Mathematics & Statistics
| American River College

Besides pre-college and college-level math classes that meet ARC graduation requirements, ARC offers an A.S. degree in mathematics that provides a foundation of mathematics for students in preparation for transfer to a four-year program in mathematics or statistics. Degree course work includes a three semester calculus series, differential equations, linear algebra, and statistics and/or symbolic logic.

(/academics/arc-program-road-maps)

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Associate Degrees for Transfer

A.S.-T. in Mathematics

This degree is designed to meet common lower-division requirements for a major in Mathematics at a CSU campus. Satisfactory completion of the ARC Mathematics transfer degree provides a solid foundation and satisfies the standard prerequisites for upper division coursework for Mathematics majors. However, it is highly recommended that students meet with a counselor since major and general education requirements vary for each college/university.

The Mathematics Associate in Science for Transfer (AS-T) Degree may be obtained by the completion of 60 transferable, semester units with a minimum 2.0 GPA, including (a) the major or area of emphasis described in the Required Program outlined below (earning a C or better in these courses) and (b) either the Intersegmental General Education Transfer Curriculum (IGETC) or the California State University General Education Breadth Requirements.

Degree Requirements

COURSE CODE	COURSE TITLE	UNITS
MATH 400	Calculus I (5)	5
MATH 401	Calculus II (5)	5
MATH 402	Calculus III (5)	5
MATH 410	Introduction to Linear Algebra (3)	3
MATH 420	Differential Equations (4)	4
Total Units:		22

The Associate in Science in Mathematics for Transfer (AS-T) degree may be obtained by completion of 60 transferable, semester units with a minimum 2.0 GPA, including (a) the major or area of emphasis described in the Required Program, and (b) either the Intersegmental General Education Transfer Curriculum (IGETC) or the California State University General Education-Breadth Requirements.

Student Learning Outcomes
Upon completion of this program, the student will be able to:

- evaluate, describe, and apply single variable calculus including various forms of derivatives and integrals, to analyze and solve problems.

- evaluate, describe, and apply multivariate calculus, linear algebra, and differential equations to analyze and solve problems.

- prepare logical arguments and use them to prove basic mathematical theorems.

- solve real-world application problems using appropriate mathematical problem-solving skills.

Career Information

Mathematicians work as statisticians, analysts, computer programmers, actuaries, researchers, planners, and educators. This transfer degree is designed to meet the common lower-division requirements for most bachelor's degrees in Mathematics.

Associate Degrees

A.S. in Mathematics

The A.S. degree in mathematics provides a foundation of mathematics for students in preparation for transfer to a four-year program in mathematics or statistics. Course work includes a three-semester calculus series, differential equations, linear algebra, and statistics and/or symbolic logic.

Degree Requirements

COURSE CODE	COURSE TITLE	UNITS
MATH 400	Calculus I	5
MATH 401	Calculus II	5
MATH 402	Calculus III	5
MATH 410	Introduction to Linear Algebra	3
MATH 420	Differential Equations	4
A minimum of 3 units from the following:		3
MATH 320	Symbolic Logic (3)	
or PHIL 324	Symbolic Logic (3)	
STAT 300	Introduction to Probability and Statistics (4)	
Total Units:		25

The Mathematics Associate in Science (A.S.) degree may be obtained by completion of the required program, plus general education requirements, plus sufficient electives to meet a 60-unit total. See ARC graduation requirements.

Student Learning Outcomes

Upon completion of this program, the student will be able to:

- Identify, formulate, and solve applied problems (using calculus and linear algebra) in verbal, numeric, graphical, and symbolic form related to science, economics, or business.

- Recognize and construct valid arguments using deductive and inductive reasoning skills.

- Define and utilize terminology of mathematics with emphasis in calculus, linear algebra, and either statistics, logic or problem solving.

- Calculate derivatives and integrals using a variety of defined rules and strategies of calculus, algebraic properties and trigonometric identities.

A.S. in Physical Science/Mathematics

This degree provides a broad study in the fields of physical science and mathematics. It is a good foundation for transfer to a four-year program in science, technology, engineering, or mathematics (STEM).

Degree Requirements

COURSE CODE	COURSE TITLE	UNITS
A minimum of 18 units from the following:		18
ASTR 300	Introduction to Astronomy (3)	
ASTR 310	The Solar System (3)	
ASTR 320	Stars, Galaxies, and Cosmology (3)	
ASTR 330	Introduction to Astrobiology (3)	
ASTR 400	Astronomy Laboratory (1)	
ASTR 481	Honors Astronomy: Stars, Galaxies, and Cosmology (4)	
ASTR 495	Independent Studies in Astronomy (1 - 3)	
ASTR 499	Experimental Offering in Astronomy (0.5 - 4)	
CHEM 305	Introduction to Chemistry (5)	
CHEM 306	Introduction to Organic and Biological Chemistry (5)	
CHEM 309	Integrated General, Organic, and Biological Chemistry (5)	
CHEM 310	Chemical Calculations (4)	
CHEM 400	General Chemistry I (5)	
CHEM 401	General Chemistry II (5)	
CHEM 420	Organic Chemistry I (5)	
CHEM 421	Organic Chemistry II (5)	
CHEM 423	Organic Chemistry - Short Survey (5)	
CHEM 495	Independent Studies in Chemistry (1 - 3)	
CHEM 499	Experimental Offering in Chemistry (0.5 - 4)	
ENGR 300	Introduction to Engineering (1)	
ENGR 310	Engineering Survey Measurements (4)	
ENGR 312	Engineering Graphics (3)	
ENGR 401	Introduction to Electrical Circuits and Devices (4)	
ENGR 413	Properties of Materials (4.5)	
ENGR 420	Statics (3)	
ENGR 495	Independent Studies in Engineering (1 - 3)	
ENGR 499	Experimental Offering in Engineering (0.5 - 4)	
GEOG 300	Physical Geography: Exploring Earth's Environmental Systems (3)	
GEOG 301	Physical Geography Laboratory (1)	
GEOG 305	Global Climate Change (3)	
GEOG 306	Weather and Climate (3)	
GEOG 307	Environmental Hazards and Natural Disasters (3)	
GEOG 308	Introduction to Oceanography (3)	
GEOG 309	Introduction to Oceanography Lab (1)	
GEOG 391	Field Studies in Geography: Mountain Landscapes (1 - 4)	
GEOG 392	Field Studies in Geography: Coastal Landscapes (1 - 4)	

