Outlines of High School Mathematics Courses

Courses Listed in Appendix A of State Board of Education Regulation 43-234 and Courses for Innovative Approach Submission

Issued by the
South Carolina Department of Education

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Contents

This version of the Outline of High School Mathematics Courses document shows the specific high school Mathematics Curriculum Course Standards matched to the course outlines in Algebra 1, 2,and 3, Geometry, Mathematics for the Technologies .1,2,3, and 4, Precalculus, and Probability and Statistics, the only specific courses with standards.

Introduction

South Carolina Mathematics Standards 2000 provides standards for grades nine through twelve and standards for Algebra 1, Algebra 2, Geometry, Precalculus, and Probability and Statistics courses. Standards were not developed for all mathematics courses listed in State Board of Education Regulation 43-234. A committee of high school mathematics teachers and district mathematics consultants under the direction of mathematics consultants at the State Department of Education developed an outline for each of the courses listed in R. 43-234 (except for Advanced Placement Calculus) and several additional courses. These outlines are suggested sequences of content to be taught in each of these courses, whether for credit in honors courses or credit in College Preparatory or Tech Prep courses. The course outlines include all of the mathematics standards for grades nine through twelve and those for courses listed in *South Carolina Mathematics Standards 2000*. Additional topics are included as well.

Districts and schools may use these course outlines as appropriate. Suggestions for use include

- as base outlines for course curriculum development;
- in development of course scope and sequence materials;
- as checklists for already-developed curricula; and
- in analysis of texts for use in each of the specified courses.

Appreciation is expressed to those individuals who helped in the development of these outlines.

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Algebra 1

Some Algebra 1 standards are intended to cover many parts of the outline, if not the entire course, and, as such, are listed in several places in the content outline.

Course Description

Algebra 1 course competencies are presented for a one-year traditional or one-semester block course that meets the state Algebra 1 standards. The Algebra 1 end-of-course test will be given at the completion of the course.

The course includes

- the use of symbolic reasoning to represent mathematical situations, to express generalizations, and to study relationships among quantities;
- the use of functions to represent and model problem situations, as well as to analyze and interpret relationships;
- the setting up of equations in a wide range of situations and the use of a variety of methods to solve the equations; and
- the use of problem solving, representation, reasoning and proof, language and communication, and connections both within and outside mathematics.

In Algebra 1, handheld graphing calculators are required as part of instruction and assessment. Students should use a variety of representations (e.g., concrete, numerical, algorithmic, graphical), tools (e.g., matrices, data), and technologies to model mathematical situations in order to solve meaningful problems. Technologies include, but are not limited to, powerful and accessible handheld calculators, as well as computers with graphing capabilities.

It is recommended that class size be no larger than twenty-five students.

Recommended Prerequisites

Students entering this course should have mastered all state-mandated eighth-grade standards.

Course Outline

This outline of Algebra 1 includes all of the standards that are eligible for end-of-course testing. Boldfaced items are not eligible for end-of-course testing; however, they are recommended as additional topics for the honors-level course.

I. Generalizations, algebraic symbols, and matrices.
   A. Represent very large and very small numbers. **Algebra 1: I.C.1**.
      1. Exponential form.
      2. Scientific form (interpreting calculator display).
   B. Use unit analysis to check measurement computations of English and metric units (e.g., 5 miles per hour = *x* feet per second). **Algebra 1: I.C.2**.
   C. Make judgments about the appropriateness of units of measure within a system and between systems. **Algebra 1: I.A.5**.
   D. Determine patterns from real-life situations and represent generalizations algebraically. **Algebra 1: I.C.3**.
   E. Represent union and intersection of sets using Venn diagrams.
   F. Recognize and justify the effects of such operations as multiplication, division, and computing powers and roots on the magnitudes of quantities. **Algebra 1: I.C.5**.
   G. Identify and use properties related to operations with matrices. **Algebra 1: I.C.6**.
      1. Addition.
      2. Subtraction.
      3. Scalar multiplication.
   H. Solve applied problems using matrices. **Algebra 1: I.C.6**.

II. Algebraic expressions in problem-solving situations.
   A. Find specific function values and evaluate expressions. **Algebra 1: I.D.1**.
   B. Use patterns to generate the laws of exponents. **Algebra 1: III.B.1.**

1. Multiplication.
2. Division.
3. Power raised to a power.

C. Apply the laws of exponents in problem situations. **Algebra 1: III.B.1.**

D. Simplify.
1. Polynomial expressions using **Algebra 1: I.D.2.**
   a. Addition.
   b. Subtraction.
   c. Multiplication.
   d. Division by monomial.
2. **Rational expressions using**
   a. Addition.
   b. Subtraction.

E. Identify the steps to simplify algebraic expressions using properties. **Algebra 1: I.D.6.**
1. Commutative.
2. Associative.
3. Distributive.

F. Use symbolic representation and reasoning to verify statements about numbers. **Algebra 1: I.C.4.**

G. Investigate factoring techniques. **Preliminary to Algebra 1:I.D.3.**
1. Greatest common factor.
2. Difference between squares.
3. Quadratic trinomial.
4. Grouping.

H. Given a problem situation, determine the type of solution needed and an appropriate technique. **Algebra 1: I.D.4.**
1. A rough estimate.
2. An approximation.
3. An exact answer.

I. Select a suitable method of computing. **Algebra 1: I.D.4.**
1. Mental mathematics.
2. Paper-and-pencil combinations.
3. Calculators.
4. Computers.

III. Relationships.

A. Describe independent and dependent quantities in functional relationships. **Algebra 1:I.A.1.**

B. Make judgments about units of measure and scales within a system and between systems. **Algebra I: I.A.5.**

C. Interpret and make inferences from explicit and recursive functional relationships. **Algebra 1: I.A.6.**

IV. Equations and inequalities.

A. Represent relationships among quantities. **Algebra 1: I.A.2.,4.; II.A.1.,3.**
1. Representations.
   a. Concrete models.
   b. Tables.
   c. Graphs.
   d. Diagrams.
   e. Verbal descriptions.
   f. Equations.
   g. Inequalities.
   h. Determine if the situation can be represented by a linear function.
2. Tools.
   a. Computer Algebra Systems (CAS).
   b. Spreadsheets.
   c. Graphing calculators.

B. Analyze problem situations. **Algebra 1: I.A.3.; II.C.1.**
1. Describe functional and recursive relations.
2. Write equations.
3. Write inequalities.

C. Transform and solve linear equations and inequalities using **Algebra 1: II.C.2.,3.**
   1. Properties.
      a. Commutative.
      b. Associative.
      c. Distributive.
      d. Equality.
   2. Forms.
      a. One-step.
      b. Multi-step.
   3. Models, including graphs.

D. For given contexts, use concrete models to interpret and determine the reasonableness of solutions to linear equations and inequalities. **Algebra 1: II.C.4.**

E. Use supporting data to explain why a solution is mathematically reasonable. **Algebra 1: I.D.5.**

V. Interpretations.

A. Develop the concept of slope as a rate of change, and determine slope in different representations. **Algebra 1: II.B.1.**
   1. Graphs.
   2. Tables.
   3. Algebraic representations.

B. Interpret the meaning of slope and intercepts in different situations involving **Algebra 1: II.B.2.**
   1. Data analysis.
   2. Symbolic representations.
   3. Graphs.

C. With and without a graphing calculator, investigate, describe, and predict the effects of changes in m and b on the graph of $y = mx + b$ and the results of these changes in applied situations. **Algebra 1: II.B.3.,6.**

D. Graph and write equations of lines with given characteris tics. **Algebra 1: II.B.4.**
   1. Two points.
   2. One point and a slope.
   3. A slope and y-intercept.

E. Determine the intercepts of linear functions in different representations. **Algebra 1: II.B.5**.
   1. Graphs.
   2. Tables.
   3. Algebraic representations.

F. Develop and graph the absolute val ue function.

G. Determine the intercepts of the absolute value function from the
   1. Graph.
   2. Table.
   3. Algebraic representation.

H. Relate direct variation to linear functions, and solve problems involving proportional change**.** **Algebra 1:II.B.7**.

VI. Linear functions and data representations.

A. For a variety of situations, identify and determine reasonable domain and range values. **Algebra 1: I.B.2; II.A.2**.

B. Match situations to given graphs, and justify or interpret the match. **Algebra 1: I.B.3.**

C. Create situations that fit given graphs. **Algebra 1: I.B.3.**

D. Represent, display, and interpret data, including representations on graphing calculators and computers. **Algebra 1: I.B.4.**
   1. Scatter plots.
   2. Bar graphs.
   3. Stem-and-leaf plots.
   4. Box-and-whiskers diagrams.

E. Write a linear equation that fits a data set, check the model for "goodness of fit," and make predictions using the model. **Algebra 1: I.B.5.**

VII. Systems of linear equations.

A. Analyze situations and formulate systems of linear equations to solve problems. **Algebra 1: II.D.1.**

B. Solve systems of linear equations using **Algebra 1: II.D.2**.
   1. Concrete models.

2. Graphs.
3. Tables.
4. Algebraic methods (e.g., elimination, substitution).
5. Technology, including CAS, spreadsheets, and graphing calculators.

C. For given contexts, interpret and determine the reasonableness of solutions to systems of linear equations. **Algebra 1: II.D.3**.

VIII. Linear and quadratic functions and data representations.

A. Identify the parent functions. **Algebra 1: I.B.1.**
1. Linear ($y = x$).
2. Quadratic ($y = x^2$).

B. Sketch the parent functions. **Algebra 1: I.B.1.**
1. Linear ($y = x$).
2. Quadratic ($y = x^2$).

IX. Quadratic functions.

A. Determine the domain and range values for quadratic functions given the constraints of the problem. **Algebra 1: III.A.1.**

B. With and without using a graphing calculator, investigate, describe, and predict the effects of changes in
1. Constant a on the graph of $y = ax^2$. **Algebra 1: III.A.2**.
2. Constant c on the graph of $y = x^2 + c$. **Algebra 1: III.A.3**.

C. For problem situations, analyze graphs of quadratic functions and draw conclusions. **Algebra I: III.A.4**.

D. Solve quadratic equations using **Algebra 1: I.D.3.; III.A.5**.
1. Concrete models.
2. Tables.
3. Graphs.
4. Algebraic methods that include factoring and using the quadratic formula, as well as CAS, spreadsheets, and graphing calculators.

E. Relate the solutions of quadratic equations to the roots of the function. **Algebra 1: III.A.6**.

X. Other functions.

A. Develop, interpret, and graph the square root function.

B. Analyze data and represent situations appropriately. **Algebra 1: III.B.2., 3.**
1. Functions.
   a. Inverse variation.
   b. Exponential growth and decay.
2. Representations.
   a. Concrete models.
   b. Tables.
   c. Graphs.
   d. Algebraic methods as well as CAS, spreadsheets, and graphing calculators.

Algebra 2

Some Algebra 2 standards are intended to cover many parts of the content outline, if not the entire course, and, as such, are listed in several places in the outline.

