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SpringBoard

Unit Activity Correlations to Common Core State Standards

Precalculus

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Number and Quantity

The Complex Number System

Perform arithmetic operations with complex numbers.

3. Find the conjugate of a complex number; use conjugates to find moduli and quotients of complex numbers.

Unit 2, Activity 2-3: Complex Polynomial Roots and Inequalities

Represent complex numbers and their operations on the complex plane.

4. Represent complex numbers on the complex plane in rectangular and polar form (including real and imaginary numbers), and explain why the rectangular and polar forms of a given complex number represent the same number.

Unit 5, Activity 5-6: DeMoivre's Theorem

5. Represent addition, subtraction, multiplication, and conjugation of complex numbers geometrically on the complex plane; use properties of this representation for computation. For example, $(-1 + \sqrt{3}\, i)^3 = 8$ because $(-1 + \sqrt{3}\, i)$ has modulus 2 and argument 120°.

Unit 2, Getting Ready
Unit 2, Activity 2-3: Complex Polynomial Roots and Inequalities
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Unit 5, Getting Ready
Unit 5, Activity 5-6: DeMoivre's Theorem

6. Calculate the distance between numbers in the complex plane as the modulus of the difference, and the midpoint of a segment as the average of the numbers at its endpoints.

Unit 5, Activity 5-6: DeMoivre's Theorem

Vector and Matrix Quantities

Represent and model with vector quantities.

1. Recognize vector quantities as having both magnitude and direction. Represent vector quantities by directed line segments, and use appropriate symbols for vectors and their magnitudes (e.g., v, |v|, ||v||, v).

Unit 6, Activity 6-2: Introduction to Vectors
Unit 6, Activity 6-3: Vectors in Two and Three Dimensions
Unit 6, Activity 6-4: Parametric Equations Revisited
Unit 6, EA 6-1: Parametric Equations and Vectors
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Unit 6, Math Standards Review

2. Find the components of a vector by subtracting the coordinates of an initial point from the coordinates of a terminal point.

Unit 6, Activity 6-2: Introduction to Vectors
Unit 6, Activity 6-3: Vectors in Two and Three Dimensions
Unit 6, Activity 6-4: Parametric Equations Revisited
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3. Solve problems involving velocity and other quantities that can be represented by vectors.

Unit 4, Activity 4-5: Law of Cosines
Unit 4, Activity 4-6: Law of Sines
Unit 4, Unit Practice
Unit 6, Activity 6-2: Introduction to Vectors
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Unit 6, Activity 6-4: Parametric Equations Revisited

Unit 6, EA 6-1: Parametric Equations and Vectors
Unit 6, Unit Practice

Perform operations on vectors.

4. Add and subtract vectors.

a. Add vectors end-to-end, component-wise, and by the parallelogram rule. Understand that the magnitude of a sum of two vectors is typically not the sum of the magnitudes.

Unit 6, Activity 6-2: Introduction to Vectors
Unit 6, Activity 6-3: Vectors in Two and Three Dimensions
Unit 6, Activity 6-4: Parametric Equations Revisited
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b. Given two vectors in magnitude and direction form, determine the magnitude and direction of their sum.

Unit 6, Activity 6-2: Introduction to Vectors
Unit 6, Activity 6-3: Vectors in Two and Three Dimensions
Unit 6, Activity 6-4: Parametric Equations Revisited
Unit 6, EA 6-1: Parametric Equations and Vectors
Unit 6, Unit Practice

c. Understand vector subtraction $v - w$ as $v + (-w)$, where $-w$ is the additive inverse of w, with the same magnitude as w and pointing in the opposite direction. Represent vector subtraction graphically by connecting the tips in the appropriate order, and perform vector subtraction component-wise.

Unit 6, Activity 6-2: Introduction to Vectors
Unit 6, Activity 6-3: Vectors in Two and Three Dimensions
Unit 6, Activity 6-4: Parametric Equations Revisited
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Unit 6, Unit Practice

5. Multiply a vector by a scalar.

a. Represent scalar multiplication graphically by scaling vectors and possibly reversing their direction; perform scalar multiplication component-wise, e.g., as $c(v_x, v_y) = (cv_x, cv_y)$.

Unit 6, Activity 6-3: Vectors in Two and Three Dimensions
Unit 6, Activity 6-4: Parametric Equations Revisited
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b. Compute the magnitude of a scalar multiple cv using $||cv|| = |c|v$. Compute the direction of cv knowing that when $|c|v \neq 0$, the direction of cv is either along v (for $c > 0$) or against v (for $c < 0$).