COURSE CODE	COURSE TITLE	UNITS
GEOG 393	Field Studies in Geography: Arid Landscapes (1 - 4)	
GEOG 394	Field Studies in Geography: Volcanic Landscapes (1 - 4)	
GEOG 495	Independent Studies in Geography (1 - 3)	
GEOG 499	Experimental Offering in Geography (0.5 - 4)	
GEOL 300	Physical Geology (3)	
GEOL 301	Physical Geology Laboratory (1)	
GEOL 305	Earth Science (3)	
GEOL 306	Earth Science Laboratory (1)	
GEOL 310	Historical Geology (3)	
GEOL 311	Historical Geology Laboratory (1)	
GEOL 320	Global Climate Change (3)	
GEOL 325	Environmental Hazards and Natural Disasters (3)	
GEOL 330	Introduction to Oceanography (3)	
GEOL 331	Introduction to Oceanography Lab (1)	
GEOL 345	Geology of California (3)	
GEOL 390	Field Studies in Geology (1 - 4)	
GEOL 495	Independent Studies in Geology (1 - 3)	
GEOL 499	Experimental Offering in Geology (0.5 - 4)	
MATH 300	Introduction to Mathematical Ideas (3)	
MATH 310	Mathematical Discovery (3)	
MATH 311	Mathematical Concepts for Elementary School Teachers - Number Systems (3)	
MATH 320	Symbolic Logic (3)	
MATH 325	Problem-Solving (3)	
MATH 330	Trigonometry (3)	
MATH 336	College Algebra (5)	
MATH 340	Calculus for Business and Economics (3)	
MATH 342	Modern Business Mathematics (3)	
MATH 355	Calculus for Biology and Medicine I (4)	
MATH 356	Calculus for Biology and Medicine II (4)	
MATH 370	Pre-Calculus Mathematics (5)	
MATH 372	College Algebra for Calculus (4)	
MATH 373	Trigonometry for Calculus (4)	
MATH 400	Calculus I (5)	
MATH 401	Calculus II (5)	
MATH 402	Calculus III (5)	
MATH 410	Introduction to Linear Algebra (3)	
MATH 420	Differential Equations (4)	
MATH 480	Honors Seminar in Mathematics (1)	
MATH 495	Independent Studies in Mathematics (1 - 3)	

COURSE CODE	COURSE TITLE	UNITS
MATH 499	Experimental Offering in Mathematics (0.5 - 4)	
PHYS 310	Conceptual Physics (3)	
PHYS 311	Basic Physics (3)	
PHYS 312	Conceptual Physics Laboratory (1)	
PHYS 350	General Physics (4)	
PHYS 360	General Physics (4)	
PHYS 410	Mechanics of Solids and Fluids (5)	
PHYS 421	Electricity and Magnetism (4)	
PHYS 431	Heat, Waves, Light and Modern Physics (4)	
PHYS 495	Independent Studies in Physics (1 - 3)	
PHYS 499	Experimental Offering in Physics (0.5 - 4)	
PS 300	Introduction to Physical Science (3)	
PS 301	Physical Science Laboratory (1)	
PS 495	Independent Studies in Physical Science (1 - 3)	
PS 499	Experimental Offering in Physical Science (0.5 - 4)	
STAT 300	Introduction to Probability and Statistics (4)	
STAT 305	Statway, Part II (6)	
STAT 495	Independent Studies in Statistics (1 - 3)	
STAT 499	Experimental Offering in Statistics (0.5 - 4)	
Total Units:		18

The Physical Science/Mathematics Associate in Science (A.S.) degree may be obtained by completion of the required program, plus general education requirements, plus sufficient electives to meet a 60-unit total. See ARC graduation requirements.

Student Learning Outcomes
Upon completion of this program, the student will be able to:

- recognize and utilize correctly the terminology of math, statistics, and/or science.

- analyze and interpret data, charts, and graphs using quantitative and qualitative methods.

- recognize and construct valid arguments using deductive and inductive reasoning.

- evaluate new and accepted ideas about the natural universe using testable methodology.

Mathematics (MATH)

MATH 10 Developing Confidence in Math

Units:	1
Hours:	18 hours LEC
Prerequisite:	None.
Advisory:	Concurrent enrollment in another math course

This course helps students recognize common misconceptions of mathematics, overcome math anxiety, and build confidence in math. Topics include relaxation techniques, study habits, and problem solving strategies. This course is also useful for tutors, counselors, and teachers interested in helping others overcome their math anxiety. Pass/No Pass only.