Course Description

Algebra 2 course competencies are presented for a one-year traditional or one-semester block course that meets the state Algebra 2 standards.

Algebra 2 contains an in-depth study of functions, patterns, relations, and concepts of number systems. This includes linear, quadratic, exponential, absolute value, radical, and rational functions. Conic sections are also addressed.

The course consists of

- the identification of appropriate domains and ranges of functions;
- the collection and organization of data, recording results, and graphical representations;
- the use of symbolic reasoning to represent algebraic situations;
- the expansion of functions for mathematical modeling to develop a versatile and powerful means for analyzing and describing their world; and
- the understanding of properties that govern the use of symbols in expressions, equations, and inequalities.

In Algebra 2, handheld calculators are required as part of instruction and assessment. Students should use a variety of representations (e.g., concrete, numerical, algorithmic, graphical), tools (e.g., matrices, data), and technologies to model situations to solve meaningful problems. Technologies include, but are not limited to, powerful and accessible handheld calculators, as well as computers with graphing capabilities.

Recommended Prerequisites

Students entering this course should have successfully completed Algebra 1, mastering the state-mandated Algebra 1 standards.

Course Outline

This outline of Algebra 2 includes all of the Algebra 2 standards, as well as additional topics. Boldfaced items are not eligible for end-of-course testing. However, they are recommended as additional topics for the honors-level course. All topics should be taught in greater depth and difficulty at the honors level.

I. Linear functions.
   A. Collect data and record results. **Algebra 1: I.B.4.,5.**
      1. Organize data.
      2. Use scatter plots.
      3. Determine the line of best fit.
   B. With and without graphing calculators, investigate, describe, and predict transformations. **Algebra 1: II.B.3.,6.**
   C. Recognize real-world phenomena modeled by linear functions. **Algebra 1: I.B.5; II.C.1.**
      1. Make predictions.
      2. Make decisions and critical judgments using the model.
   D. Determine the change in slope relative to the change in the independent variable. **Algebra 1:II.B.6; Algebra 2: I.A.5.**
   E. Determine inverse relationships between various functions. **Algebra 2: II.A.4.**
   F. Investigate the composition of functions. **Algebra 2: II.A.3**.

II. Solving equations and inequalities.
   A. Solve systems of equations or inequalities **Algebra 2: I.B.2**.
      1. Algebraically.
      2. Graphically.
      3. Using matrices.
      4. Using tables (graphing calculators)

B. Verify solutions with and without technology. **Algebra 2: I.B.2.**
C. Demonstrate no solution or multiple solutions. **Algebra 2: I.B.4.**
D. Identify and use properties related to operations with matrices. **Algebra 2: I.B.6**.
E. Analyze situations and formulate systems of equations and inequalities in two or more unknowns in order to solve problems. **Algebra 2: I.B.1.**
F. Analyze absolute value equations and inequalities. **Algebra 2: III.C.3.**
G. Solve linear programming problems with and without technology. **Algebra 2: I.B.5.**

III. Algebraic expressions. **Extension of Algebra 1 concepts**.
A. Radicals. (Algebra I: I.D.1., 6.)
1. Simplifying.
2. Operations.
B. Laws of exponents. (Algebra 1: III.B.1.)

IV. Number systems. **Algebra 2: I.B.3.**
A. Real number system and its subsets.
B. Imaginary and complex numbers.
C. Properties.

V. Quadratic functions.
A. Representation of quadratic functions. **Algebra 2: III.A.1.**
1. Algebraic.
2. Graphical.
3. Tabular.
4. Verbal.
B. Determine reasonable domain and range values for given problem situations. **Algebra 2: I.A.1.,2.**
C. Establish basic concepts of parent functions. **Algebra 2: II.A.1.**
D. Investigate, describe, and predict effects of **Algebra 2: II.A.2.**
1. Vertical and horizontal translations.
2. Reflections and dilations.
E. Recognize real-world phenomena modeled by quadratics. **Algebra 2: I.A.3.4,; III.A.3.; B.3.**
1. Identify maximum and minimum. **III.B.3.**
2. Use parent function to sketch graphs. **III.A.3.**
3. Make predictions. **I.A.4**.
4. Make decisions and critical judgments using the model. **I.A.4.**
F. Use the parent function to investigate, describe, and predict the effects of changes in a, h, and k on the graphs of $y = a(x - h)^2 + k$. **Algebra 2: III.A.3.**
G. Use complex numbers to describe solutions. **Algebra 2: III.A.4**.

VI. Quadratic equations and inequalities.
A. Solve quadratic equations using **Algebra 2: III.B.2.,3.**
1. Factoring.
2. Completing the square.
3. Quadratic formula.
B. Analyze solutions using the discriminant. **Algebra 2: III.B.3.**
C. Formulate quadratic equations to solve problems. **Algebra 2: III.B.1.**
D. Use technology to compare and translate between algebraic and graphical solutions of quadratic equations. **Algebra 2: III.A.2.,III.B.4**.

VII. Rational functions.
A. Determine reasonable domain and range values for given situations. **Algebra 2: I.A.1.,2.**
B. Evaluate. **Algebra 1**
C. Represent rational functions with and without use of technology. **Algebra 2: I.A.3., II.A.1.; IV.A.1.**
1. Algebraic.
2. Tabular.
3. Graphical.
4. Verbal.
D. Solve problems using direct and indirect variation. **Algebra 2: IV. A.2**.
E. Recognize real-world phenomena. **Algebra 2: I.A.4**.
1. Make predictions.
2. Make decisions and critical judgments using the model given.

VIII. Exponential functions.

A. Identify reasonable domain and range. **Algebra 2: I.A.1.,2.**

B. Represent exponential functions. **Algebra 2: I.A.3., II.A.1.; IV.B.1.**

1. Algebraic.
2. Tabular.
3. Graphical.
4. Verbal.

C. Represent exponential functions with and without the use of technology. **Algebra 2: IV.B.1.**

D. Analyze a situation modeled by an exponential function. **Algebra 2: IV.B.2**.

E. Formulate an equation or inequality. **Algebra 2: IV.B.2**.

F. Solve real-world problems. **Algebra 2: I.A.4.;IV. B.2.**

1. Make predictions.
2. Make decisions and critical judgments.

IX. Logarithmic functions.

A. Describe the general shape of the graph and the effect of transfor mations on the domain and range.

B. Develop the connection between exponential and logarithmic functions.

C. Investigate asymptotic behavior.

D. Investigate logarithmic properties graphically and algebraically.

E. Solve exponential and logarithmic equations and inequalities using graphs, tables, algebraic methods, and technology and including reasonableness of solutions.

X. Conic sections.

A. Identify algebraic representations of conics.

B. Determine the type, shape, and location of a conic section through completing the square **Algebra 2: II.B.3**.

C. Graph conic sections.

D. Explain each conic section as the intersection of a plane and cone(s). **Algebra 2: II.B.1.**

E. Identify symmetries from graphs of conic sections. **Algebra 2: II.B.2**.

F. Solve real-world problems.

1. Make predictions.
2. Make decisions and critical judgments.

XI. Radical functions and absolute value functions.

A. Represent radical and absolute value functions. **Algebra 2: I.A.3., II.A.1.; III.C.1.**

1. Algebraic.
2. Tabular.
3. Graphical.
4. Verbal.

B. Solve square root and absolute value equations and inequalities. **Algebra 2: III.C.2.**

C. Verify solutions using technology. **Algebra 2: III.C.2.**

D. Analyze situations modeled by square root and absolute value functions. **Algebra 2: I.A.4.;III.C.3.**

E. Solve problems by formulating equations and inequalities. **Algebra 2: III.C.3.**

F. Determine reasonable domain and range values for given problem situations. **Algebra 2: I.A.1.,2.**

XII. Polynomial functions.

A. Characteristics.

1. Describe the general shape of the graph and the effect of transformations on the domain and range.

2. Recognize the connections among the significant points of a function, the graph of a function, and the algebraic representation of a function.

a. Roots.

b. Maximum points and minimum points.

3. Investigate continuity and end behavior.

B. Solve polynomial equations and inequalities using graphs, tables, algebraic methods, and technology.

C. Problem situations.

1. Analyze a verbal, graphical, or tabular representation of a polynomial function.

2. Analyze a problem situation by formulating an equation or inequality.

Algebra 3
(Innovative Approach)

Course Description

Algebra 3 is a program of mathematical studies focusing on the development of the student's ability to understand and apply the study of functions and advanced mathematics concepts to solve problems. The course will include a study of polynomial, rational, exponential, logarithmic, and trigonometric functions. Emphasis is on active participation through modeling, technology lab activities, group activities, and communication in mathematics. *Algebra 3 is not part of the defined program and will need to be taught as an innovative approach course*.

Students are expected to use technology, including graphing calculators, computers, and data-gathering equipment throughout the course. *Graphing calculators should be an integral part of all instruction.*

Recommended Prerequisites

It is recommended that students have an Algebra 2 background before taking Algebra 3. This course is designed for students on a block schedule who have taken Algebra 2 but who do not have a strong enough background to go directly into Precalculus. It is a bridge between Algebra 2 and Precalculus, including some of the culminating topics of Algebra 2 and some of the introductory topics of Precalculus. Students could take a sequence of Algebra 2, Algebra 3, and then Precalculus.

Course Outline

I. Linear and quadratic functions.
- A. Linear functions.
  1. Write equations of parallel lines, perpendicular lines, and perpendicular bisectors. **Algebra 1:II.C.1.; Geometry: III.A.2.**
  2. Model real-world phenomena with linear function. **Algebra 1: II.C.1.**
- B. Quadratic functions.
  1. Represent quadratic functions in algebraic, tabular, graphical, and verbal forms. **Algebra 2: III.A.1.**
  2. Apply basic transformations. **Algebra 2: III.A.3.**
  3. Model real-world phenomena with quadratic functions. **Algebra 2: I.A.4.; III.B.1.**
- C. Systems of equations.
  1. Solve systems of linear equations. **Algebra 2: I.B.2.**
  2. Solve systems of linear-quadratic and quadratic-quadratic equations. **Algebra 2: I.B.2.**

II. Polynomial functions.
- A. Polynomial functions.
  1. Describe the general shape of a graph and the effect of transformations on the domain and range. **Precalculus: II.A.1.**
  2. Recognize the connections among the significant points of a function, the graph of a function, and the algebraic representation of a function. **Precalculus: I.A.6.**
     a. Roots.
     b. Maximum points and minimum points.
  3. Investigate continuity and end behavior. **Precalculus: I.A.7.**
  4. Solve equations and inequalities using graphs, tables, algebraic methods, and technology. **Precalculus: II.A.3.**
- B. Problem situations.
  1. Analyze a verbal, graphical, or tabular representation of a polynomial function. **Precalculus: II.A.2.**
  2. Analyze a problem situation by formulating an equation or inequality. **Precalculus: II.A.4**.