Unit 6, Activity 6-3: Vectors in Two and Three Dimensions
Unit 6, Activity 6-4: Parametric Equations Revisited
Unit 6, EA 6-1: Parametric Equations and Vectors
Unit 6, Unit Practice

Perform operations on matrices and use matrices in applications.

6. Use matrices to represent and manipulate data, e.g., to represent payoffs or incidence relationships in a network.

Unit 6, Activity 6-3: Vectors in Two and Three Dimensions

7. Multiply matrices by scalars to produce new matrices, e.g., as when all of the payoffs in a game are doubled.

Unit 6, Activity 6-3: Vectors in Two and Three Dimensions

8. Add, subtract, and multiply matrices of appropriate dimensions.

Unit 6, Activity 6-3: Vectors in Two and Three Dimensions

9. Understand that, unlike multiplication of numbers, matrix multiplication for square matrices is not a commutative operation, but still satisfies the associative and distributive properties.

Unit 1, Activity 1-6: Matrix Operations
Unit 1, Activity 1-7: Matrix Properties and Equations

10. Understand that the zero and identity matrices play a role in matrix addition and multiplication similar to the role of 0 and 1 in the real numbers. The determinant of a square matrix is nonzero if and only if the matrix has a multiplicative inverse.

Unit 1, Activity 1-6: Matrix Operations
Unit 1, Activity 1-7: Matrix Properties and Equations

12. Work with 2 × 2 matrices as transformations of the plane, and interpret the absolute value of the determinant in terms of area.

Unit 5, EA 5-3: Matrices, Transformations, and Vectors
Unit 5, Activity 5-7: Transformations with Matrices

Algebra

Reasoning with Equations and Inequalities

Solve systems of equations

8. Represent a system of linear equations as a single matrix equation in a vector variable.

Unit 1, Activity 1-6: Matrix Operations
Unit 1, Activity 1-7: Matrix Properties and Equations

9. Find the inverse of a matrix if it exists and use it to solve systems of linear equations (using technology for matrices of dimension 3 × 3 or greater).

Unit 1, Activity 1-6: Matrix Operations
Unit 1, Activity 1-7: Matrix Properties and Equations

Functions

Interpreting Functions

Analyze functions using different representations

7. Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.

d. Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior.

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Unit 2, Activity 2-4: Rational Functions
Unit 2, Activity 2-5: Rational Functions
Unit 2, EA 2-2: Rational Functions
Unit 2, Activity 2-8: Transformations of Functions
Unit 2, Activity 2-9: Effects of Transformations
Unit 2, EA 2-3: Transformed Functions
Unit 2, Unit Practice
Unit 2, Math Standards Review

Building Functions

Build a function that models a relationship between two quantities

1. Write a function that describes a relationship between two quantities.

c. Compose functions. For example, if T(y) is the temperature in the atmosphere as a function of height, and h(t) is the height of a weather balloon as a function of time, then T(h(t)) is the temperature at the location of the weather balloon as a function of time.

Unit 2, Activity 2-7: Logarithms
Unit 2, Activity 2-8: Transformations of Functions
Unit 2, Activity 2-9: Effects of Transformations
Unit 2, EA 2-3: Transformed Functions
Unit 7, Activity 7-1: Modeling Functions

Build new functions from existing functions

4. Find inverse functions.

b. Verify by composition that one function is the inverse of another.

Unit 2, Activity 2-7: Logarithms
Unit 2, Activity 2-8: Transformations of Functions
Unit 2, Activity 2-9: Effects of Transformations
Unit 2, EA 2-3: Transformed Functions

c. Read values of an inverse function from a graph or a table, given that the function has an inverse.

Unit 3, Getting Ready
Unit 3, Activity 3-6 Inverse Trigonometric Functions

d. Produce an invertible function from a non-invertible function by restricting the domain.

Unit 3, Getting Ready
Unit 3, Activity 3-6 Inverse Trigonometric Functions

5. Understand the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents.

Unit 2, Activity 2-6: Exponential Functions
Unit 2, Activity 2-7: Logarithms
Unit 2, Activity 2-8: Transformations of Functions
Unit 2, Activity 2-9: Effects of Transformations
Unit 2, EA 2-3: Transformed Functions
Unit 2, Unit Practice
Unit 2, Unit Reflection

Trigonometric Functions

Extend the domain of trigonometric functions using the unit circle

3. Use special triangles to determine geometrically the values of sine, cosine, tangent for π/3, π/4 and π/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.