Student Learning Outcomes

Upon completion of this course, the student will be able to:

- analyze causes of math anxiety

- examine myths about mathematics

- describe the experiences in mathematics which have influenced personal attitudes towards math

- compare personal learning experiences, as related to mathematics

- apply skills to overcome fear and achieve success in mathematics

- create a study plan for mathematics courses

- apply learning strategies to achieve success in mathematics

MATH 25 Computational Arithmetic

Units:	3
Hours:	54 hours LEC
Prerequisite:	None.
Advisory:	Placement through the math assessment process.

This course introduces the fundamentals of arithmetic with an emphasis on computational skills. Topics include whole numbers, exponents, order of operations, factors, fractions, decimals, problem solving, and applications.

Student Learning Outcomes

Upon completion of this course, the student will be able to:

- evaluate problems using addition, subtraction, multiplication, and division of whole numbers, fractions, and decimals.

- use the order of operations to simplify expressions.

- read, write, and round whole numbers and decimals.

- identify and use factors and prime factorization of whole numbers.

- identify types of fractions.

- simplify fractions.

- demonstrate the relationships between fractions and decimals.

- set up and solve application problems using computational arithmetic.

MATH 32 Pre-Algebra

Units:	3
Hours:	54 hours LEC

Prerequisite:	MATH 24, 25, or 41 with a grade of "C" or better, or placement through the assessment process.

This course briefly reviews the fundamentals of arithmetic, including fractions, decimals, and order of operations. Course content includes signed numbers, ratios, proportions, percent, concepts of variables, area/perimeter/volume of geometric figures, and solving basic linear equations.

Student Learning Outcomes
Upon completion of this course, the student will be able to:

- evaluate numerical expressions that contain integers, fractions, and decimals using the order of operations

- evaluate algebraic expressions for given value(s) of the variable(s)

- simplify variable expressions by using the distributive property and combining similar terms

- solve elementary linear equations

- set up and solve elementary application problems, including problems involving percents, ratios, and proportions

- convert between percents, decimals, and fractions

- convert units of measurement, including U.S. and metric systems

- evaluate numerical square root expressions

- calculate area, perimeter, and volume of geometric figures

MATH 41 Algebra Readiness - Part I

Units:	3
Hours:	54 hours LEC
Prerequisite:	None.
Advisory:	CISC 100, CISC 300, or CISC 305 with a grade of "C" or better, AND ENGRD 116 or ESLR 320 with a grade of "C" or better. Placement through the math assessment process.

This course is the first of two parts covering algebra readiness in a mastery-based learning environment. The fundamentals of arithmetic are introduced, with an emphasis on problem solving and computational skills. Topics include whole numbers, exponents, order of operations, factors, fractions, decimals, proportion, ratios, rates, problem solving, and applications. The course is offered through the Multimedia Math Learning Center (MMLC), using an independent study approach under the direction of an instructor. Computer-based instruction via the Internet is an integral part of the course. Students are required to purchase a workbook that is bundled with the on-line video and math content system. One set of materials can be used for multiple MMLC courses, if completed in consecutive semesters. The content in the course is organized into various modules. Each module must be completed at a mastery level before the student moves on to the next. Students will demonstrate mastery by successfully completing assignments and then earning at least 80% on the module exam that is taken on-line in the MMLC. If necessary students will repeat the exam until mastery is achieved. All modules must be completed before the student takes the final exam, a comprehensive test on paper that is taken once and determines the majority of the course grade. Regular class attendance is required throughout the semester, including the mandatory orientation during the first class meeting. Students may also visit the MMLC during other hours of operation to receive tutoring, complete assignments, and take exams. This course may be completed as quickly as possible but no later than the end of the semester. Students who complete this course during the first half of the semester may sign up immediately for MATH 42. For the most updated information, please visit the MMLC web page on the ARC website. Completion of MATH 41 with a grade of "C" or better meets the prerequisite for MATH 42 and MATH 32.

Student Learning Outcomes
Upon completion of this course, the student will be able to:

- evaluate problems using addition, subtraction, multiplication, and division of whole numbers, fractions, and decimals.

- use the order of operations to simplify expressions.

- read, write, and round whole numbers and decimals.

- identify and use factors and prime factorizations of whole numbers.

- analyze and simplify fractions.

- demonstrate the relationships between fractions, decimals, and percents.

- analyze and estimate problems involving whole numbers, fractions, and decimals.

- set up and solve application problems using computational arithmetic.

MATH 42 Algebra Readiness - Part II

Units:	3
Hours:	54 hours LEC
Prerequisite:	MATH 41 with a grade of "C" or better

This course is the second of two parts covering algebra readiness in a mastery-based learning environment. The fundamentals of pre-algebra are introduced, with an emphasis on problem solving skills. Topics include order of operations, signed numbers, application problems, concepts of variables, exponents, operations on signed fractions, percent problems, solving algebraic equations, the rectangular coordinate system, introduction to graphing linear equations, applications of equations, and area/perimeter of geometric figures. The course is offered through the Multimedia Math Learning Center (MMLC), using an independent study approach under the direction of an instructor. Details about the program can be found in the catalog description for MATH 41. This course may be completed as quickly as possible but no later than the end of the semester. Students who complete this course during the first half of the semester may sign up immediately for MATH 131. For the most updated information, please visit the MMLC web page on the ARC website. Completion of MATH 41 AND MATH 42 with grades of "C" or better meets the prerequisite for MATH 131, MATH 100, MATH 103, MATH 129, and STAT 105.

