Indiana Mathematics

Analytical Algebra II: Grades 9, 10, 11, 12

Adopted 2023

Mathematics Process Standards	1. **Make sense of problems and persevere in solving them.** HS.PS.1 2. **Reason abstractly and quantitatively.** HS.PS.2 3. **Construct viable arguments and critique the reasoning of others.** HS.PS.3 4. **Model with mathematics.** HS.PS.4 5. **Use appropriate tools strategically.** HS.PS.5 6. **Attend to precision.** HS.PS.6 7. **Look for and make use of structure.** HS.PS.7 8. **Look for and express regularity in repeated reasoning.** HS.PS.8
Arithmetic and Structure of Expressions, Equations, and Functions	. **Students simplify, manipulate, and solve nonlinear expressions, equations, and functions in a variety of forms.** AAII.ASE. 1. Explain how extending the properties of integer exponents to rational numbers allows for a notation for radicals in terms of rational exponents (e.g., 5 ^{1/3}) and explain how this is defined. AAII.ASE.1 2. Rewrite algebraic rational expressions in equivalent forms (e.g., using properties of exponents and factoring techniques) and describe how rewriting those expressions reveals mathematical structure. Add, subtract, multiply, and divide algebraic rational expressions. AAII.ASE.2 3. Solve systems of equations consisting of linear and nonlinear equations or functions in two variables algebraically and graphically. AAII.ASE.3
Function Families	FF. **Students represent nonlinear functions in a variety of forms, recognizing and applying key features based on the type of function.** AAII.FF

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1. Using technology, identify, create, and connect algebraic and graphical representations of each of the function families listed. Model real-world situations with each function family: AAII.FF.1
   a. Quadratic AAII.FF.1.A
   b. Polynomial AAII.FF.1.B
   c. Square root AAII.FF.1.C
   d. Rational AAII.FF.1.D
   e. Exponential AAII.FF.1.E
   f. Piecewise-defined and absolute value functions AAII.FF.1.F
2. Graph each of the families of function with and without technology. Identify and describe key features, such as intercepts, domain and range, asymptotes, symmetry, and end behavior. Create inverse functions algebraically and/or graphically based on a given function. AAII.FF.2
3. Use graphical and algebraic structures and techniques to transform functions into equivalent forms to expose different information and identify key features. Connect the meaning of the key features to contextual situations. AAII.FF.3
4. Solve real-world problems with each function family, including situations in the context of science and economic phenomena. AAII.FF.4

Modeling with Functions and Data

MFD. Students represent real-world situations with linear and nonlinear functions, and use these equations to solve problems. AAII.MFD

1. Define functions and their inverses and illustrate examples algebraically and graphically. Identify real-world situations that can be modeled using functions. AAII.MFD.1
2. Represent real-world problems that can be modeled by linear, quadratic, exponential, and rational functions using tables, graphs, and equations. Use technology to represent the functional relationships and translate and interpret different forms (e.g., vertex form of a quadratic, intercepts, end behavior) with respect to the context. AAII.MFD.2
3. Use technology to find a linear, quadratic, or exponential function that models a relationship for a bivariate data set to make predictions; interpret the correlation coefficient for linear models. Compare and evaluate model fit using different function families. AAII.MFD.3
4. Explore the effects of function transformations using graphing technology. Explain the effects of transformations of functions such as f(x) + k, kf(x), f(kx), or f(x + k) for different functions and values of k. AAII.MFD.4

Modeling with Advanced Algebra

MAA. Students use advanced algebra concepts to model real-world function situations and use specific algebraic techniques to reveal and make use of structure with families of functions. AAII.MAA

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1. Use algebraic and graphical strategies to make use of structure with quadratic, polynomial, and rational functions to solve real-world problems, including but not limited to: AAII.MAA.1
    a. Completing the square to rewrite contextual quadratic functions in vertex form and interpret the outcome; AAII.MAA.1.A
    b. Determining the number of solutions to a function using graphical and algebraic forms (including the discriminant and complex numbers as appropriate); AAII.MAA.1.B
    c. Factoring, chunking, and rewriting functions using properties of exponents; and AAII.MAA.1.C
    d. Identifying and explaining extraneous roots. AAII.MAA.1.D
2. Represent and solve real-world systems of linear equations and inequalities in two or three variables algebraically and using technology. Interpret the solution, and determine whether it is reasonable. AAII.MAA.2
3. Model real-world phenomena using linear programming and matrices. AAII.MAA.3

Modeling with Data and Statistics

MDS. Students use statistics and probability techniques to collect and interpret complex data that can be modeled using functions. AAII.MDS

1. Distinguish between random and non-random sampling methods, identify possible sources of bias in sampling, describe how such bias can be controlled and reduced, evaluate the characteristics of a good survey and well-designed experiment, design simple experiments or investigations to collect data to answer questions of interest, and make inferences from sample results. AAII.MDS.1
2. Using the results of a simulation, decide if a specified model is consistent with the results. Construct a theoretical model, and apply the law of large numbers to show the relationship between the two models. AAII.MDS.2
3. Use data science techniques such as predictive modeling, linear algebra, and conditional probability to analyze data sets and make and evaluate claims. AAII.MDS.3

Modeling with Quantities

MQ. Students use combinatorics to quantify and model real-world situations. AAII.MQ

1. Using technology, model real-world probability situations using permutations, combinations, and the Fundamental Counting Principle. AAII.MQ.1