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Core Subject Area: Secondary III Mathematics

Mathematics, Secondary III

Standard	Designated Sections
Unit 1: Inferences and conclusions from data	
Summarize, represent and interpret data on a single count or measurement system. *While students may have heard of the normal distribution, it is unlikely that they will have prior experience using it to make specific estimates. Build on students' understanding of data dis- tributions to help them see how the normal distribution uses area to make estimates of frequencies (which can be expressed as probabilities). Emphasize that only some data are well described by a normal distribution.*	
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.	Module 8 Task 1 What is Normal? Module 8 Task 2 Just ACT Normal Module 8 Task 3 Y B Normal? Module 8 Task 4 Whoa! That's Weird!
Understand and evaluate random processes underlying statistical experiments. *For S.IC.2, include comparing theoreti- cal and empirical results to evaluate the effectiveness of a treatment.*	
S.IC.1 Understand that statistics allows inferences to be made about population parameters based on a random sample from that population.	Module 8 Task 5 Would You Like to Try a Sample? Module 8 Task 7 Let's Investigate
S.IC.2 Decide if a specified model is consistent with results from a given data-generating	Module 8 Task 6 I'm Going to Find Out

process, e.g., using simulation. For example, a model says a spinning coin falls heads up with probability 0.5. Would a result of five tails in a row cause you to question the model?	Module 8 Task 7 Let's Investigate Module 8 Task 8 Slacker's Simulation
Make inferences and justify conclusions from sample surveys, experiments, and observational studies. *In earlier grades, students are introduced to different ways of collecting data and use graphical displays and summary statistics to make comparisons. These ideas are revisited with a focus on how the way in which data is collected determines the scope and nature of the conclusions that can be drawn from that data. The concept of statistical significance is developed in- formally through simulation as meaning a result that is unlikely to have occurred solely as a result of random selection in sampling or random assignment in an experiment.* *For S.IC.4 and 5, focus on the variability of results from experiments—that is, focus on statistics as a way of dealing with, not eliminating, inherent randomness.*	
S.IC.3 Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.	Module 8 Task 8 Slacker's Simulation
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.	
S.IC.5 Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.	
S.IC.6 Evaluate reports based on data.	
Unit 2: Polynomials, rational and radical relationships	
Use complex numbers in polynomial identities and equations. *Build on work with quadratic equations in Secondary Mathematics II. Limit to polynomials with real coefficients.*	
N.CN.8 Extend polynomial identities to the complex numbers. *For example, rewrite* x^2 *+ 4 as (x + 2i)(x – 2i)*.	Module 3 Task 6 Seeing Structure **N.CN.8 is throughout Module 3 and 4, both in the tasks and in the RSG's.
N.CN.9 Know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials.	Module 3 Task 5 The Expansion Module 3 Task 6 Seeing Structure Module 3 Task 7 Graphing All Poly's Module 3 Task 8 I Know, What Do You Know?
Interpret the structure of expressions. *Extend to polynomial and rational expressions.*	
A.SSE.1 Interpret expressions that represent a quantity in terms of its context.* **a.** Interpret parts of an expression, such as terms, factors, and coefficients. **b** Interpret complicated expressions by viewing one or more of their parts as a single entity. *For example, interpret* $P(1+r)^n$ *as the product of P and a factor not depending on P*.	Module 3 Task 2 Which is Greater? Module 4 Task 2 All in the Family

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 $(x^2 - y^2)(x^2 + y^2)$.	**A.SSE.2 is throughout Module 3 and 4, both in the tasks and in the RSG's.
Write expressions in equivalent forms to solve problems. *Consider extending A.SSE.4 to infinite geometric series in curricular implementations of this course description.*	
A.SSE.4 Derive the formula for the sum of a geometric series (when the common ratio is not 1), and use the formula to solve problems. *For example, calculate mortgage payments.**	
Perform arithmetic operations on polynomials. *Extend beyond the quadratic polynomials found in Secondary Mathematics II.*	
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.	Module 3 Task 4 Combining Polynomials
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 a factor of *p(x).*	Module 3 Task 7 Graphing All Poly's Module 3 Task 8 I Know, What Do You Know
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.	Module 3 Task 5 The Expansion Module 3 Task 6 Seeing Structure Module 3 Task 7 Graphing All Poly's Module 3 Task 8 I Know, What Do You Know
Use polynomial identities to solve problems. *Extend beyond the quadratic polynomials found in Secondary Mathematics II.*	
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.*	
A.APR.5 Know and apply the Binomial Theorem for the expansion of $(x+ y)^n$ in powers of *x* and *y* for a positive integer *n,* where *x* and *y* are any given numbers, with coefficients determined by example by Pascal's Triangle.	Module 3 Task 5 The Expansion
Rewrite rational expressions. *The limitations on rational functions apply to the rational expressions in A.APR.6. A.APR.7 requires the general division algorithm for polynomials.*	
A.APR.6 Rewrite simple rational expressions in different forms; write $\frac{a(x)}{b(x)}$ in the form	Module 4 Task 4 Rational Expressions