Student Learning Outcomes
Upon completion of this course, the student will be able to:

- evaluate expressions that contain addition, subtraction, multiplication, and division of real numbers.

- solve numerical and applied percent problems.

- simplify algebraic expressions using order of operations.

- evaluate and simplify exponential and square root expressions.

- solve linear equations, including those with signed numbers, fractions, and/or decimals.

- set up and solve elementary application problems using algebraic techniques.

- compute perimeter and area of geometric figures.

- translate words into symbols and equations.

- perform operations on signed fractions.

- graph linear equations.

MATH 100 Elementary Algebra

Units:	5
Hours:	90 hours LEC

| Prerequisite: | MATH 32, 39, or 42 with a grade of "C" or better, or placement through the assessment process. |

This course covers the fundamental concepts and operations of algebra and incorporates problem-solving skills. Topics include properties of real numbers, linear equations and inequalities, integer exponents, polynomials, and factoring polynomials. Other topics include rational and radical expressions, rational and radical equations, graphing and finding equations of lines, graphing and solving systems of linear equations, and graphing and solving quadratic equations.

Student Learning Outcomes
Upon completion of this course, the student will be able to:

- simplify expressions using the basic operations and properties of real numbers.

- solve one-variable equations and inequalities.

- combine polynomials using the basic operations of polynomials.

- factor polynomials.

- simplify rational expressions.

- solve rational equations.

- solve linear equations.

- graph linear equations.

- find the equation of a line given (a) the slope and a point on the line, and (b) two points on the line.

- solve and graph systems of linear equations.

- simplify expressions containing integer exponents.

- simplify expressions containing second and third degree roots.

- solve quadratic equations.

- graph quadratic equations.

- develop an appropriate equation or system of equations and use the resulting equation(s) to solve application problems.

MATH 110 Elementary Geometry

Units:	5
Hours:	90 hours LEC
Prerequisite:	MATH 100, 104, or 132 with a grade of "C" or better, or placement through the assessment process.

This course covers aspects of elementary geometry. Topics include geometric terms and definitions, properties of parallel lines and parallelograms, congruent and similar triangles, properties of triangles, right triangles, basic trigonometry, properties of circles, geometric constructions, areas, and volumes. The course also emphasizes problem-solving strategies, elementary logic, and writing proofs.

Student Learning Outcomes
Upon completion of this course, the student will be able to:

- compute lengths, areas, and volumes of geometric objects

- apply algebraic skills to geometric problems

- solve mathematical and logical problems which require geometric skills

- prove geometric theorems using direct proof structures

- construct geometric loci using a straightedge and compass

- select the appropriate trigonometric identity to find angles and sides of right triangles

- identify theorems that relate angles, arcs, intercepted arcs in circles and polygons

MATH 120 Intermediate Algebra

Units:	5
Hours:	90 hours LEC
Prerequisite:	MATH 100, 104, or 132 with a grade of "C" or better, or placement through the assessment process.
General Education:	AA/AS Area II(b)

This course extends and reviews the concepts of elementary algebra while incorporating applications and problem-solving skills. Reviewed and extended topics include linear and quadratic equations and their graphs, linear inequalities, systems of linear equations, exponents, factoring polynomials, rational expressions, and radicals. New topics include absolute value equations and inequalities, graphs of absolute value functions, equations of parallel and perpendicular lines, graphs of linear inequalities, graphs of systems of linear inequalities, functions, function notation, domain and range, inverse functions, exponential and logarithmic functions and their graphs, quadratic and polynomial functions and their graphs, an introduction to the complex number system, finding the real and complex solutions for a variety of equations, an introduction to conic sections, and nonlinear systems of equations and their graphs.

Student Learning Outcomes
Upon completion of this course, the student will be able to:

- graph and solve linear inequalities.

- graph systems of linear inequalities.

- solve equations and inequalities containing absolute values.

- solve and graph linear equations and systems of linear equations.

- create linear equations that pass through a given point and are parallel to a given line.

- create linear equations that pass through a given point and are perpendicular to a given line.

- simplify polynomial expressions.

- choose and apply appropriate techniques to factor a variety of polynomials.

- state whether a mathematical relation is a function and find its domain and range.

- construct the inverse of a given function.

- sketch graphs of basic exponential functions.

- utilize the properties of exponents to simplify exponential expressions and to solve exponential equations.

- sketch graphs of basic logarithmic functions.

- utilize the properties of logarithms to simplify logarithmic expressions and to solve logarithmic equations.

- simplify expressions containing radicals, using complex numbers where appropriate.

- solve quadratic equations for real and complex solutions.

- solve equations containing radicals.

- simplify rational expressions and solve rational equations for real and complex solutions.

- sketch graphs of basic conic sections.

- solve and graph systems of non-linear equations.

- develop an appropriate equation or system of equations and use the resulting equation(s) to solve application problems.

MATH 125 Intermediate Algebra with Applications

Units:	4
Hours:	72 hours LEC
Prerequisite:	MATH 100 or 132 with a grade of "C" or better, or placement through the assessment process.
General Education:	AA/AS Area II(b)

This is an intermediate algebra course for non-STEM students. Topics include linear functions, models, systems, and graphs, as well as polynomial, exponential, logarithmic, and quadratic functions. The course emphasizes authentic applications and mathematical models using real-world data. This course does not meet the prerequisite for STEM-track math courses.

Student Learning Outcomes
Upon completion of this course, the student will be able to:

- identify and solve various types of equations and systems of equations.

- factor a variety of polynomials.

