed degree three.
All coefficients should be integers.

Calculator Designation
NEUTRAL – a calculator may or may not be available for items

High School Algebra 2

Mathematics		A2.REI.B.3
REI **B** **3**	**Reasoning with Equations and Inequalities** **Solve general systems of equations and inequalities.** Create and solve systems of equations that may include non-linear equations and inequalities.	

Expectation Unwrapped

The student will write a system of equations to model a context or setting that may include non-linear equations and inequalities.

The student will solve systems of equations that may include non-linear equations and inequalities.

DOK Ceiling
3

Item Format
Selected Response
Constructed Response
Technology Enhanced

Sample Stems

State Assessment Content Limits/Boundaries Classroom Work Should Include Extension
Systems of equations should be limited to: linear – linear (writing the system is required), linear – linear – linear, linear – quadratic, quadratic – quadratic and non-linear – non-linear.
Systems of equations should only have three or fewer unknowns.
If circles are used the equations should be given in $(x-h)^2+(y-k)^2=r^2$ form.

Calculator Designation
YES – a calculator will be available for items

High School Algebra 2

Mathematics		A2.APR.A.1
APR **A** **1**	**Arithmetic with Polynomials and Rational Expressions** **Perform operations on polynomials and rational expressions** Extend the knowledge of factoring to include factors with complex coefficients.	

Expectation Unwrapped

The student will extend the knowledge of factoring to completely factor general polynomial expressions.

The student will factor simple expressions that require complex coefficients, such as $x^2 + 16 = (x + 4i)(x - 4i)$.

DOK Ceiling
2

Item Format
Selected Response
Constructed Response
Technology Enhanced

Sample Stems

Factor $x^3 + 8$

Factor completely
$2x^4 + 250x$
$4x^4 - x^3 - 8x + 2$
$x^4 + 3x^3 - 4x^2 - 12x$

State Assessment Content Limits/Boundaries Classroom Work Should Include Extension
Any of the following factoring problems can be assessed: difference of squares, trinomials, sum of cubes, difference of cubes, GCF, factor by grouping and quartic with no more than four terms.

Calculator Designation
NEUTRAL – a calculator may or may not be available for items

High School Algebra 2

Mathematics		A2.APR.A.2
APR A 2	**Arithmetic with Polynomials and Rational Expressions** **Perform operations on polynomials and rational expressions** Understand the Remainder Theorem and use it to solve problems.	

Expectation Unwrapped

The student will divide polynomials, using long division and synthetic division, by given factors or zeros to determine other factors.

Students will understand that a remainder of zero indicates the divisor is a factor of the dividend.

Students will understand that a remainder other than zero indicates the divisor is not a factor of the dividend.

Students will express the result as a quotient with a remainder.

DOK Ceiling
2

Item Format
Selected Response
Constructed Response
Technology Enhanced

Sample Stems

State Assessment Content Limits/Boundaries Classroom Work Should Include Extension
Divisors should not be greater than degree two.
Dividends should not be greater than degree four.

Calculator Designation
NEUTRAL – a calculator may or may not be available for items

High School Algebra 2

Mathematics		A2.APR.A.3
APR A 3	**Arithmetic with Polynomials and Rational Expressions** **Perform operations on polynomials and rational expressions** Find the least common multiple of two or more polynomials.	

Expectation Unwrapped	DOK Ceiling
The student will determine the least common multiple for two or more polynomials.	1
	Item Format Selected Response Constructed Response Technology Enhanced
	Sample Stems
State Assessment Content Limits/Boundaries Classroom Work Should Include Extension Factorable polynomials of degree four or less.	**Calculator Designation** **NEUTRAL** – a calculator may or may not be available for items

High School Algebra 2

Mathematics		A2.APR.A.4
APR **A** **4**	**Arithmetic with Polynomials and Rational Expressions** **Perform operations on polynomials and rational expressions** Add, subtract, multiply and divide rational expressions.	