III. Exponential and logarithmic functions.
- A. Exponential functions.
  1. Describe the general shape of a graph and the effect of transformations on the domain and range. **Precalculus: II.B.2.**
  2. Investigate asymptotic behavior. **Precalculus: II.B.2.**
  3. Investigate exponential properties graphically and algebraically. **Precalculus: II.B.2., 5.**

4. Solve exponential equations and inequalities using graphs, tables, algebraic methods, and technology, and investigate the reasonableness of solutions. **Precalculus: II.B.4**.
5. Model real-world phenomena with exponential functions. **Precalculus: II.B.5., 6**.

B. Logarithmic functions.
1. Describe the general shape of a graph and the effect of transformations on the domain and range. **Precalculus: I.B.1.; II.B.2.**
2. Develop the connection between exponential and logarithmic functions. **Precalculus: II.B.1.**
3. Investigate asymptotic behavior. **Precalculus: II.B.2.**
4. Investigate logarithmic properties graphically and algebraically. **Precalculus: I.B.3.; II.B.7**
5. Solve logarithmic equations and inequalities using graphs, tables, algebraic methods, and technology, and investigate the reasonableness of solutions. **Precalculus: II.B.4.**

C. Problem situations.
1. Analyze a verbal, graphical, or tabular representation of an exponential or logarithmic function. **Precalculus: II.B.5.**
2. Analyze a problem situation by formulating an equation or inequality. **Precalculus: II.B.5.**
3. Model real-world phenomena with logarithmic functions. **Precalculus: II.B.5., 6.**

IV. Conic sections.

A. Conic sections.
1. Identify the graph of a conic section from its algebraic equation. **Algebra 2: II.B.3.**
2. Graph a conic section including translations. **Precalculus: III.B.3.**

B. Problem situations.
1. Model real-world phenomena with conic sections. **Precalculus: III.B.1., 2.**
2. Solve systems of second-degree equations that model real-world phenomena. Algebra 2: I.B.2.

V. Trigonometric functions.

A. Triangle trigonometry.
1. Evaluate all six trigonometric functions using a right triangle. **Precalculus: I.A.4.**
2. Solve problems using the law of sines and the law of cosines. **Precalculus: II.C.3.**
3. Find the area of a triangle. **Precalculus: II.C.3.**

B. Problem situations.
1. Analyze a verbal, graphical, or tabular representation of a trigonometric function. **Precalculus: II.B.7.**
2. Analyze a problem situation by formulating an equation or inequality. **Precalculus: II.C.1., 2.**
3. Analyze graphical data gathered by technical equipment. **Precalculus: II.B.7.**

Calculus

Course Description

Calculus involves the continued study of functions, rates, and accumulation. For Advanced Placement Calculus, a syllabus is supplied by the College Board. For those students electing to take Calculus without the Advanced Placement designation, the following syllabus is suggested. Depending upon the needs of the students and the curricula of other courses offered by districts and/or schools, numerous different syllabi may be written to address these needs by selecting topics in various combinations from the ones listed, as well as others. One sample syllabus is shown below to provide an example of how selected topics may be organized to meet curricular needs of students.

Recommended Prerequisites

This course is appropriate for students who have completed Algebra 1, Algebra 2, Geometry, and Precalculus (or International Baccalaureate Math Methods or International Baccalaureate Math Studies). In particular, students must be familiar with the properties of functions, the algebra of functions, and the graphs of functions. Students must also understand the language of various functions (e.g., domain and range, odd and even, periodic, symmetry, zeros, intercepts) and be very familiar with the unit circle and the values of trigonometric functions of numbers.

Sample Course Outline

I. Limits of functions.
- A. Understanding the limit process.
  1. Limits that exist.
  2. Limits that fail to exist.
  3. One-sided limits.
  4. Infinite limits.
- B. Calculating limits.
  1. Algebraic.
     a. Cancellation techniques.
     b. Rationalization techniques.
  2. Graphical.
  3. Tabular.

II. Continuity.
- A. Understanding continuity.
  1. Graphical.
  2. Terms of limits.
- B. Properties of continuity.
- C. Intermediate value theorem.
- D. Values of continuity and discontinuity.

III. Asymptotic and unbounded behavior.
- A. Asymptotes in terms of graphical behavior.
- B. Vertical asymptotes.
- C. Limits involving infinity.
- D. Horizontal asymptotes.

IV. Derivatives.
- A. Concept of the derivative.
  1. Definition as limit of the difference quotient.
  2. Geometric, numeric, and analytic presentations.
  3. Instantaneous rate of change.
  4. Relationship between differentiability and continuity.
- B. Finding the derivative of a function.
  1. Constant rule.
  2. Power rule.
  3. Product rule.

4. Quotient rule.
5. Chain rule.
6. All trigonometric functions.
7. All inverse trigonometric functions.*
8. Logarithmic.*
9. Exponential.*
10. Bases other than e functions.*

C. Derivative at a point.
1. Slope of a curve at a point.
2. Tangent line to a curve at a point.
3. Approximate rate of change from graph and table of values.

D. Relationships of the derivative.
1. Characteristics of f and f'.
2. Increasing and decreasing behavior of f and the sign of f'.
3. Mean value theorem.
4. Rolle's theorem.

E. Application of derivatives.
1. Analysis of curves.
2. Relative extrema of a function.
3. Optimization.
4. Modeling rates of change (related rates problems).
5. Implicit differentiation.
6. Velocity, speed, and acceleration.
7. Business and economics (marginal profit, marginal revenue, and marginal cost).

F. Second derivative.
1. Characteristics of f, f', f?.
2. Relationship between the concavity of f and the sign of f?.
3. Points of inflection of a function.

V. Integrals.

A. Techniques of antidifferentiation.
1. Basic integration rules.
2. U-substitution (include change of limits of definite integrals).
3. Antiderivatives for all trigonometric functions.
4. Antiderivatives for all inverse trigonometric functions.

B. Fundamental theorem of calculus.
1. Definite integrals.
2. Representation of an area under a curve.

C. Relationship of integral.*
1. Specific antiderivative using initial conditions.
2. Area under the curve.
   a. Using geometry.
   b. Using integration.
3. Area between two curves.
4. Numerical integration.
   a. Trapezoidal rule.
   b. Simpson's rule.
5. Average value.
6. Separable differential equations.
7. Growth and decay modeling.
8. Riemann sums using left, right, and midpoint evaluation points.
9. Volume.
   a. Disc method.
   b. Washer method.

* These topics could be taught in various sequences .

Discrete Mathematics

Course Description

Discrete Mathematics is the study of mathematical systems defined on discrete sets—those with a countable number of elements. It involves the study of objects and ideas that can be divided into separate or discontinuous parts. Most of the mathematics in this area has been discovered during the twentieth century. Among possible topics to be studied are decision making, matrix algebra, graph theory, set theory, Boolean algebra, combinatorics, circuits, discrete probability, recursion, modular arithmetic, network models, sequences and series, mathematical induction, vectors, relations, functions, algorithms, logic, and codes. As well as being of mathematical interest, many of these topics play an important role in information technology and computer science. Discrete mathematics is used every day by computer scientists, computer programmers, electrical engineers, computer engineers, and scientists in the physical, natural, and social sciences.

Depending upon the needs of students and the curricula of other courses offered by districts and/or schools, numerous different syllabi may be written to address these needs by selecting topics in various combinations from the ones listed above, as well as others. One sample syllabus is shown below to provide an example of how selected topics may be organized to meet curricular needs of students.

Recommended Prerequisites

Students entering this course should have successfully completed Algebra 1 (or its equivalent), Algebra 2, and Geometry, having mastered the mathematics standards for those courses.

Sample Course Outline

Alternate topics are included at the end of this sample.

I. Social decision making.
   - A. Use group ranking methods to obtain a single result.
   - B. Determine power indexes for weighted voting systems.
   - C. Solve fair division problems.
     1. Continuous examples.
     2. Discrete examples.
   - D. Solve apportionment problems using a variety of methods.
     1. Hamilton method.
     2. Hill method.
     3. Jefferson method.
     4. Webster method.

II. Graph theory.
   - A. Define basic terms and concepts.
     1. Graphs.
     2. Vertices.
     3. Edges.
     4. Connected graph.
     5. Complete graph.
     6. Digraphs.
     7. Adjacency matrix.
     8. Bipartite graph.
     9. Planarity.
   - B. Represent real-world situations using graphs.
   - C. Find the critical path.
   - D. Define Euler circuits and paths.
   - E. Define Hamiltonian circuits and paths.
   - F. Color graphs.
   - G. Define and identify trees.

H. Find minimum spanning trees.

III. Matrix theory.
- A. Write an adjacency matrix for a graph.
- B. Perform basic matrix operations.
- C. Use the Leslie model to find population distributions.
- D. Use the Leontief input-output model to analyze the flow of goods and services among sectors in an economy.
- E. Identify Markov chains.
- F. Investigate game theory
  1. With a single best strategy.
  2. Without a single best strategy.

IV. Counting techniques.
- A. Define combinations and permutations.
- B. Evaluate expressions indicating permutations or combinations.
- C. Construct and examine Pascal's triangle.
- D. Use the addition and multiplication principles to solve problems.
- E. Define and calculate conditional probabilities.
- F. Calculate expected value.

V. Iteration and recursive relations.
- A. Determine the terms of a sequence.
  1. Explicit.
  2. Recursive.
- B. Evaluate sums of geometric series.
  1. Finite.
  2. Infinite.
- C. Solve problems using recursion and mixed recursion.
- D. Solve exponential growth problems.
- E. Solve finance and population problems.
- F. Use the method of finite differences for finding closed-form solutions.
- G. Construct cobweb diagrams.
- H. Define fractals.
- I. Investigate chaos theory.

VI. Linear programming.
- A. Solve real-world problems using linear programming.
- B. Use technology to solve linear programming problems.

VII. Mathematical induction.

VIII. Logic.
- A. Identify a statement as existential, universal, or neither.
- B. Write and use counterexamples and properties.
- C. Negate statements.
- D. Determine the truth of a conditional statement.
- E. Write a logical expression to describe a simple network.
- F. Find the contrapositive, converse, or inverse of a conditional statement.
- G. Use logic to prove or disprove a statement.
- H. Determine the validity or invalidity of arguments.

Depending upon the needs of students and the curricula of other courses offered by districts and/or schools, one or more of the following may be taught instead of selected topics in the sample syllabus shown above.

Alternate Topics and Related Objectives

I. Vectors.
- A. Solve problems involving two-dimensional and three-dimensional vectors.
  1. Geometric representation of vectors.
  2. Geometric representation of complex numbers.
  3. Algebraic representation of vectors.
  4. Vectors and parametric equations.

5. Dot product.
6. Cross product.
7. Vectors and planes.

II. Sequences and series.
- A. Solve problems involving series and sequences.
  1. Arithmetic sequences.
  2. Geometric sequences.
  3. The *n*th term of an arithmetic or geometric sequence.
  4. Recursive definitions of sequences.
  5. Arithmetic series.
  6. Geometric series.
  7. The sum of *n* terms of an arithmetic or geometric series.
  8. Infinite geometric series.
  9. Sums of special geometric series.
  10. Fibonacci series.
- B. Write proofs of the validity of summation formulas.
  1. Summation formula by Gauss.
  2. Mathematical induction.