- collect like terms in simplifying polynomial, exponential, and logarithmic functions.

- create graphs of lines, parabolas, exponential, and logarithmic functions.

- associate equations and information from tables or charts with their corresponding graphs.

- explain the concept of a mathematical function/relation and use functional notation appropriately to formulate solutions.

- construct and compare inverse functions with their original functions.

- explain what a logarithm is and solve logarithmic equations and applications.

MATH 129 Elementary and Intermediate Algebra

Units:	9
Hours:	162 hours LEC
Prerequisite:	MATH 32 or 42 with a grade of "C" or better, or placement through the assessment process.
General Education:	AA/AS Area II(b)

This course covers the concepts of elementary and intermediate algebra with an emphasis on problem solving. Topics include linear and quadratic equations, inequalities, factoring polynomials, rational expressions, exponents, radicals, graphing, and system of equations. Additional topics include graphs and their translations and reflections, functions, exponential and logarithmic functions, graphs of quadratic and polynomial functions, nonlinear systems of equations, polynomial and rational inequalities, and an introduction to conic sections.

Student Learning Outcomes
Upon completion of this course, the student will be able to:

- recognize and solve various types of equations, inequalities, and systems of equations, and related applications.

- factor a variety of polynomials.

- collect like terms in simplifying polynomial, rational, exponential, and logarithmic expressions.

- sketch graphs of lines and conics and functions.

- associate equations and information from tables or charts with their corresponding graphs.

- recognize and explain the concept of a mathematical function/relation and use functional notation appropriately to formulate solutions.

- compare and contrast the properties of a mathematical function and its inverse function.

- analyze and solve applications related to linear, rational, and radical equations.

- define what a logarithm is and solve logarithmic equations and applications.

- define what an exponential function is and solve exponential equations and applications.

MATH 131 Combined Algebra - Part I

Units:	3
Hours:	54 hours LEC
Prerequisite:	MATH 32, 39, or 42 with a grade of "C" or better, or placement through the assessment process.
Advisory:	CISC 100, CISC 300, or CISC 305 with a grade of "C" or better, AND ENGRD 116 or ESLR 320 with a grade of "C" or better.

This course is the first of three parts covering combined algebra in a mastery-based learning environment. Problem-solving skills are emphasized throughout the course. Topics include linear equations and inequalities, integer exponents, polynomials, systems of linear equations, the rectangular coordinate system, graphs and equations of lines, and related applications. The course is offered through the Multimedia Math Learning Center (MMLC), using an independent study approach under the direction of an instructor. Computer-based instruction via the Internet is an integral part of the course. Students are required to purchase a workbook that is bundled with the on-line video and math content system. One set of materials can be used for multiple MMLC courses, if completed in consecutive semesters. The content in the course is organized into various modules. Each module must be completed at a mastery level before the student moves on to the next. Students will demonstrate mastery by successfully completing assignments and then earning at least 80% on the module exam that is taken on-line in the MMLC. If necessary students will repeat the exam until mastery is achieved. All modules must be completed before the student takes the final exam, a comprehensive test on paper that is taken once and determines the majority of the course grade. Regular class attendance is required throughout the semester, including the mandatory orientation during the first class meeting. Students may also visit the MMLC during other hours of operation to receive tutoring, complete assignments, and take exams. This course may be completed as quickly as possible but no later than the end of the semester. Students who complete this course during the first half of the semester may sign up immediately for MATH 132. For the most updated information, please visit the MMLC web page on the ARC website. Completion of MATH 131 AND MATH 132 with grades of "C" or better meets the prerequisite for MATH 133, MATH 110, MATH 120, and MATH 125.

Student Learning Outcomes
Upon completion of this course, the student will be able to:

- solve linear equations and inequalities.

- graph linear equations and inequalities.

- apply appropriate solving techniques to solve systems of linear equations.

- demonstrate addition, subtraction, and multiplication of polynomials.

- apply properties of exponents.

- set up and solve application problems using appropriate algebraic methods.

MATH 132 Combined Algebra - Part II

Units:	3
Hours:	54 hours LEC
Prerequisite:	MATH 131 with a grade of "C" or better

This course is the second of three parts covering combined algebra in a mastery-based learning environment. Problem-solving skills are emphasized throughout the course. Topics include polynomial factorization, rational expressions and equations, radical expressions and equations, rational exponents, and related applications. The course is offered through the Multimedia Math Learning Center (MMLC), using an independent study approach under the direction of an instructor. Details about the program can be found in the catalog description for MATH 131. This course may be completed as quickly as possible but no later than the end of the semester. Students who complete this course during the first half of the semester may sign up immediately for MATH 133. For the most updated information, please visit the MMLC web page on the ARC website. Completion of MATH 131 AND MATH 132 with grades of "C" or better meets the prerequisite for MATH 133, MATH 110, MATH 120, and MATH 125.

Student Learning Outcomes
Upon completion of this course, the student will be able to:

- apply appropriate factoring techniques to polynomials.

- demonstrate factoring and algebraic techniques to solve quadratic equations.

- simplify rational expressions and solve equations with rational expressions.

- identify and solve variation applications.

- use roots, radicals, and exponents in simplifying expressions.

- solve equations with radical expressions.

- set up and solve application problems using appropriate algebraic methods.