Expectation Unwrapped

The student will add and subtract rational expressions, including those with polynomial numerators and denominators, including those unlike denominators.

The student will multiply and divide rational expressions, including those with polynomial numerators and denominators.

Final answers should not have common factors in the numerators and denominators.

DOK Ceiling
2

Item Format
Selected Response
Constructed Response
Technology Enhanced

Sample Stems

State Assessment Content Limits/Boundaries Classroom Work Should Include Extension
Polynomials should not exceed degree four.
The number of expressions should not exceed three for an addition, subtraction or multiplication problem.

Calculator Designation
NEUTRAL – a calculator may or may not be available for items

High School Algebra 2

Mathematics		A2.APR.A.5
APR **A** **5**	**Arithmetic with Polynomials and Rational Expressions** **Perform operations on polynomials and rational expressions** Identify zeros of polynomials when suitable factorizations are available, and use the zeros to sketch the function defined by the polynomial.	

Expectation Unwrapped

The student will factor polynomials and use the zero-product property to identify the zeros.

The student will use the zeros and other key characteristics to sketch the function defined by the polynomial.

DOK Ceiling
3

Item Format
Selected Response
Constructed Response
Technology Enhanced

Sample Stems

State Assessment Content Limits/Boundaries Classroom Work Should Include Extension
Polynomials should be no greater degree than four.
Intercepts should be written as ordered pairs in items and in responses.

Calculator Designation
NEUTRAL – a calculator may or may not be available for items

High School Algebra 2

Mathematics		A2.IF.A.1
IF **A** **1**	**Interpreting Functions** **Use and interpret functions** Identify and interpret key characteristics of functions represented graphically, with tables and with algebraic symbolism to solve problems.	

Expectation Unwrapped

The student will identify the following key characteristics of functions from graphs, tables and equations: domain, range, end behavior, x- and y-intercepts, local maxima and minima values, symmetries, points of discontinuity, intervals of increasing and decreasing, and horizontal and vertical asymptotes.

The student will identify these key characteristics for general polynomials, square roots, cube roots, absolute value of linear functions, simple piece-wise defined, step functions, exponential, logarithmic, and rational functions.

The student will be able to represent a given function as a table, equation or graph.

The student will be able to determine specific values of a function from a table, graph, or equation.

DOK Ceiling

3

Item Format

Selected Response
Constructed Response
Technology Enhanced

Sample Stems

State Assessment Content Limits/Boundaries Classroom Work Should Include Extension

Polynomials should be of no greater degree than four.
Intercepts are ordered pairs.
Limit rational functions to those without oblique asymptotes.

Calculator Designation

YES – a calculator will be available for items

High School Algebra 2

Mathematics		A2.IF.A.2
IF **A** **2**	**Interpreting Functions** **Use and interpret functions** Translate between equivalent forms of functions.	

Expectation Unwrapped

The student will translate between equivalent forms of functions.

The student will find equivalent forms of functions to highlight key characteristics.

e.g. Write a quadratic function in vertex form, standard form, and/or intercept form by factorization, completing the square and multiplication.

Note about quadratic functions:

Vertex form is $y = a(x-h)^2 + k$ where (h, k) is the vertex of the function

Standard form is $y = ax^2 + bx + c$

Intercept form is $y = a(x-p)(x-q)$ where p and q are the x intercepts of the function

DOK Ceiling

2

Item Format

Selected Response
Constructed Response
Technology Enhanced

Sample Stems

State Assessment Content Limits/Boundaries Classroom Work Should Include Extension

Polynomials should not exceed degree four.

Calculator Designation

NEUTRAL – a calculator may or may not be available for items

High School Algebra 2

Mathematics		A2.BF.A.1
BF **A** **1**	**Building Functions** **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).	

Expectation Unwrapped

The student will add functions to create new functions, and determine the domain and range of the new function, (modifying the domain and range as necessary).