$q(x) + \frac{r(x)}{b(x)}$ where $a(x), b(x), q(x) and\ r(x)$ are polynomials with 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.	
A.APR.7 Understand the rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication, and division by a nonzero rational expression; add, subtract, multiply and divide rational expressions.	Module 4 Task 3 What Does it Mean to be Rational?
Understand solving equations as a process of reasoning and explain the reasoning. *Extend to simple rational and radical equations.*	
A.REI.2 Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.	Module 4 Task 7 Graphing Rational Functions **A.REI.2 is found in several RSG's throughout Module 4
Represent and solve equations and inequalities graphically. *Include combinations of linear, polynomial, rational, radical, absolute value, and exponential functions.*	
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.	Module 4 Task 7 Graphing Rational Functions **A.REI.11 is found throughout Secondary III
Analyze functions using different representations. *Relate F.IF.7c to the relationship between zeros of quadratic functions and their factored forms.*	
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. c. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.	Module 3 Task 3 All About Behavior Module 3 Task 6 Seeing Structure Module 3 Task 7 Graphing All Poly's Module 3 Task 8 I Know, What Do You Know
Unit 3: Trigonometry of general triangles and trigonometric functions.	
Apply trigonometry to general traingles. *With respect to the general case of the Law of Sines and Cosines, the definition of sine and cosine must be extended to obtuse angles.*	
G.SRT.9 Derive the formula A = 1⁄2 ab sin(C) for the area of a triangle by drawing an auxiliary line from a vertex perpendicular to the opposite side.	Module 5 Task 8 Triangle Areas by Trig
G.SRT.10 Prove the Laws of Sines and Cosines and use them to solve problems.	Module 5 Task 6 More Than Right Module 5 Task 7 Justifying the Laws Module 5 Task 8 Triangle Areas by Trig
G.SRT.11 Understand and apply the Law of Sines and the Law of Cosines to find unknown measurements in right and non-right triangles (e.g., surveying problems, resultant forces).	Module 5 Task 5 Special Rights Module 5 Task 6 More Than Right

	Module 5 Task 7 Justifying the Laws Module 5 Task 8 Triangle Areas by Trig
Extend the domain of trigonometric functions using the unit circle.	
F.TF.1 Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle.	Module 6 Task 6 Diggin' It Module 6 Task 7 Staking It Module 6 Task 9 Water Wheels and 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.	Module 6 Task 3 More "Sine" Language Module 6 Task 5 Moving Shadows Module 6 Task 6 Diggin' It Module 6 Task 7 Staking It Module 6 Task 8 "Sine"ing and "Cosine"ing It Module 6 Task 9 Water Wheels and the Unit Circle Module 6 Task 13 Off on a Tangent
F.TF.3 Use special triangles to determine geometrically the values of sine, cosine, tangent for /3, and /6, and use the unit circle to express the values of sine, cosine, and tangent for π - x, π + x, and 2π – x in terms of their values for x, where x is any real number.	Module 6 Task 13 Off on a Tangent
F.TF.4 (+ in Utah) Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions.	Module 6 Task 13 Off on a Tangent
Model periodic phenomena with trigonometric functions.	
F.TF.5 Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.	Module 6 Task 1 George W. Ferris' Day Off Module 6 Task 2 "Sine" Language Module 6 Task 4 More Ferris Wheels Module 6 Task 5 Moving Shadows Module 6 Task 10 High Noon and Sunset Shadows Module 6 Task 11 High Tide Module 6 Task 12 Getting on the Right Wavelength
Unit 4: Mathematical modeling	
Create equations that describe numbers or relationships. *For A.CED.1, use all available types of functions to create such equations, including root functions, but constrain to simple cases. While functions used in A.CED.2, 3, and 4 will often be linear, exponential, or quadratic the types of problems should draw from more complex situations than those addressed in Secondary Mathematics I. For example, finding the equation of a line through a given point perpendicular to another line allows one to find the distance from a point to a line. Note that the example given for A.CED.4 applies to earlier instances of this standard, not to the current course.*	