MATH 133 Combined Algebra - Part III

Units:	3
Hours:	54 hours LEC
Prerequisite:	MATH 132 with a grade of "C" or better
General Education:	AA/AS Area II(b)

This course is the third of three parts covering combined algebra in a mastery-based learning environment. Problem-solving skills are emphasized throughout the course. Topics include function evaluation and notation, inverse functions, solving quadratic equations, complex numbers, graphs of quadratic functions, exponential and logarithmic functions, properties of logarithms, conic sections, and related applications. The course is offered through the Multimedia Math Learning Center (MMLC), using an independent study approach under the direction of an instructor. Details about the program can be found in the catalog description for MATH 131. This course may be completed as quickly as possible but no later than the end of the semester. For the most updated information, please visit the MMLC web page on the ARC website. Completion of MATH 131, MATH 132, AND MATH 133 with grades of "C" or better is equivalent to the completion of MATH 120 or MATH 125 or MATH 129.

Student Learning Outcomes
Upon completion of this course, the student will be able to:

- differentiate between a mathematical function and relation.

- evaluate functions using function notation.

- solve quadratic equations using a variety of algebraic methods.

- analyze and graph quadratic functions.

- analyze and graph exponential and logarithmic functions.

- solve exponential and logarithmic equations using algebraic properties.

- classify and construct graphs of conic sections.

- set up and solve application problems using appropriate algebraic methods.

MATH 145 Mathematics for the Trades

Units:	1.5
Hours:	23 hours LEC; 12 hours LAB
Prerequisite:	None.

This course introduces mathematics applicable to technical programs of study. Topics include the use of mathematical operators on whole numbers, fractions, and decimals. Additional content includes fundamentals of algebra, basic geometry, and triangle trigonometry. This course is intended for those in Pre-Apprenticeship programs or other technical educational programs. Completion of this course does not fulfill any prerequisites for any course, including MATH courses, at American River College.

Student Learning Outcomes
Upon completion of this course, the student will be able to:

- solve application problems which require basic algebraic skills.

- evaluate problems using addition, subtraction, multiplication, and division of whole numbers.

- evaluate problems using addition, subtraction, multiplication, and division of fractions.

- evaluate problems using addition, subtraction, multiplication, and division of decimals.

- apply basic geometric formulas and properties to solve problems.

- apply and use trigonometric ratios of right triangles to solve application problems.

- apply dimensional analysis in performing technical calculations.

- use units and dimensions in measurement problems involving customary units and metric terms.

- demonstrate problem-solving techniques of applications using ratio and proportions.

MATH 294 Topics in Mathematics

Units:	0.5 - 4
Hours:	9 - 72 hours LEC
Prerequisite:	None.

This course is designed to give students an opportunity to study topics in mathematics not included in current course offerings. Individualized topics are developed to foster, complement and build upon arithmetic, geometric and algebraic skills with an emphasis on critical thinking.

Student Learning Outcomes
Upon completion of this course, the student will be able to:

- define the vocabulary of a given mathematical topic.

- translate open-ended problems into the given mathematical topic.

- apply techniques (processes or algorithms) to manipulate, illustrate or compute the mathematical objects of the given mathematical topic.

- generalize the techniques (processes or algorithms) of the given mathematical topic to other settings.

MATH 295 Independent Studies in Mathematics

Units:	1 - 3
Hours:	54 - 162 hours LAB
Prerequisite:	None.

Independent Study is an opportunity for the student to extend classroom experience in this subject, while working independently of a formal classroom situation. Independent study is an extension of work offered in a specific class in the college catalog. To be eligible for independent study, students must have completed the basic regular catalog course at American River College. They must also discuss the study with a professor in this subject and secure approval. Only one independent study for each catalog course will be allowed.

MATH 300 Introduction to Mathematical Ideas

Units:	3
Hours:	54 hours LEC
Prerequisite:	MATH 120, 124, 125, 129, or 133 with a grade of "C" or better, or placement through the assessment process.
Transferable:	CSU; UC
General Education:	AA/AS Area II(b); CSU Area B4; IGETC Area 2

This course makes fundamental concepts and processes more meaningful for non-mathematics majors through a study of several mathematical topics, including the history of mathematics, numeration systems, logic, geometry, algebraic modeling, combinatorics, probability, statistics, sets, matrices, consumer mathematics, equations and inequalities, functions and graphs, problem solving, graph theory, voting and apportionment, and number theory. This course is not recommended for students entering elementary school teaching or business administration majors.

Student Learning Outcomes
Upon completion of this course, the student will be able to:

- discuss several branches of mathematics, including their history and uses beyond mathematics.

- identify appropriate procedures and solve exercises from selected mathematical topics.

- apply critical thinking skills to solve exercises in new settings.

- explain the process and results of several mathematical procedures.

MATH 310 Mathematical Discovery

Units:	3
Hours:	54 hours LEC

Prerequisite:	MATH 110 with a grade of "C" or better or successful completion of high school geometry, AND MATH 120, 125, 129, or 133 with a "C" or better, or placement through the assessment process. Geometry is the only high school course that can be used to meet the prerequisite.
Transferable:	CSU; UC
General Education:	AA/AS Area II(b); CSU Area B4

This course explores mathematical patterns and relations as well as the formulation and proof of conjectures. Topics from number theory, probability and statistics, and geometry are investigated. This course is recommended for students interested in a degree in education.

Student Learning Outcomes
Upon completion of this course, the student will be able to:

- explore and discover mathematical patterns and relations for a variety of problems from number theory, statistics, and geometry.

- formulate conjectures based on exploration in a variety of problems from number theory, geometry, and statistics.

- prove or find a counterexample for proposed conjectures.

- analyze statistical data.

- calculate probabilities by applying appropriate statistical concepts.