The student will subtract functions to create new functions, and determine the domain and range of the new function (modifying the domain and range as necessary).

The student will multiply functions to create new functions, and determine the domain and range of the new function, (modifying the domain and range as necessary).

The student will divide functions to create new functions, and determine the domain and range of the new function, (modifying the domain and range as necessary).

The student will compose functions, and determine the domain and range of the new function.

DOK Ceiling
2

Item Format
Selected Response
Constructed Response
Technology Enhanced

Sample Stems

State Assessment Content Limits/Boundaries Classroom Work Should Include Extension
The number of functions to compose should be restricted to two.
Domains and ranges will be given in word form (i.e., all reals) or as inequalities.
The degree of the polynomials to be composed should be no greater than a linear function with a quadratic function.
Items may contain $f(g(x))$ and $f \circ g(x)$ notation.

Calculator Designation
NEUTRAL – a calculator may or may not be available for items

High School Algebra 2

Mathematics		A2.BF.A.2
BF **A** **2**	**Building Functions** **Create new functions from existing functions.** Derive inverses of functions, and compose the inverse with the original function to show that the functions are inverses.	

Expectation Unwrapped

The student will derive inverses of given functions.

The student will compose functions to determine if they are inverses.

The student will compose the inverse with the original function to prove that the functions are inverses.

DOK Ceiling
2

Item Format
Selected Response
Constructed Response
Technology Enhanced

Sample Stems

State Assessment Content Limits/Boundaries Classroom Work Should Include Extension
Limit functions to linear, quadratic, exponential, logarithmic and cubic.
Cubic functions will be limited to $f(x) = ax^3 + b$

Calculator Designation
YES – a calculator will be available for items

High School Algebra 2

Mathematics		A2.BF.A.3
BF **A** **3**	**Building Functions** **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.	

Expectation Unwrapped

The student will describe the effects of transformations algebraically using *a, h*, and *k*, given an equation in the form *f(x)=a(x-h)+k,* or given other general forms of the functions listed.

The student will describe the effects of transformations graphically using terms such as horizontal or vertical stretch (expansion) or shrink (compression), reflection, horizontal and vertical translation, and dilation.

The student will create equations from the linear, quadratic, cubic, square and cube root, and absolute value, exponential and logarithmic parent functions that produce the above listed transformations.

The student will create graphs from the linear, quadratic, cubic, square and cube root, absolute value, exponential and logarithmic parent graphs that demonstrate vertical stretch (expansion) or shrink (compression), reflection, horizontal and vertical translation, and dilation.

DOK Ceiling
3

Item Format
Selected Response
Constructed Response
Technology Enhanced

Sample Stems

State Assessment Content Limits/Boundaries Classroom Work Should Include Extension

Use a values of $-3 \leq a \leq 3$.
Use h and k values of $-10 \leq h \leq 10$ and $-10 \leq k \leq 10$.
Referencing a reflection should be “across” a line not “over” a line.

Calculator Designation

NEUTRAL – a calculator may or may not be available for items

High School Algebra 2

Mathematics		A2.FM.A.1
FM A 1	**Modeling** **Use functions to model real-world problems** Create functions and use them to solve applications of quadratic and exponential function model problems.	
Expectation Unwrapped The student will create quadratic or exponential equations to model problems. The student will solve quadratic or exponential equations to determine solutions to problems algebraically or graphically. e.g. Price-demand-cost-revenue—profit situations, compound interest problems, and exponential growth or decay problems.		**DOK Ceiling** 3 **Item Format** Selected Response Constructed Response Technology Enhanced **Sample Stems**
State Assessment Content Limits/Boundaries Classroom Work Should Include Extension		**Calculator Designation** **YES** – a calculator will be available for items