Unit 3, Activity 3-3: Trigonometric Functions and the Unit Circle
Unit 3, Activity 3-4: Graphs of the form y = A sin[B(x – C)] + D
Unit 3, Activity 3-5: Graphs of Other Trigonometric Functions
Unit 3, EA 3-1: Angles, Unit Circle, Trigonometric Graphs
Unit 3, Activity 3-6 Inverse Trigonometric Functions
Unit 3, Activity 3-7: Solving Simple Trigonometric Equations
Unit 3, EA 3-2: Inverse Trig Functions and Equations
Unit 3, Unit Practice

4. Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions.

Unit 3, Activity 3-4: Graphs of the form y = A sin[B(x – C)] + D
Unit 3, Activity 3-5: Graphs of Other Trigonometric Functions

Model periodic phenomena with trigonometric functions

6. Understand that restricting a trigonometric function to a domain on which it is always increasing or always decreasing allows its inverse to be constructed.

Unit 3, Activity 3-6 Inverse Trigonometric Functions
Unit 3, Activity 3-7: Solving Simple Trigonometric Equations
Unit 3, EA 3-2: Inverse Trig Functions and Equations
Unit 3, Unit Practice

7. Use inverse functions to solve trigonometric equations that arise in modeling contexts; evaluate the solutions using technology, and interpret them in terms of the context.

Unit 3, Activity 3-7: Solving Simple Trigonometric Equations
Unit 3, EA 3-2: Inverse Trig Functions and Equations
Unit 3, Unit Practice

Prove and apply trigonometric identities

9. Prove the addition and subtraction formulas for sine, cosine, and tangent and use them to solve problems.

Unit 4, Activity 4-3: Multiple Angle Identities
Unit 4, EA 4-1: Trigonometric Equations and Identities
Unit 4, Unit Practice
Unit 4, Math Standards Review

Geometry

Expressing Geometric Properties with Equations

Translate between the geometric description and the equation for a conic section

3. Derive the equations of ellipses and hyperbolas given the foci, using the fact that the sum or difference of distances from the foci is constant.

Unit 5, Activity 5-2: Ellipses and Hyperbolas
Unit 5, Unit Practice

Geometric Measurement and Dimension

Explain volume formulas and use them to solve problems

2. Give an informal argument using Cavalieri's principle for the formulas for the volume of a sphere and other solid figures.

Unit 6, Activity 6-3: Volume

Statistics and Probability

Using Probability to Make Decisions

Calculate expected values and use them to solve problems

1. Define a random variable for a quantity of interest by assigning a numerical value to each event in a sample space; graph the corresponding probability distribution using the same graphical displays as for data distributions.

Unit 6, Activity 6-3: Normal Distribution

2. Calculate the expected value of a random variable; interpret it as the mean of the probability distribution.

Unit 6, Activity 6-3: Normal Distribution

3. Develop a probability distribution for a random variable defined for a sample space in which theoretical probabilities can be calculated; find the expected value. For example, find the theoretical probability distribution for the number of correct answers obtained by guessing on all five questions of a multiple-choice test where each question has four choices, and find the expected grade under various grading schemes.

Unit 6, Activity 6-3: Normal Distribution

4. Develop a probability distribution for a random variable defined for a sample space in which probabilities are assigned empirically; find the expected value. For example, find a current data distribution on the number of TV sets per household in the United States, and calculate the expected number of sets per household. How many TV sets would you expect to find in 100 randomly selected households?

Unit 7, Activity 7-1: Probability Experiments
Unit 7, EA 7-1: Counting and Probability
Unit 7, Activity 7-2: Dependent and Independent Events
Unit 7, EA 7-2: Compound Events, Probability, Simulation
Unit 7, Activity 7-3: Dependent Compound Events
Unit 7, Activity 7-4: Geometric Probability
Unit 4, Activity 4-7: Binomial Probability

Use probability to evaluate outcomes of decisions

5. Weigh the possible outcomes of a decision by assigning probabilities to payoff values and finding expected values.

a. Find the expected payoff for a game of chance. For example, find the expected winnings from a state lottery ticket or a game at a fast-food restaurant.

Unit 5, Activity 5-1: Probability

b. Evaluate and compare strategies on the basis of expected values. For example, compare a high-deductible versus a low-deductible automobile insurance policy using various, but reasonable, chances of having a minor or a major accident.

Unit 5, Activity 5-1: Probability