III. Matrices and determinants.
- A. Solve problems using matrices.
  1. Matrix addition.
  2. Scalar multiplication.
  3. Matrix multiplication.
  4. Inverse matrices.
- B. Solve problems using matrices and determinants.
  1. Systems of equations.
  2. Transformations using matrices.
  3. Systems with augmented matrices.

IV. Graphs and their applications.
- A. Special functions.
  1. Piecewise functions.
  2. Greatest integer functions.
- B. Venn diagrams.
- C. Linear programming.
- D. Paths and circuits.
  1. Multigraphs.
  2. Loops and parallel edges.
  3. Paths, simple paths, distinct cycles, and their lengths.
  4. Euler paths or circuits.
- E. Coloring a graph.
  1. Chromatic number for a graph.
  2. Welsh-Powell algorithm to color graph.
- F. Directed graphs.

V. Recurrence.
- A. Values and initial conditions.
- B. First-order linear difference equations.
- C. Second-order homogeneous linear difference equations.
- D. Searching and sorting algorithms.

VI. Arithmetic.
- A. Bases (decimal, binary, octal, hexadecimal).
- B. Conversions between bases.
- C. Arithmetic in non-decimal bases.
- D. Computer representation of numbers.
- E. Computer arithmetic.

VII. Propositional logic.
- A. Propositions.

B. Binary connectives.
C. Truth tables.
D. Laws of logic.
E. Validity of arguments.
F. Predicate logic.
G. Quantifiers.

VIII. Boolean algebra.
A. Axiomatic definition.
B. Simplifying Boolean expressions.
C. Digital circuits.
D. Disjunctive normal form.
E. Karnaugh maps.
F. Logic gates.

Geometry

Some Geometry standards are intended to cover the entire course, and, as such, are listed in several places in the content outline.

Course Description

Geometry is the mathematical study of shapes, their properties, and their relationships. The course competencies are presented as a one-year traditional or one-semester block course that meets the state geometry standards. Emphasis is placed on student discovery and exploration and on formulating and defending conjectures. Geometry includes an in-depth study of reasoning, polygons, congruence, similarity, right triangles, circles, area, volume, and transformations. Students will use a variety of approaches, such as coordinate, transformational, and axiomatic systems. **Geometry I.B.2.** They will also develop an appreciation for the connections between geometry and other disciplines such as art and architecture.

Students are expected to use technology throughout the course, particularly interactive, dynamic software. **Geometry: I.D.2.**

It is recommended that class size be no larger than twenty-five students because of the computer-based nature of the class.

Recommended Prerequisites

Students entering this course should have successfully completed Algebra 1 or its equivalent, having mastered the state-mandated Algebra 1 standards.

Course Outline

Students who complete the geometry course will know and understand the core materials in the outline below. Boldfaced items indicate additional material to be covered in geometry at the honors level. All topics should be taught in greater depth and difficulty at the honors level.

I. Exploration and overview of geometry.
   - A. Develop an awareness of the structure of a mathematical system, connecting definitions and postulates. **Geometry: I.A.1.**
   - B. Recognize that the study of geometry was developed for a variety of purposes and has historical significance. **Geometry: I.A.2.**
   - C. Define basic geometric terms. **Geometry:** Part of **I.A.1.**
   - D. Explore attributes of geometric figures using **Geometry: I.B.1.**
     1. Constructions with straightedge and compass.
     2. Paper folding.
     3. Dynamic, interactive geometry software.
   - E. Explore the basic transformations. **Geometry: III.B.1.,2.**
     1. Translation.
     2. Rotation.
     3. Reflection.
     4. Dilation.

II. Logical reasoning.
   - A. Define and use conditional statements. **Geometry: part of I.A.1.**
   - B. Determine the truth value of the converse of a conditional statement. **Geometry: I.C.1**
   - C. Use logical reasoning to draw conclusions about geometric figures from given assumptions. **Geometry: I.C.2.**
   - D. Construct and judge validity of a logical argument consisting of a set of premises and a conclusion. **Geometry: I.C.3.**
   - E. Use inductive reasoning to formulate a conjecture. **Geometry: I.C.4.**
   - F. Use deductive reasoning to prove a statement. **Geometry: I.C.5.**
   - **G. Find the contrapositive, converse, and inverse of a statement.**
   - **H. Write and use counterexamples.**

I. Determine the truth of a conditional statement using a truth table.
J. Determine the validity or invalidity of an argument using truth tables.
K. Use truth tables to show that statements are tautologies, contradictions, or are logically equivalent.

III. Lines and triangles.
A. Based on explorations and using concrete models and geometry software, formulate and test conjectures about properties of **Geometry: IV.B.1.a.**
1. Parallel lines.
2. Perpendicular lines.
3. Two parallel lines cut by a transversal line.
B. Use numeric and geometric patterns to make generalizations about **Geometry: II.A.1.**
1. Angle relationships.
2. Inequalities in triangles.
C. Justify and apply triangle congruence relationships. **Geometry: V.B.2.**
D. Use congruence transformations to make conjectures about and justify properties of triangles. **Geometry: V.B.1.**
E. Identify, describe, and defend congruence between shapes. **Geometry: V.B.3.**

IV. Polygons and quadrilaterals.
A. Use numeric and geometric patterns to make generalizations about properties of **Geometry: II.A.1.**
1. Polygons.
2. Angle relationships in polygons.
B. Based on explorations and use of concrete models and geometry software, formulate and test conjectures about properties and attributes of polygons and their component parts. **Geometry: IV.B.1.b.**
C. Explore symmetry in regular polygons, and analyze the symmetry of objects using the language of transformations. **Geometry: III.B.3.**
D. Use transformations and their compositions to make connections between mathematics and applications including tessellations or fractals, in particular with graphing calculators and geometry software. **Geometry: III.B.4.**
E. Find optimal solutions to problems involving paths, networks, or relationships among a finite number of objects, using digraphs or vertex-edge graphs. **Geometry: I.D.3.**

V. Coordinate geometry.
A. Given geometric figures, utilize a coordinate system to identify and justify conjectures. **Geometry: III.A.1.**
B. Use slopes and equations of lines to investigate geometric relationships of **Geometry: III.A.2.**
1. Parallel lines.
2. Perpendicular lines.
3. Special segments of triangles.
4. Special segments of other polygons.
C. Develop and use formulas including distance and midpoint. **Geometry: III.A.3.**
D. Given two ordered pairs **Geometry: III.A.4.**
1. Find the distance between them.
2. Locate the midpoint.
3. Determine the slope of the line that contains them.
E. Plot coordinates for translations and describe the vertical and horizontal transformational vector(s). **Geometry: III.B.1.**

VI. Area and perimeter.
A. Find areas of **Geometry: IV.A.1.**
1. Regular polygons.
2. Composite figures.
3. Circles.
B. Using graphing calculators, spreadsheets and dynamic, interactive geometry software, determine and describe the resulting change in the area and perimeter when one or more dimensions is changed, and apply this idea in solving problems. **Geometry: I.D.1., IV.A.5., V.A.7.**
C. Develop and use Pick's theorem for finding the area of an irregular polygon.

VII. Three-dimensional figures.
A. Use numeric and geometric patterns to make generalizations about solid figures. **Geometry: II.A.1.**
B. Draw, examine, and classify cross sections of three-dimensional objects. **Geometry: II.A.3.**
C. Construct a three-dimensional object using a two-dimensional diagram such as a blueprint or pattern. **Geometry: II.A.4.**

D. Use top, front, side, and corner views of three-dimensional objects to create accurate and complete representations and solve problems. **Geometry: I.D.1., II.A.5.**

E. Represent a three-dimensional object in two dimensions using graph or dot paper. **Geometry: II.A.6.**

F. Use formulas for surface area and volume of three-dimensional objects to solve practical problems. **Geometry: I.D.1., IV.A.4.**

G. Using graphing calculators, spreadsheets, and dynamic, interactive geometry software, determine and describe the resulting change in volume when one or more dimensions is changed. **Geometry: IV.A.5.; V.A.7.**

VIII. Similarity.

A. Use numeric and geometric patterns to make generalizations about ratios in similar figures. **Geometry: II.A.1.**

B. Identify, describe, and defend similarity between shapes. **Geometry: V.A.1.**

C. Justify conjectures about geometric figures using similarity and transformations. **Geometry: V.A.2.**

D. Utilize ratios to solve problems involving similar figures in a variety of ways, including the use of dynamic, interactive geometry software. **Geometry: I.D.1., V.A.3.**

E. Solve applied problems using scale modeling. **Geometry: I.D.1., V.A.4.**

F. Solve problems using proportion involving similar figures. **Geometry: I.D.1., V.A.8.**

G. Develop, apply, and justify triangle similarity relationships. **Geometry: V.A.5.**

IX. Right triangles.

A. Develop, extend, use, and prove the Pythagorean Theorem. **Geometry: IV.A.3.**

B. Identify and use the right triangle theorems for

1. 45°-45°-90° triangles.
2. 30°-60°-90° triangles.

C. Identify and apply patterns from right triangles to solve problems. **Geometry: I.D.1., II.A.2.**

D. Explore concepts and applications of trigonometry by solving applied problems using right triangle trigonometry (sine, cosine, and tangent). **Geometry: I.D.1., V.A.6.**

X. Circles.

A. Use numeric and geometric patterns to make generalizations about circles. **Geometry: II.A.1.**

B. Find areas of sectors and arc lengths of circles using proportional reasoning. **Geometry: IV.A.2.**

C. Based on explorations and using concrete models and geometry software, formulate and test conjectures about properties and attributes of circles and the lines that intersect them. **Geometry: IV.B.1.c.**

Mathematics for the Technologies 1

Course Description

Mathematics for the Technologies 1 and Mathematics for the Technologies 2 course competencies are presented as two-year consecutive, sequential courses that meet the state Algebra 1 st0andards. The Algebra 1 end-of-course test will be given at the completion of Mathematics for the Technologies 2.

Mathematics for the Technologies is a program of mathematical studies focusing on the development of the student's ability to understand and apply mathematics to solve realistic workplace problems. Skills in algebra are taught through an integrative approach. Emphasis is on active participation through appropriate project work, laboratory activities, group and individual assignments, discussion, practice, and exposition. Students are expected to use scientific calculators, graphing calculators, and/or computers throughout the year. Instructors are encouraged to work with occupational instructors and local business and industry personnel to incorporate career and technology applications of mathematics.

Recommended Prerequisites

Students entering this course should have mastered all state-mandated eighth-grade standards. It is highly recommended that students who score at the basic or below basic achievement levels on the Palmetto Achievement Challenge Test participate in a transition program to attain and reinforce needed concepts and skills. School scheduling would dictate whether this program is offered prior to or simultaneous with the Mathematics for the Technologies course.