High School Algebra 2

Mathematics		A2.DS.A.1
DS **A** **1**	**Data and Statistical Analysis** **Make inferences and justify conclusions.** Analyze how random sampling could be used to make inferences about population parameters.	
Expectation Unwrapped The student will understand random sampling. The student will explain how a random sample can be used to make an inference about a population. The student will analyze situations to determine if random sampling was used.		**DOK Ceiling** 3 **Item Format** Selected Response Constructed Response Technology Enhanced **Sample Stems**
State Assessment Content Limits/Boundaries Classroom Work Should Include Extension		**Calculator Designation** **NEUTRAL** – a calculator may or may not be available for items

High School Algebra 2

Mathematics		A2.DS.A.2
DS **A** **2**	**Data and Statistical Analysis** **Make inferences and justify conclusions.** Determine whether a specified model is consistent with a given data set.	
Expectation Unwrapped The student will determine whether a specified model is consistent with a given data set.		**DOK Ceiling** 2 **Item Format** Selected Response Constructed Response Technology Enhanced **Sample Stems** A model says a spinning coin falls heads up with probability 0.5. Would an experimental result of 5 tails in a row cause you to question the model?
State Assessment Content Limits/Boundaries Classroom Work Should Include Extension Specified models might include dot plots, histograms, frequency tables, lists or simulation result statements.		**Calculator Designation** **NEUTRAL** – a calculator may or may not be available for items

High School Algebra 2

Mathematics		A2.DS.A.3
DS **A** **3**	**Data and Statistical Analysis** **Make inferences and justify conclusions.** Describe and explain the purposes, relationship to randomization and differences among sample surveys, experiments and observational studies.	

Expectation Unwrapped

The student will describe and explain the purposes and relationship to random sampling in sample surveys.

The student will describe and explain the purposes and relationship to randomization of applying treatment in experiments.

The student will describe and explain the purposes and relationship to randomization in sampling for observational studies.

The student will describe and explain the differences between random samples in surveys, experiments, and observational study.

DOK Ceiling

3

Item Format

Selected Response
Constructed Response
Technology Enhanced

Sample Stems

The Principal says that students are driving too fast on the street in front of the school.
John asks the local police officer to park on the street and measure the speed of each car.
Jenny asks each student in the parking lot if they drive too fast on the street.
Describe the each study and the issues that may arise.

State Assessment Content Limits/Boundaries Classroom Work Should Include Extension

Calculator Designation

NEUTRAL – a calculator may or may not be available for items

High School Algebra 2

Mathematics		A2.DS.A.4
DS **A** **4**	**Data and Statistical Analysis** **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.	

Expectation Unwrapped

The student will use data from a sample to estimate characteristics of the population.

The student will recognize the meaning of margin of error, given a margin of error, in the estimates.

DOK Ceiling
2

Item Format
Selected Response
Constructed Response
Technology Enhanced

Sample Stems

Marvin's Chip Company claims their chip bags contain a mean of 9 oz of chips with a margin of error of +/- .04 oz.

A randomly selected box containing 10 bags of chips is selected and the individual bags are weighed with the following results (in oz):

9.0 9.3 8.5 8.8 9.1 9.5 8.9 8.8 9.2 8.9

Does the data support Marvin's claim?

State Assessment Content Limits/Boundaries Classroom Work Should Include Extension

Data samples should be limited at ten.
Decimal values should be no more than three places.

Calculator Designation

YES – a calculator will be available for items

High School Algebra 2

Mathematics		A2.DS.A.5
DS **A** **5**	**Data and Statistical Analysis** **Make inferences and justify conclusions.** Describe and explain how the relative sizes of a sample and the population affect the margin of error of predictions.	

Expectation Unwrapped

The student will be able to explain that larger sample sizes lead to smaller margin of error.

The student will be able to explain that larger populations require larger sample size to decrease the margin of error.

The students will be able to describe how the validity of an inference is affected by the margin of error.

DOK Ceiling

2

Item Format

Selected Response
Constructed Response
Technology Enhanced

Sample Stems

Given a statistic and margin of error give the range of values the population is likely to be within.

Explain some reasons why a sample statistic may be different from a population statistic.