MATH 311 Mathematical Concepts for Elementary School Teachers - Number Systems

Units:	3
Hours:	54 hours LEC
Prerequisite:	MATH 120, 125, 129, or 133 with a grade of "C" or better, or placement through the assessment process.
Transferable:	CSU; UC
General Education:	AA/AS Area II(b); CSU Area B4
C-ID:	C-ID MATH 120

This course focuses on the development of quantitative reasoning skills through in-depth, integrated explorations of topics in mathematics, including history of real number systems and subsystems, basic number theory, sets and relations, logic, mathematical induction, and current national and state curriculum standards for mathematics. It emphasizes comprehension and critical analysis of mathematical concepts and applications of logical reasoning.

Student Learning Outcomes
Upon completion of this course, the student will be able to:

- summarize the historical development of numeration systems, including an examination of the base ten numeration system and an analysis of place value systems in general using exponent and place value notation

- perform calculations with place value systems

- evaluate the equivalence of numeric algorithms and explain the advantages and disadvantages of equivalent algorithms in different circumstances

- apply algorithms from number theory to determine divisibility in a variety of settings

- analyze least common multiples and greatest common divisors and their role in standard algorithms

- explain the concept of rational numbers, using both ratio and decimal representations; analyze the arithmetic algorithms for these two representations; and justify their equivalence

- analyze the structure and properties of whole, rational, and real number systems; define the concept of rational and irrational numbers, including their decimal representation; and illustrate the use of a number line representation

- develop and reinforce conceptual understanding of mathematical topics through the use of patterns, problem solving, communication, connections,

modeling, reasoning, and representation

- apply basic tools such as sets, functions, and logic together with deductive or inductive reasoning to solve problems from an elementary to advanced level of math

- develop activities implementing curriculum standards

MATH 320 Symbolic Logic

Same As:	PHIL 324
Units:	3
Hours:	54 hours LEC
Prerequisite:	MATH 120, 125, 129, or 133 with a grade of "C" or better, or placement through the assessment process.
Transferable:	CSU; UC
General Education:	AA/AS Area II(b)
C-ID:	C-ID PHIL 210

This course is an introduction to symbolic logic. It includes a study of the logic of sentences (propositional logic) and the logic of classes and relations (predicate logic), together with an introduction to the nature of deductive systems. This course is not open to students who have completed PHIL 324.

Student Learning Outcomes
Upon completion of this course, the student will be able to:

- represent statements of English in well-formed sentences of predicate logic.

- prove the validity of statements and arguments in predicate logic using formal proof techniques.

- apply truth table or truth tree methods to determine semantic properties such as invalidity and consistency.

- construct interpretations that satisfy statements and sets of statements.

- distinguish classical first order logical systems from other logical systems.

MATH 325 Problem-Solving

Units:	3
Hours:	54 hours LEC
Prerequisite:	MATH 120, 125, 129, or 133 with a grade of "C" or better, or placement through the assessment process.
Transferable:	CSU
General Education:	AA/AS Area II(b); CSU Area B4

This course focuses on the development of specific strategies and skills necessary to solve real-world and advanced mathematics problems. It emphasizes the development of logical, organizational, and divergent thinking, as well as written and oral communication skills, individual and group work, and clear presentation of mathematical work. Topics include drawing a diagram, eliminating possibilities, making a systematic list, looking for a pattern, guessing and checking, solving an easier related problem, working backwards, using algebraic representation, and applying the method of finite differences.

Student Learning Outcomes
Upon completion of this course, the student will be able to:

- identify a collection of problem-solving strategies that would apply to a given mathematical situation, problem, or puzzle.

- generate suitable plans for solving a variety of mathematical problems.

- recognize similarities and differences in problems across various mathematical contexts.

- evaluate the appropriateness of a particular problem-solving strategy for a given mathematical problem.

- organize and present solutions to mathematics problems in a clear, coherent fashion in both written and oral forms.

- apply topics from mathematics, including functions, sequences, finite differences, counting methods, and factoring.

MATH 336 College Algebra

Units:	5
Hours:	90 hours LEC
Prerequisite:	MATH 120, 124, 129, or 133 with a grade of "C" or better, or placement through the assessment process.
Transferable:	CSU; UC
General Education:	AA/AS Area II(b); CSU Area B4; IGETC Area 2
C-ID:	C-ID MATH 150

This course reviews and covers topics beyond those studied in intermediate algebra, including functions, matrices, The Rational Root Theorem, partial fractions, sequences and series, mathematical induction, and The Binomial Theorem. It focuses on applications and graphing of polynomial, logarithmic, and exponential functions, as well as solving systems of linear and non-linear equations and inequalities. It also covers analytic geometry, including straight lines, conic sections, and curve sketching.