It is recommended that class size be no larger than twenty-two students because of the hands-on, laboratory-based nature of the courses.

Course Outline

All of the following items are identified as eligible for end-of-course testing and are essential for success in subsequent math courses.

I. Generalizations and algebraic symbols.
   - A. Use unit analysis to check measurement computations of English and metric units (e.g., 5 miles per hour = *x* feet per second). **Algebra 1: I.C.2**.
   - B. Make judgments about the appropriateness of units of measure within a system and between systems. **Algebra 1: I.A.5**.
   - C. Determine patterns. **Algebra 1: I.C.3.**
   - D. Recognize and justify the effects of such operations as multiplication, division, and computing powers and roots on the magnitudes of quantities. **Algebra 1: I.C.5.**

II. Algebraic expressions in problem-solving situations.
   - A. Find specific function values and evaluate expressions. **Algebra 1: I.D.1.**
   - B. Simplify polynomial expressions using **Algebra 1: I.D.2.**
     1. Addition.
     2. Subtraction.
   - C. Identify the steps to simplify algebraic expressions. **Algebra 1: I.D.6.**
     1. Commutative.
     2. Associative.
     3. Distributive.
   - D. Use symbolic representation and reasoning to verify statements about numbers. **Algebra 1: I.C.4**.
   - E. Given a problem situation, determine the type of solution required and an appropriate technique. **Algebra 1: I.D.4**.
     1. A rough estimate.
     2. An approximation.
     3. An exact answer .
   - F. Select a suitable method of computing. **Algebra 1: I.D.4.**
     1. Mental mathematics.

2. Paper-and-pencil combinations.
3. Calculators.
4. Computers.

III. Equations and inequalities.

A. Transform and solve linear equations and inequalities using **Algebra 1: II.C.2.,3.**

1. Forms.
   a. One-step.
   b. Multi-step.
2. Properties.
   a. Commutative.
   b. Associative.
   c. Distributive.
   d. Equality.
3. Models, including graphs.

B. Represent relationships among quantities. **Algebra 1: I.A.2.,4.; II.A.1.,3.**

1. Representations.
   a. Concrete models.
   b. Tables.
   c. Graphs.
   d. Diagrams.
   e. Verbal descriptions.
   f. Equations.
   g. Inequalities.
   h. Determine if the situation can be represented by a linear function.
2. Tools.
   a. Computer Algebra Systems (CAS).
   b. Spreadsheets.
   c. Graphing calculators.

C. Analyze problem situations. **Algebra 1: I.A.3.; II.C.1.**

1. Describe functional and recursive relations.
2. Write equations.
3. Write inequalities.

D. For given contexts, use concrete models to interpret and determine the reasonableness of solutions to linear equations and inequalities. **Algebra 1: II.C.4.**

E. Use supporting data to explain why a solution is mathematically reasonable. **Algebra 1: I.D.5.**

IV. Slopes of lines.

A. Develop the concept of slope as a rate of change, and determine slope. **Algebra 1: II.B.1.**

1. Graphs.
2. Tables.
3. Algebraic representations.

B. Interpret the meaning of slope and intercepts in situations involving **Algebra 1: II.B.2**.

1. Data.
2. Symbolic representations.
3. Graphs.

C. With and without a graphing calculator, investigate, describe, and predict the effects of changes in m and b on the graph of $y = mx + b$ and the results of these changes in applied situations. **Algebra 1: II.B.3.,6.**

D. Graph and write equations of lines with given characteristics. **Algebra 1: II.B.4.**

1. Two points.
2. One point and a slope.
3. A slope and y-intercept.

E. Determine the intercepts of linear functions using **Algebra 1: II.B.5.**

1. Graphs.
2. Tables.

V. Linear functions and data representations.

A. For a variety of situations, identify and determine reasonable domain and range values. **Algebra 1: I.B.2.; II.A.2**.

B. Match situations to given graphs, and justify or interpret the match. **Algebra 1: I.B.3**.
C. Create situations that fit given graphs. **Algebra 1: I.B.3.**
D. Represent, display, and interpret data, including representations on graphing calculators and computers. **Algebra 1: I.B.4**.
    1. Scatter plots.
    2. Bar graphs.

Mathematics for the Technologies 2

Course Description

Mathematics for the Technologies 1 and Math for the Technologies 2 course competencies are presented as two-year consecutive, sequential courses that meet the state Algebra 1 standards. The Algebra 1 end-of-course test will be given at the completion of Mathematics for the Technologies 2.

Mathematics for the Technologies is a program of mathematical studies focusing on the development of the student's ability to understand and apply mathematics to solve realistic workplace problems. Skills in algebra are taught through an integrative approach. Emphasis is on active participation through appropriate project work, laboratory activities, group and individual assignments, discussion, practice, and exposition. Students are expected to use scientific calculators, graphing calculators, and/or computers throughout the year. Instructors are encouraged to work with occupational instructors and local business and industry personnel to incorporate career and technology applications of mathematics.

It is recommended that class size be no larger than twenty-two students due to the hands-on, laboratory-based nature of the courses.

Recommended Prerequisites

Students entering this course should have successfully completed Mathematics for the Technologies 1 or have completed Algebra 1 but with minimal success.

Course Outline

All of the following items are identified as eligible for end-of-course testing and are essential for success in subsequent mathematics courses.

I. Generalizations, algebraic symbols, and matrices.
- A. Represent very large and very small numbers in **Algebra 1: I.C.1.**
  1. Exponential form.
  2. Scientific form (interpreting calculator display).
- B. Identify and use properties related to operations with matrices. **Algebra 1: I.C.6.**
  1. Addition.
  2. Subtraction.
  3. Scalar multiplication.
- C. Solve applied problems using matrices. **Algebra 1: I.C.6.**

II. Algebraic expressions in problem-solving situations.
- A. Find specific function values, and evaluate expressions. **Algebra 1: I.D.1.**
- B. Use patterns to generate the laws of exponents. **Algebra 1: III.B.1**.
  1. Multiplication.
  2. Division.
  3. Power raised to a power.
- C. Apply the laws of exponents in problem situations. **Algebra 1: III.B.1**.
- D. Simplify polynomial expressions using **Algebra 1: I.D.2.**
  1. Multiplication.
  2. Division by monomial.
- E. Investigate factoring techniques using **Preliminary to Algebra 1: I.D.3.**
  1. Greatest common factor.
  2. Difference between squares.
  3. Quadratic trinomial.
  4. Grouping.

III. Interpretations.
- A. Relate direct variation to linear functions. **Algebra 1: II.B.7.**
- B. Solve problems involving proportional change. **Algebra 1: II.B.7**.

IV. Linear functions and data representations.
- A. Extend the study of linear functions. **Algebra 1: I.B.2.; II.A.2**.
  1. Domain.
  2. Range.
  3. Graph interpretations.
- B. Represent, display, and interpret data, including representations on graphing calculators and computers. **Algebra 1: I.B.4.**
  1. Scatter plots.
  2. Stem-and-leaf plots.
  3. Box-and-whiskers diagrams.
- C. Write a linear equation that fits a data set, check the model for "goodness-of-fit," and make predictions using the model. **Algebra 1: I.B.5.**

V. Systems of linear equations.
- A. Analyze situations and formulate systems of linear equations to solve problems. **Algebra 1: II.D.1.**
- B. Solve systems of linear equations using **Algebra 1: II.D.2.**
  1. Concrete models.
  2. Graphs.
  3. Tables.
  4. Algebraic methods (e.g., elimination, substitution) including Computer Algebra Systems (CAS), spreadsheets, and graphing calculators.
- C. For given contexts, interpret and determine the reasonableness of solutions to systems of linear equations. **Algebra 1: II.D.3.**

VI. Linear and quadratic functions and data representations.
- A. Identify the parent functions. **Algebra 1: I.B.1.**
  1. Linear ($y = x$).
  2. Quadratic ($y = x^2$).
- B. Sketch the parent functions. **Algebra 1: I.B.1.**
  1. Linear ($y = x$).
  2. Quadratic ($y = x^2$).

VII. Quadratic functions.
- A. Determine the domain and range values for quadratic functions given the constraints of the problem. **Algebra 1: III.A.1**.
- B. With and without using a graphing calculator, investigate, describe, and predict the effects of changing the
  1. Constant a on the graph of $y = ax^2$. **Algebra 1: III.A.2**.
  2. Constant c on the graph of $y = x^2 + c$ **Algebra 1: III.A.3.**
- C. For problem situations, analyze graphs of quadratic functions, and draw conclusions. **Algebra 1: III.A.4.**
- D. Solve quadratic equations using **Algebra 1: I.D.3.; III.A.5.**
  1. Concrete models.
  2. Tables.
  3. Graphs.
  4. Algebraic methods that include factoring and using the quadratic formula, as well as CAS, spreadsheets, and graphing calculators.
- E. Relate the solutions of quadratic equations to the roots of the function. **Algebra 1: III.A.6.**

VIII. Other functions.
- A. Data as functions. **Algebra 1: III.B.2.,3.**
  1. Inverse variation.
  2. Exponential growth and decay.
- B. Data as representations. **Algebra 1: III.B.2.,3**.
  1. Concrete models.
  2. Tables.
  3. Graphs.
  4. Algebraic methods as well as CAS, spreadsheets, and graphing calculators.

IX. Relationships (Insert this section as appropriate in the content outline.)
- **A.** Describe independent and dependent quantities in functional relationships. **Algebra 1: I.A.1.**
- B. Interpret and make inferences from explicit and recursive functional relationships. **Algebra 1: I.A.6.**

Mathematics for the Technologies 3

Course Description

Mathematics for the Technologies 3 is presented as the third in a sequence of courses to meet the state Algebra 1 and Geometry standards.

Mathematics for the Technologies is a program of mathematical studies focusing on the development of the student's ability to understand and apply mathematics to solve realistic workplace problems. Skills in geometry are taught through an integrative approach. Emphasis is on active participation through appropriate project work, laboratory activities, group and individual assignments, discussion, practice, and exposition. Students are expected to use scientific calculators, graphing calculators, and/or computers with dynamic, interactive software throughout the year. **Geometry: I.D.2**. Instructors are encouraged to incorporate workplace competency skills (oral and written communication, cooperative work) and work with occupational instructors and local business and industry personnel to incorporate career and technology applications of mathematics.

It is recommended that class size be no larger than twenty-two students due to the hands-on, laboratory-based nature of the courses.

Recommended Prerequisites

Students entering this course should have successfully completed Mathematics for the Technologies 1 and 2 or Algebra 1, having mastered the state-mandated standards.

Course Outline

The student who completes the Mathematics for the Technologies 3 will know and understand the following core materials:

I. Exploration and overview of geometry.
   - A. Develop an awareness of the structure of a mathematical system, connecting definitions and postulates. **Geometry: I.A.1.**
   - B. Recognize that the study of geometry was developed for a variety of purposes and has historical significance. **Geometry: I.A.2**.
   - C. Explore attributes of geometric figures using constructions with **Geometry: I.B.1.**
     1. Straightedge and compass.
     2. Paper folding.
     3. Dynamic, interactive geometry software.
   - D. Make and verify conjectures of basic geometric terms. **Geometry: I.B.2.**
   - E. Explore the basic transformations. **Geometry: III.B.1., 2.**
     1. Translation.
     2. Rotation.
     3. Reflection.
     4. Dilation.