Given a known population. Pull various random samples to compare common measures of center and spread between the sample and population. How does varying the size of the sample affect the difference between the sample and population statistics?

State Assessment Content Limits/Boundaries Classroom Work Should Include Extension

The items will not require the calculation of a margin of error.

Calculator Designation

NEUTRAL – a calculator may or may not be available for items

<table>
<tr><th colspan="2">Mathematics</th><th>A2.DS.A.6</th></tr>
<tr><td>DS
A
6</td><td colspan="2">Data and Statistical Analysis
Make inferences and justify conclusions.
Analyze decisions and strategies using probability concepts.</td></tr>
<tr><td colspan="2"><u>Expectation Unwrapped</u>

The student will analyze decisions using probability concepts.

The student will analyze strategies using probability concepts.</td><td><u>DOK Ceiling</u>
3

<u>Item Format</u>
Selected Response
Constructed Response
Technology Enhanced

<u>Sample Stems</u>

Given a bag with 5 red marbles and 5 white marble, you choose a marble from the bag without looking, put it aside and then choose another marble, again without looking.

From the list below, select all methods that would result in determining the probability you would select one red and one white marble.</td></tr>
<tr><td colspan="2"><u>State Assessment Content Limits/Boundaries Classroom Work Should Include Extension</u></td><td><u>Calculator Designation</u>
YES – a calculator will be available for items</td></tr>
</table>

High School Algebra 2

Mathematics		A2.DS.A.7
DS **A** **7**	**Data and Statistical Analysis** **Make inferences and justify conclusions.** Evaluate reports based on data.	
Expectation Unwrapped The student will evaluate statistical reports to determine statistical issues such as bias, validity of resource, reasonable reporting of statistical analysis and accurate graphical representations.		**DOK Ceiling** 3 **Item Format** Selected Response Constructed Response Technology Enhanced **Sample Stems**
State Assessment Content Limits/Boundaries Classroom Work Should Include Extension		**Calculator Designation** **YES** – a calculator will be available for items

High School Algebra 2

Mathematics		A2.DS.B.8
DS **B** **8**	**Data and Statistical Analysis** **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.	

Expectation Unwrapped

The student will know and be able to use the 68-95-99.7 rule to determine the percentages of data above or below the mean for given standard deviations.

The student will be able to draw and label the normal curve with values on the horizontal axis when given the mean and standard deviation.

The student will be able to draw and label the standard normal curve with percentages using the empirical rule (68-95-99.7 rule).

DOK Ceiling

3

Item Format

Selected Response
Constructed Response
Technology Enhanced

Sample Stems

Suppose the test scores in a school are normally distributed with a mean of 72 and a standard deviation of 8. Find what percentage of the students scored above 64.

A student takes a simple random sample of students from his high school of 2580 students asking how much they usually spend on fast food each week. The data was normally distributed with a mean of $6.50 and a standard deviation of $1.75. Approximately how many students at the school spend between $8.25 and $10 each week?

State Assessment Content Limits/Boundaries Classroom Work Should Include Extension

Standard deviations should be restricted to integer values from negative three to three.

Calculator Designation

YES – a calculator will be available for items

Mathematics		A2.DS.B.9
DS B 9	**Data and Statistical Analysis** **Fit a data set to a normal distribution.** Fit a data set to a distribution using its mean and standard deviation to determine whether the data is approximately normally distributed.	
Expectation Unwrapped The student will determine from a data set if approximately 68% of the data is within one standard deviation of the mean, if approximately 95% of the data is within two standard deviations of the mean, and if approximately 99.7% (all) of the data is within three standard deviations of the mean.		**DOK Ceiling** 2 **Item Format** Selected Response Constructed Response Technology Enhanced **Sample Stems**
State Assessment Content Limits/Boundaries Classroom Work Should Include Extension Data sets should be no more than fifty numbers.		**Calculator Designation** **YES** – a calculator will be available for items