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.CED.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.	Module 3 Task 1 Scott's Macho March Madness Module 4 Task 1 The Gift
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.	
A.CED.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. *For example, rearrange Ohm's law V = IR to highlight resistance R.*	
Interpret functions that arise in applications in terms of a context. *Emphasize the selection of a model function based on behavior of data and 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.*	Module 1 Task 1 Brutus Bites Back Module 1 Task 2 Flipping Ferraris Module 1 Task 3 Tracking the Tortoise Module 3 Task 2 Which is Greater? Module 3 Task 6 Seeing Structure Module 4 Task 2 All in the Family Module 4 Task 5 Watch Your Behavior Module 4 Task 6 Features of Rational Functions Module 4 Task 7 Graphing Rational Functions
F.IF.5 Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. *For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.* ★	Module 4 Task 1 The Gift Module 6 Task 13 Off on a Tangent
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. ★	Module 3 Task 3 All About Behavior
Analyze functions using different representations. *Focus on applications and how key features relate to characteristics of a situation, making selection of a particular type of function model appropriate.*	
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.	Module 4 Task 1 The Gift Module 4 Task 2 All in the Family

b. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions. e. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.	Module 4 Task 5 Watch Your Behavior Module 4 Task 6 Features of Rational Functions Module 4 Task 7 Graphing Rational Functions
F.IF.8 Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.	Module 2 Task 3 Chopping Logs Module 2 Task 4 Log-Arithm-etic Module 5 Task 8 Triangle Areas by Trig
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 of another, say which has the larger maximum.*	Module 3 Task 3 All About Behavior Module 4 Task 2 All in the Family
Build a function that models a relationship between two quantities. *Develop models for more complex or sophisticated situations than in previous courses.*	
F.BF.1 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.* c. (+) Compose Functions.	Module 1 Task 1 Brutus Bites Back Module 1 Task 2 Flipping Ferraris Module 1 Task 3 Tracking the Tortoise Module 3 Task 1 Scott's Macho March Madness (1b) Module 3 Task 4 Combining Polynomials (F.BF.1b) Module 7 Task 2 Imagineering (F.BF.1b) Module 7 Task 3 The Bungee Jump Simulator (F.BF.1b) Module 7 Task 4 Composing and Decomposing (F.BF.1c) Module 7 Task 5 Translating My Composition (F.BF.1c) Module 7 Task 6 Different Combinations (F.BF.1b, 1c)
Build new functions from existing functions. *Use transformations of function to find more optimum models as students consider increasingly more complex situations. For F.BF.3, note the effect of multiple transformations on a single function and the common effect of each transformation across function types. Include functions only defined by a graph. Extend F.BF.4 to simple rational, simple radical, and simple exponential functions; connect F.BF.4a to F.LE.4.*	
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.*	Module 4 Task 2 All in the Family Module 6 Task 10 High Noon and Sunset Shadows Module 6 Task 12 Getting on the Right Wavelength Module 7 Task 1 Function Family Reunion Module 7 Task 5 Translating My Composition
F.BF.4 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) = 2 x^3 or f(x) = (x+1)/(x-1) for x ≠1.*	Module 1 Task 1 Brutus Bites Back Module 1 Task 2 Flipping Ferraris Module 1 Task 3 Tracking the Tortoise

b. Verify by composition that one function is the inverse of another.	Module 1 Task 4 Pulling a Rabbit Out of a Hat Module 1 Task 5 Inverse Universe Module 6 Task 11 High Tide Module 6 Task 12 Getting on the Right Wavelength
F.BF.4 Find inverse functions. c. (+) Read values of an inverse function from a graph or a table, given that the function has an inverse. d. (+) Produce an invertible function from a non-invertible function by restricting the domain.	Module 1 Task 2 Flipping Ferraris Module 1 Task 3 Tracking the Tortoise Module 1 Task 5 Inverse Universe
F.BF.5 (+ in Utah) Understand the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents.	Module 2 Task 1 Log Logic Module 2 Task 2 Falling Off A Log
Construct and compare linear, quadratic, and exponential models and solve problems. *Consider extending this unit to include the relationship between properties of logarithms and properties of exponents, such as the connection between the properties of exponents and the basic logarithm property that log xy = log x + log y.*	
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.	Module 3 Task 1 Scott's Macho March Madness Module 3 Task 2 Which is Greater?
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.	Module 2 Task 1 Log Logic Module 2 Task 3 Chopping Logs Module 2 Task 4 Log-Arithm-etic Module 2 Task 5 Powerful Tens
Visualize relationships between two dimensional and three-dimensional objects.	
G.GMD.4 Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.	Module 5 Task 1 Any Way You Slice It Module 5 Task 2 Any Way You Spin It Module 5 Task 3 Take Another Spin
Apply Geometric concepts in modeling situations.	
G.MG.1 Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).	Module 5 Task 3 Take Another Spin Module 5 Task 4 Hard As Nails
G.MG.2 Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).	Module 5 Task 4 Hard As Nails
G.MG.3 Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).	Module 5 Task 4 Hard As Nails