II. Logical reasoning.
   - A. Define and use conditional statements. **Geometry:** Part of **I.A.1.**
   - B. Determine the truth value of the converse of a conditional statement. **Geometry: I.C.1.**
   - C. Use logical reasoning to draw conclusions about geometric figures from given assumptions. **Geometry: I.C.2.**
   - D. Construct and judge validity of a logical argument consisting of a set of premises and a conclusion. Geometry: I.C.3.
   - E. Use inductive reasoning to formulate a conjecture. **Geometry: I.C.4.**
   - F. Use deductive reasoning to provide an informal proof for a statement. **Geometry: I.C.5.**

III. Lines and triangles.
   - A. Based on explorations and using concrete models and geometry software, formulate and test conjectures about properties of **Geometry: IV.B.1.a.**

1. Parallel lines.
2. Perpendicular lines.
3. Two parallel lines cut by a transversal line.

B. Use numeric and geometric patterns to make generalizations about **Geometry: II.A.1.**
1. Angle relationships
2. Inequalities in triangles.

C. Justify and apply triangle congruence relationships. **Geometry: V.B.2.**

D. Use congruence transformations to make conjectures about and justify properties of triangles. **Geometry: V.B.1.**

E. Identify, describe, and defend congruence between shapes. **Geometry: V.B.3.**

IV. Polygons and quadrilaterals.

A. Use numeric and geometric patterns to make generalizations about properties of **Geometry: II.A.1.**
1. Polygons.
2. Angle relationships in polygons.

B. Based on explorations and using concrete models and geometry software, formulate and test conjectures about properties and attributes of polygons and their component parts. **Geometry: IV.B.1.b.**

C. Analyze the symmetry of objects using the language of transformations. **Geometry: III.B.3**.

D. Use transformations and their compositions to make connections between mathematics and applications including tessellations or fractals, in particular with graphing calculators and geometry software. **Geometry: III.B.4.**

E. Find optimal solutions to problems involving paths, networks, or relationships among a finite number of objects. **Geometry: I.D.3.**

V. Coordinate geometry.

A. Given geometric figures, utilize a coordinate system to identify and justify conjectures. **Geometry: III.A.1.**

B. Use slopes and equations of lines to investigate geometric relationships of **Geometry: III.A.2.**
1. Parallel lines.
2. Perpendicular lines.
3. Special segments of triangles.
4. Special segments of other polygons.

C. Develop and use formulas including distance and midpoint. **Geometry: III.A.3.**

D. Given two ordered pairs **Geometry: III.A.4.**
1. Find the distance between them.
2. Locate the midpoint.
3. Determine the slope of the line that contains them.

E. Plot coordinates for translations, and describe the vertical and horizontal transformational vector(s). **Geometry: III.B.1.**

VI. Area and perimeter.

A. Find areas of **Geometry: IV.A.1**.
1. Regular polygons.
2. Composite figures.
3. Circles.

B. Using graphing calculators, spreadsheets, and dynamic, interactive geometry software, determine and describe the resulting change in the area and perimeter when one or more dimensions is changed, and apply this idea in solving problems. **Geometry: I.D.1., IV.A.5., V.A.7.**

VII. Three-dimensional figures.

A. Use numeric and geometric patterns to make generalizations about solid figures. **Geometry: II.A.1.**

B. Draw, examine, and classify cross sections of three-dimensional objects. **Geometry: II.A.3.**

C. Construct a three-dimensional object using a two-dimensional diagram, such as a blueprint or pattern. **Geometry: II.A.4.**

D. Use top, front, side, and corner views of three-dimensional objects to create accurate and complete representations and solve problems. **Geometry: I.D.1., II.A.5.**

E. Represent a three-dimensional object in two dimensions using graph or dot paper. **Geometry: II.A.6.**

F. Use formulas for surface area and volume of three-dimensional objects to solve practical problems. **Geometry: I.D.1., IV.A.4.**

G. Using graphing calculators, spreadsheets, and dynamic, interactive geometry software, determine and describe the resulting change in volume when one or more dimensions is changed. **Geometry: IV.A.5., V.A.7.**

VIII. Similarity.

A. Use numeric and geometric patterns to make generalizations about ratios in similar figures. **Geometry: II.A.1.**

B. Identify, describe, and defend similarity between shapes. **Geometry: V.A.1.**
C. Justify conjectures about geometric figures using similarity and transformations. **Geometry: V.A.2.**
D. Utilize ratios to solve problems involving similar figures in a variety of ways, including the use of dynamic, interactive geometry software. Geometry: **I.D.1., V.A.3.**
E. Solve applied problems using scale modeling. **Geometry: I.D.1., V.A.4.**
F. Solve problems using proportion involving similar figures. **Geometry: I.D.1., V.A.8.**
G. Develop, apply, and justify triangle similarity relationships. **Geometry: V.A.5.**

IX. Right triangles.
A. Develop, extend, and use the Pythagorean Theorem. **Geometry: IV.A.3.**
B. Identify and use the right triangle theorems for **Geometry: II.A.2.**
1. 45°-45°-90° triangles.
2. 30°-60°-90° triangles.
C. Explore concepts and applications of trigonometry by solving applied problems, using right triangle trigonometry (sine, cosine, tangent). **Geometry: I.D.1., V.A.6.**

X. Circles.
A. Use numeric and geometric patterns to make generalizations about circles. **Geometry: II.A.1.**
B. Find areas of sectors and arc lengths of circles using proportional reasoning. **Geometry: IV.A.2.**
C. Based on explorations and using concrete models and geometry software, formulate and test conjectures about properties and attributes of circles and the lines that intersect them. **Geometry: IV.B.1.c.**

Mathematics for the Technologies 4

Course Description

The Probability and Statistics Course Standards from the South Carolina Mathematics Curriculum Standards are shown in green and in bold print at the places in the course outline where they should be addressed. In many cases, a standard will be found in more than one place in the outline.

Mathematics for the Technologies 4 focuses on the development of the student's understanding of and ability to apply mathematics to solve real-world problems dealing with probability, statistics, and data analysis. Students should have mastered Algebra 1 (Mathematics for the Technologies 1 and 2) standards prior to enrolling in this course. Students are expected to utilize scientific calculators, graphing calculators, and/or computer software throughout the course. It is recommended that class size be no larger than twenty-two students due to the hands-on, laboratory-based nature of this course.

Classroom teachers will determine, based upon the needs of students, the emphasis given to the various topics and the extent of calculator or computer use. Classroom teachers are encouraged to work with occupational instructors and local businesses to incorporate career and technology applications of mathematics in the workplace.

Students will

- work with a set of data to perform statistical analyses and summarize the results;
- examine ways to organize and display data to draw conclusions about relationships that may exist in the data set;
- describe and summarize data numerically using central tendency, variation, and position statistics;
- describe and summarize data numerically using distributions;
- utilize statistical applications to solve problems from a workplace or manufacturing environment;
- use counting methods and probability formulas to evaluate the likelihood of events occurring; and
- apply probability as a decision-making tool to workplace applications.

Recommended Prerequisites

Students entering this course should have successfully completed Mathematics for the Technologies 1 and Mathematics for the Technologies 2 or Algebra 1, having mastered all state-mandated standards through Algebra 1. (Successful completion of Mathematics for the Technologies 3 is also recommended prior to this course.)

Course Outline

I. Foundations of data analysis.
   A. Differentiate between descriptive and inferential statistics. **Probability and Statistics: I.A.2.**
   B. Identify and classify variables.
      1. Discrete or continuous. **Probability and Statistics: I.B.1.**
      2. Categorical or quantitative. **Probability and Statistics: I.B.1.**
   C. Identify and classify methods of data collection.
      1. Identify basic sampling techniques. **Probability and Statistics: I.A.2.,3. III.A.1.,2.**
         a. Random.
         b. Systematic.
         c. Stratified.
         d. Cluster.
      2. Discuss the advantages and disadvantages of various sampling techniques.
      3. Distinguish among surveys, observational studies, and controlled experiments. **Probability and Statistics: I.A.1.,4.,5.,6.**
      4. Recognize the method of data collection used to gather data from a given statistical study. **Probability and Statistics: I.A.2.**
      5. Identify and discuss bias factors (e.g., voluntary response, convenience). **Probability and Statistics: I.B.2.**

D. Distinguish between statistic and parameter. **Probability and Statistics: I.D.1.**

II. Univariate data displays.

A. Determine an appropriate data display, and construct the display. **Probability and Statistics: I.C.1.,2.**

1. Pictograph. **Probability and Statistics: II.A.1.**
2. Dot plot. **Probability and Statistics: II.A.1.,2.**
3. Bar graph. **Probability and Statistics: I.C.1., II.B.4.**
4. Pie chart. **Probability and Statistics: I.C.1.**
5. Frequency distributions.
   a. Categorical frequency distribution (Pareto chart). **Probability and Statistics: I.C.1., II.B.4.**
   b. Histogram. **Probability and Statistics: I.C.2.**
   c. Frequency polygon.
   d. Cumulative frequency distribution (ogive).
6. Time series plot.
7. Stem plot (stem-and-leaf). **Probability and Statistics: I.C.1,2.**
   a. Standard.
   b. Back-to-back (to compare two data sets with common stems).
   c. Expanded (stem expansion based on the number of data values within the stem; i.e., group by five or two as needed).
   d. Truncated (data is rounded before use)—optional.
8. Box plot (box-and-whisker)—teach in conjunction with measures of position. **Probability and Statistics: I.C.1.,2.**
   a. Single.
   b. Parallel (horizontal or vertical arrangement with a common scale for comparing data sets).

B. Interpret the graphical display.

1. Center. **Probability and Statistics: I.D.2., II.C.1.**
   a. Mean.
   b. Median.
   c. Mode.
2. Spread **Probability and Statistics: I.D.2., II.C.1.**
   a. Range.
   b. Variance.
   c. Standard deviation.
   d. Mean deviation (optional).
   e. Interquartile range (IQR).
3. Position. **Probability and Statistics: I.D.3.**
   a. Median.
   b. Quartiles.
   c. Deciles.
   d. Percentiles.
   e. Standard scores (z-scores).
4. Shape. **Probability and Statistics: II.A.1., C.2.**
   a. Symmetric.
   b. Skewed.
5. Outliers. **Probability and Statistics: I.C.1.,2.**

III. Applications of measures of central tendency and variation.

A. Solve problems in manufacturing and/or business environments. **Probability and Statistics: III.D.1.**

1. Control charts.
2. Process and quality control.
3. Calculation of capability indexes.
4. Computer graphing utilities.

B. Analyze precision, accuracy, and approximate error in measurement situations. **Probability and Statistics: I.A.3..**

C. Solve problems using the normal curve. **Probability and Statistics: II.A.3.**

IV. Basic probability concepts and applications .

A. Apply counting techniques to determine the number of outcomes. **Probability and Statistics: IV.A.1.**

1. Tree diagram. **Probability and Statistics: IV.A.2.**

2. Counting principle. **Probability and Statistics: IV.D.3.**
3. Permutations (with and without repetition). **Probability and Statistics: IV.A.1.**
4. Combinations.
    a. Pascal's triangle and binomial coefficients (optional). **Probability and Statistics: IV.A.3.**
    b. Committees as subgroups of larger group . **Probability and Statistics: IV.A.1.,2.**

B. Determine and display a sample space. **Probability and Statistics: IV.A.2.**
1. List.
2. Chart.
3. Picture.
4. Tree diagram.

C. Compute and display classical (theoretical) and empirical (experimental) probability. **Probability and Statistics: IV.E.1.**
1. Simple.
2. Complementary.
3. Compound. **Probability and Statistics: IV.E.1.**
    a. Mutually exclusive (disjoint) events. **Probability and Statistics: IV.D.1.**
    b. Inclusive (joint) events.
    c. Independent events.
    d. Dependent events.
4. Conditional probability. **Probability and Statistics: IV.D.2.**
5. Use Venn diagrams or two-way tables to illustrate simple, complementary, compound, and conditional probability. **Probability and Statistics: IV.A.2.**

D. Conduct and interpret simple probability experiments. **Probability and Statistics: IV.B.1.,2.**
1. Manipulatives (e.g., spinners, dice, cards, and coins).
2. Simulations (using random number tables, graphing calculators, or computer software).

V. Probability distributions.

A. Construct a classical (theoretical) probability distribution using a sample space. **Probability and Statistics: IV.A.1.**

B. Construct an empirical (experimental) probability distribution using simulation. **Probability and Statistics: IV.B.1.**

C. Compare classical (theoretical) probabilities from the sample space to the empirical (experimental) probabilities from a simulation. **Probability and Statistics: IV.B.1.**

D. Calculate the mean of a probability distribution, and apply it to expected value problems. **Probability and Statistics: IV.C.2.**

E. Solve problems using the binomial probability distribution table. **Probability and Statistics: IV.A.3.**

VI. Bivariate data and scatter plots.

A. Construct a scatter plot from given data. **Probability and Statistics: II.B.3.**

B. Describe the shape of a scatter plot as linear, quadratic, or exponential. **Probability and Statistics: II.B.3.**

C. Examine scatter plots to determine positive, negative, or no correlation. **Probability and Statistics: I.D.5.**

D. Write a linear equation that represents the relationship between the variables. **Probability and Statistics: II.B.2.,3.**
1. Intuitive methods (estimate using linguini or clear ruler). **Probability and Statistics: II.D.1.**
2. Median-median line (optional).
3. Linear regression using a graphing calculator or computer software (and interpret the meaning of the correlation coefficient, r). **Probability and Statistics: II.B.1.,3., D.2.**

E. Make predictions (interpolate or extrapolate). **Probability and Statistics: II.B.2.**

F. Explain limitations of the linear model. **Probability and Statistics: II.B.2.,3.**

VII. Project design.

A. Use any of the statistical and probability knowledge to design a culminating project.
1. Experiments. **Probability and Statistics: I.A.1-7., B.2.**
2. Observational studies. **Probability and Statistics: I.A.1.**
3. Surveys.

B. Collect, analyze, and display the data. **Probability and Statistics: I.A.2.,3., C.2., III.A.1.,2.**

C. Produce a report.

VIII. Optional topics.

A. Hypothesis Testing. **Probability and Statistics: III.D.2**

1. Write null and alternate hypotheses.
2. Test hypotheses. .
    a. Difference between two means.
    b. Difference between two proportions.
    c. Chi-square procedures. **Probability and Statistics: IV.C.1.,2.**
    d. Non-normal distributions.
    e. T distributions.

B. Confidence intervals. **Probability and Statistics: III.D.1.**

C. Curves of best fit. **Probability and Statistics: III.D.2**

Precalculus

Course Description

Precalculus is a program of mathematical studies focusing on the development of the student's ability to understand and apply the study of functions and advanced mathematics concepts to solve problems. The course will include an in-depth study of polynomial, rational, exponential, logarithmic, and trigonometric functions. Other topics studied are sequences, series, vectors, conic sections, parametric equations, and polar curves. Emphasis is placed on active participation through modeling, technology lab activities, group activities, and communication in mathematics.

Students are expected to use technology, including graphing calculators, computers, and data-gathering equipment throughout the course. *Graphing calculators should be an integral part of all instruction.*

Recommended Prerequisites

It is recommended that a student successfully complete Algebra 2 before taking Precalculus. Students who need a stronger background could follow Algebra 2 with Algebra 3 and then Precalculus. *Algebra 3 is not part of the defined program and will need to be taught as an innovative approach course*.

Boldfaced items indicate additional material to be covered in Precalculus at the honors level. All topics should be taught in greater depth and difficulty at the honors level.

Course Outline

I. Functions.
- A. Characteristics and representations of functions.
  1. Determine the domain and range from algebraic representations, graphs, and tables. **Precalculus: I.A.2., II.A.1., II.B.3.**
  2. Describe symmetry of even and odd functions. **Precalculus: I.A.5.**
- B. Operations on functions.
  1. Apply basic transformations. **Precalculus: I.B.1.**
     a. $a \bullet f(x)$, $f(x) + d$, $f(x - c)$, $f(b \bullet x)$.
     b. $|f(x)|$, $f(|x|)$.
  2. Perform operations and describe the procedures and results verbally, numerically, algebraically, and graphically. **Precalculus: I.B.2.**
     a. Composition and decomposition.
     b. Inverses.

II. Polynomial and rational functions.
- A. Polynomial functions.
  1. Describe the general shape of the graph and the effect of transformations on the domain and range. **Precalculus: I.A.1.,II.A.1.**
  2. Recognize the connections among the significant points of a function, the graph of the function, and the algebraic representation of the function. **Precalculus: I.A.6.**
     a. Roots.
     b. Maximum points and minimum points.
  3. Investigate continuity and end behavior. **Precalculus: I.A.7.**
  4. Solve equations and inequalities using graphs, tables, algebraic methods, and technology. **Precalculus: II.A.3.**
- B. Rational functions.
  1. Describe the general shape of the graph and the effect of transformations on the domain and range. **Precalculus: I.A.1., II.A.1.**
  2. Investigate continuity, asymptotes, and limits. **Precalculus: I.A.7., II.A.1.**
  3. Solve equations and inequalities using graphs, tables, algebraic methods, and technology. **Precalculus: II.A.3.**
  4. **Decompose a rational expression into partial fractions.**
- C. Problem situations.

1. Analyze a verbal, graphical, or tabular representation of a polynomial or rational function. **Precalculus: II.A.2.**
2. Analyze a problem situation by formulating an equation or an inequality. **Precalculus: II.A.4.**

III. Exponential and logarithmic functions.

A. Exponential functions.
1. Describe the general shape of a graph and the effect of transformations on the domain and range. **Precalculus: I.A.1., II.B.2.**
2. Investigate asymptotic behavior. **Precalculus: II.B.2.**
3. Investigate exponential properties graphically and algebraically. **Precalculus: I.B.3.**
4. Solve exponential equations and inequalities using graphs, tables, algebraic methods, and technology, including reasonableness of solutions. **Precalculus: II.B.3.,4.**

B. Logarithmic functions.
1. Describe the general shape of a graph and the effect of transformations on the domain and range. **Precalculus: I.A.1., II.B.2.**
2. Develop the connection between exponential and logarithmic functions. **Precalculus: II.B.1.**
3. Investigate asymptotic behavior. **Precalculus: II.B.2.**
4. Investigate logarithmic properties graphically and algebraically. **Precalculus: I.B.3.**
5. Solve logarithmic equations and inequalities using graphs, tables, algebraic methods, and technology, including reasonableness of solutions. **Precalculus: II.B.3., 4.**

C. Problem situation.
1. Analyze a verbal, graphical, or tabular representation of an exponential or logarithmic function. **Precalculus: II.B.5.**
2. Analyze a problem situation by formulating an equation or inequality. **Precalculus: II.B.5.**
3. Solve rate of change problems, such as inflation, spread of disease, population growth, tax brackets, pollution, or other such problems. **Precalculus: II.B.6.**
4. Analyze graphical data gathered by technical equipment. **Precalculus: II.B.7.**

IV. Trigonometric functions.

A. Circular functions.
1. Use the wrapping function to define and evaluate all six trigonometric functions. **Precalculus: I.A.3.**
2. Describe the general shape of a graph and the effect of transformations on the domain and range. **Precalculus: I.A.1.,**
3. Investigate transformations of graphs including periodicity, amplitude, phase shift, and vertical shift.
4. Investigate identities graphically, and verify algebraically. **Precalculus: I.B.3.**
5. Solve trigonometric equations.

B. Triangle trigonometry.
1. Evaluate all six trigonometric functions using a right triangle. **Precalculus: I.A.3.**
2. Solve problems using the law of sines and law of cosines. **Precalculus: II.C.3.**
3. Find the area of a triangle.

C. Vectors.
1. Model situations defined by magnitude and direction. **Precalculus: III.C.1, .2.**
2. Find distance graphically. **Precalculus: III.C.3.**

D. Problem situations.
1. Analyze a verbal, graphical, or tabular representation of a trigonometric function. **Precalculus: II.C.1., 2., 3.**
2. Analyze a problem situation by formulating an equation or inequality. **Precalculus: II.C.1., 2., 3.**
3. Analyze graphical data gathered by technical equipment. **Precalculus: II.C.1., 2., 3.**

E. Inverse trigonometric functions.
1. Describe the general shape of a graph and the effect of transformations on the domain and range.
2. Evaluate inverse trigonometric functions.

V. Conic sections, parametric representations, and polar representations.

A. Conic sections.
1. Use conic sections to model motion and planetary motion. **Precalculus: III.B.1.**
2. Use conic sections to model the reflective properties of light and sound. **Precalculus: III.B.2.**
3. **Solve systems of second-degree equations and inequalities.**

B. Parametric equations.
1. Convert between rectangular and parametric form. **Precalculus: III.B.3.**
2. Graph parametric equations. **Precalculus: III.B.3.**

3. Use parametric equations to simulate problems involving motion. **Precalculus: III.B.4.**

C. Polar equations.

1. Convert between rectangular and polar form. **Precalculus: III.B.5.**
2. Graph polar equations. **Precalculus: III.B.5.**
3. **Write complex numbers in polar form.**
4. **Find products, quotients, powers, and roots of complex numbers in polar form.**

VI. Sequences and series.

A. Sequences.

1. Represent patterns using arithmetic and geometric sequences. **Precalculus: III.A.1**.
2. Solve real-life problems using arithmetic, geometric, and other sequences. **Precalculus: III.A.2.**
3. Describe limits of sequences. **Precalculus: III.A.4.**

B. Series.

1. Represent patterns using arithmetic and geometric series, including sigma notation.
2. Solve real-life problems using arithmetic, geometric, and other series.
3. Investigate convergent and divergent series. **Precalculus: III.A.4.**

C. Problem solving.

1. Solve problems including sums, binomial expansion, the binomial theorem, combinations, and Pascal's triangle. **Precalculus: III.A.5.**
2. Use the principle of mathematical induction. **Precalculus: III.A.6.**
3. Apply informal concepts of successive approximations, upper and lower bounds, and limits in measurement situations, such as estimated lengths of curves, areas of curved regions, and volume of curved solids. **Precalculus: III.A.3.**

VII. Iteration and fractals.

A. Iteration functions using real numbers.

B. Investigate fractals.

Probability, Statistics, and Data Analysis

Course Description

The Probability and Statistics Course Standards from the South Carolina Mathematics Curriculum Standards are shown in green and in bold print at the places in the course outline where they should be addressed. In many cases, a standard will be found in more than one place in the outline.

Probability, Statistics, and Data Analysis is a course in which students learn the fundamental principles of probability and statistics and apply these principles to data analysis. Students are expected to utilize scientific calculators, graphing calculators, and/or computer software throughout the year.

Teachers should encourage their students to utilize the skills emphasized in this course through projects, investigations, case studies, and other appropriate methods.

Students will

- work with a set of data to perform statistical analyses and summarize the results;
- examine ways to organize and display data to draw conclusions about relationships that may exist in the data set;
- describe and summarize data numerically using central tendency, variation, and position statistics;
- describe and summarize data numerically using distributions;
- utilize statistical applications to solve a wide variety of problems from agriculture, biology, business, economics, education, psychology, engineering, medicine, sociology, and computer sciences;
- use counting methods and probability formulas to evaluate the likelihood of events occurring; and
- apply probability and statistical tests as decision-making tools in hypothesis-testing applications.

Recommended Prerequisites

Students entering this course should have successfully completed Algebra 1 and Algebra 2, having mastered all state-mandated standards in Algebra 1 and Algebra 2.

Course Outline

I. Foundations of data analysis.
   A. Differentiate between descriptive and inferential statistics. **Probability and Statistics: I A.2.**
   B. Identify and classify variables. **Probability and Statistics: I.B.1.**
      1. Discrete or continuous.
      2. Categorical or quantitative.
   C. Identify and classify methods of data collection.
      1. Identify basic sampling techniques. **Probability and Statistics: I.A.2, 3., III.A.1.,2.**
         a. Random.
         b. Systematic.
         c. Stratified.
         d. Cluster.
      2. Discuss the advantages and disadvantages of various sampling techniques.
      3. Distinguish among surveys, observational studies, and controlled experiments. **Probability and Statistics: I.A.1.,4.,5.,6.**
      4. Recognize the method of data collection used to gather data from a given statistical study and evaluate the legitimacy of conclusions about the population based on the sample(s) studied. **Probability and Statistics: I.A.2.**
      5. Identify and discuss bias factors (e.g., voluntary response, convenience). **Probability and Statistics: I.B.2.**
   D. Distinguish between statistic and parameter. **Probability and Statistics: I.D.1.**

II. Univariate data displays.

A. Determine an appropriate data display, and construct the display. **Probability and Statistics: I.C.1.,2., II.A.1.,2., II.B.4.**
   1. Pictograph. **Probability and Statistics: II.A.1.**
   2. Dot plot. **Probability and Statistics: II.A.1., 2.**
   3. Bar graph. **Probability and Statistics: I C.1., II.B.4.**
   4. Pie chart. **Probability and Statistics: I.C.1.**
   5. Frequency distributions.
      a. Categorical frequency distribution (Pareto chart). **Probability and Statistics: I.C.1., II.B.4.**
      b. Histogram. **Probability and Statistics: I.C.2..**
      c. Frequency polygon.
      d. Cumulative frequency distribution (ogive).
   6. Time series plot.
   7. Stem plot (stem-and-leaf). **Probability and Statistics: I.C.1.,2..**
      a. Standard.
      b. Back-to-back (to compare two data sets with common stems).
      c. Expanded (stem expansion based on the number of data values within the stem; i.e., group by five or two as needed).
      d. Truncated (data is rounded before use)—optional.
   8. Box plot (box-and-whisker)—teach in conjunction with measures of position. **Probability and Statistics: I.C.1.,2.**
      a. Single.
      b. Parallel (horizontal or vertical arrangement with a common scale for comparing data sets).

B. Interpret the graphical display.
   1. Center. **Probability and Statistics: I.D.2., II.C.1.**
      a. Mean.
      b. Median.
      c. Mode.
      d. Midrange.
   2. Spread. **Probability and Statistics: I.D.2., II.C.1.**
      a. Range.
      b. Variance.
      c. Standard deviation.
      d. Mean deviation (optional).
      e. Interquartile range (IQR).
   3. Position. **Probability and Statistics: I.D.3.**
      a. Median.
      b. Quartiles.
      c. Deciles.
      d. Percentiles.
      e. Standard scores (z-scores).
   4. Shape. **Probability and Statistics: II.A.1., II.C.2.**
      a. Symmetric.
      b. Skewed.
   5. Outliers. **Probability and Statistics: I.C.1.,2.**

III. Bivariate data and scatter plots.

A. Construct a scatter plot from given data. **Probability and Statistics: II.B.3.**

B. Describe the shape of a scatter plot as linear, quadratic, or exponential. **Probability and Statistics: II.B.3.**

C. Examine scatter plots to determine positive, negative, or no correlation. **Probability and Statistics: I.D.5.**

D. Find and interpret the value of the coefficient of determination, r^2. **Probability and Statistics: II.B.1.,3..**

E. Find and interpret the value of the correlation coefficient, *r*. **Probability and Statistics: II.B.1., 3.**

F. Write a linear equation that represents the relationship between the variables. **Probability and Statistics: II.B.2.,3.**
   1. Intuitive methods (estimate using linguini or clear ruler). **Probability and Statistics: II.D.1.**
   2. Linear regression using a graphing calculator or computer software. **Probability and Statistics: II.D.2.**

G. Make predictions (interpolate or extrapolate). **Probability and Statistics: II.B.2.**

H. Explain limitations of the linear model. **Probability and Statistics: II.B.2.,3.**

IV. Basic probability concepts and applications.

A. Apply counting techniques to determine the number of outcomes. **Probability and Statistics: IV.A.1.**
   1. Tree diagram. **Probability and Statistics: IV.A.2.**
   2. Counting principle. **Probability and Statistics: IV.D.3.**
   3. Permutations (with and without repetition). **Probability and Statistics: IV.A.1.**
   4. Combinations. **Probability and Statistics: IV.A.1.**
      a. Pascal's triangle and binomial coefficients. **Probability and Statistics: IV.A.3.**
      b. Committees as subgroups of larger group. **Probability and Statistics: IV.A.1.,2.**

B. Determine and display a sample space. **Probability and Statistics: IV.A.2.**
   1. List.
   2. Chart.
   3. Picture.
   4. Tree diagram.

C. Compute and display classical (theoretical) and empirical (experimental) probability. **Probability and Statistics: IV.E.1.**
   1. Simple.
   2. Complementary.
   3. Compound. **Probability and Statistics: IV.E.1.**
      a. Mutually exclusive (disjoint) events. **Probability and Statistics: IV.D.1.**
      b. Inclusive (joint) events.
      c. Independent events.
      d. Dependent events.
   4. Conditional probability. **Probability and Statistics: IV.D.2.**
   5. Venn diagrams and/or two-way tables to illustrate simple, complementary, compound, and conditional probability. **Probability and Statistics: IV.A.2.**

D. Conduct and interpret simple probability experiments. **Probability and Statistics: IV.B.1.,2.**
   1. Manipulatives (e.g., spinners, dice, cards, coins).
   2. Simulations (using random number tables, graphing calculators, or computer software).

V. Probability distributions.

A. Construct a classical (theoretical) probability distribution using a sample space. **Probability and Statistics: IV.A.1**.

B. Construct an empirical (experimental) probability distribution using simulation. **Probability and Statistics: IV.B.1.**

C. Compare classical (theoretical) probabilities from the sample space to the empirical (experimental) probabilities from a simulation. **Probability and Statistics: IV.B.1.**

D. Calculate the mean, variance, and expected value of a discrete random variable. **Probability and Statistics: IV.C.1.,2.**

E. Contingency or two-way tables
   1. Display variables in a two-way table. **Probability and Statistics: I.C.3.**
   2. Calculate marginal distributions in a two-way table. **Probability and Statistics: I D4.**

F. Find the exact probability of a specific number of trials from a binomial experiment. **Probability and Statistics: IV.A.3.**

G. Find the mean, variance, and standard deviation for the variables of a binomial distribution. **Probability and Statistics: IV.A.3.**

H. Find the probabilities for outcomes of variables using other distributions such as geometric and Poisson (optional).

VI. Statistical inference.

A. Identify the properties of a normal distribution and apply the empirical rule to data displaying a normal distribution. **Probability and Statistics: II.A.3.**

B. Find the area under the standard normal curve given various z values and vice versa. **Probability and Statistics: I.D.3.**

C. Find the probability for a normally-distributed variable by transforming it into a standard normal variable and vice versa. **Probability and Statistics: I.D.3.**

D. Use the central limit theorem to solve problems involving sample means for large and small samples. **Probability and Statistics: III.B.1.,2.**

E. Use the normal approximation to compute probabilities for a binomial variable. **Probability and Statistics: IV.A.3., B.1.,2.**

F. Find the confidence interval for the mean with a known or unknown standard deviation for small and large sample sizes. **Probability and Statistics: III.D.1.**

G. Find the confidence interval for a population proportion. **Probability and Statistics: III.D.1.**

VII. Hypothesis testing.

A. Write null and alternative hypotheses.

B. Find critical values for testing a mean or proportion against the population mean or proportion using the appropriate test, based on the samp le size. **Probability and Statistics: III.D.2.**

C. Find critical values for testing the difference between two means or two proportions using the appropriate test, based on the sample size. **Probability and Statistics: III.D.2.**

D. Test hypotheses using confidence intervals. **Probability and Statistics: III.D.1.**

E. Test observed values versus expected values using the chi-square test. **Probability and Statistics: IV.C.1.,2.**

VIII. Project design.

A. Validity of Statistical Studies **Probability and Statistics: III.C.1.,2.**

1. Given a published report based on data, determine:
    a. Design of the study
    b. Appropriateness of the data analysis
    c. Validity of the conclusions
    d. Interpretation of results

B. Use any of the statistical and probability knowledge to design a culminating project.

1. Experiments. **Probability and Statistics: I.A.1.-7., B.2.**
2. Observational studies. **Probability and Statistics: I.A.1.**
3. Surveys.

C. Collect, analyze, and display the data. **Probability and Statistics: I,A.2.3., C.2., III.A.1.,2.**

D. Produce a report.

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