Student Learning Outcomes
Upon completion of this course, the student will be able to:

- apply the basic concepts of the complex and real number systems to solve equations and inequalities

- analyze various functions, including their properties, operations, difference quotients, and graphs

- solve equations involving various functions, including linear, polynomial, absolute value, rational, exponential, logarithmic, and radical

- apply the Remainder, Factor, Rational Root, and Binomial Theorems; Descartes' Rule of Signs; and the Fundamental Theorem of Algebra

- analyze the geometry of lines and conic sections

- solve word problems using methods from algebra and analytic geometry

- solve systems of linear and nonlinear equations and inequalities, including applications of matrices, determinants, and Cramer's Rule

- find the sum of a geometric series

- use arithmetic and geometric sequences to solve application problems

- use mathematical induction as a proof technique

- apply partial fraction decomposition techniques to rewite a rational expression as a sum or difference of partial fractions

MATH 340 Calculus for Business and Economics

Units:	3
Hours:	54 hours LEC
Prerequisite:	MATH 120, 129, or 133 with a grade of "C" or better, or placement through the assessment process.
Transferable:	CSU; UC (UC credit limitation: MATH 340, 350 & 400 combined: maximum credit, one course)

This course introduces how differential calculus and integral calculus are used in the fields of business, economics, social science, and biological science. Topics include finding limits, applying various rules to find derivatives of polynomial, rational, exponential, and logarithmic functions, as well as using derivatives to analyze marginal cost, revenue, and profit. It is not recommended for mathematics and physical science majors.

Student Learning Outcomes
Upon completion of this course, the student will be able to:

- evaluate and explore functions that represent quantities important in business, including profit, average cost, supply, and demand

- compute limits graphically, numerically, and analytically

- find derivatives of various functions, including polynomial, rational, exponential, and logarithmic functions using the Power, Product, Quotient, and Chain Rules

- find the equation of the tangent line to a polynomial, rational, exponential, or logarithmic function, using derivatives

- sketch the graph of functions using horizontal and vertical asymptotes, intercepts, first and second derivatives to determine intervals of increase and decrease, maximum and minimum values, intervals of concavity, and points of inflection.

- recognize and solve business applications that call for derivatives of single or multivariable functions including implicit differentiation, related rates, and optimization problems

- find antiderivatives of various functions using substitution, integration by parts, and other methods

- evaluate definite integrals using the Fundamental Theorem of Calculus

- recognize and solve business applications that call for antiderivatives of single variable or multivariable functions

MATH 342 Modern Business Mathematics

Units:	3
Hours:	54 hours LEC
Prerequisite:	MATH 120, 124, 129, or 133 with a grade of "C" or better, or placement through the assessment process.
Transferable:	CSU; UC
General Education:	AA/AS Area II(b); CSU Area B4; IGETC Area 2

This course is designed around applications of mathematics in economic and business contexts. Specific topics include functions and related business formulas, tables and graphs, finance (interest and exponential models in economics), rates of change, including applications and optimization, and linear programming.

Student Learning Outcomes
Upon completion of this course, the student will be able to:

- analyze formulas, tables, graphs, and data sets in order to form conclusions or make predictions.

- identify and graph linear, quadratic, rational, polynomial, exponential, and logarithmic functions.

- formulate and apply exponential growth or decay functions pertaining to business applications.

- calculate both present and future values involving simple interest, compound interest, and annuities.

- analyze applications of annuities involving loan amortization and sinking funds, applying necessary formulas.

- evaluate rates of change for a variety of elementary functions and apply them to marginal analysis.

- find and interpret optimum values related to business applications.

- solve linear programming problems by the graphical approach.

MATH 355 Calculus for Biology and Medicine I

Units:	4
Hours:	72 hours LEC
Prerequisite:	MATH 330 or 373 with a grade of "C" or better, or placement through the assessment process.
Advisory:	MATH 370
Transferable:	CSU; UC
General Education:	AA/AS Area II(b); CSU Area B4; IGETC Area 2

This course is an introduction to differential calculus and elementary differential equations via applications in biology and medicine. It covers limits, derivatives of polynomials, trigonometric and exponential functions, graphing, and applications of the derivative to biology and medicine. Topics include the Fundamental Theorem of Calculus and techniques of integration, including integral tables and numerical methods.

Student Learning Outcomes
Upon completion of this course, the student will be able to:

- differentiate polynomial, radical, trigonometric, logarithmic, and exponential functions.

- graph and analyze the curves of elementary functions.

- calculate maxima and minima of elementary functions.

- apply derivatives to applications in biology and medicine.

- integrate basic elementary functions.

- apply the Fundamental Theorem of Calculus to the evaluation of definite integrals.

MATH 356 Calculus for Biology and Medicine II

Units:	4
Hours:	72 hours LEC
Prerequisite:	MATH 355 with a grade of "C" or better
Transferable:	CSU; UC
General Education:	AA/AS Area II(b); CSU Area B4; IGETC Area 2

This course covers matrix algebra with eigenvalues and eigenvectors, systems of linear equations, functions of several variables, partial derivatives, systems of differential equations, and applications to biology and medicine. This course is a superset of MATH 351, treating additional topics and covering them in more depth.

Student Learning Outcomes
Upon completion of this course, the student will be able to:

- solve systems of linear equations with matrix techniques.

- compute eigenvalues and eigenvectors for square matrices.

- solve systems of linear differential equations.

- apply systems of linear differential equations to problems in biology and medicine.

- compute partial derivatives of functions of several variables.

- compute double integrals.

- identify absolute and local extrema of functions of two variables.

- calculate equations of tangent planes to graphs of functions of two variables.

MATH 370 Pre-Calculus Mathematics

Units:	5
Hours:	90 hours LEC
Prerequisite:	MATH 330 or 373 with a grade of "C" or better, or placement through the assessment process.
Transferable:	CSU; UC
General Education:	AA/AS Area II(b); CSU Area B4; IGETC Area 2
C-ID:	C-ID MATH 155

This course provides foundational mathematics and problems that require critical thinking in preparation for the calculus sequence for science, technology, engineering, and mathematics (STEM) majors. Topics include rigorous treatment of polynomial, rational, logarithmic, exponential, and trigonometric functions, including graphing and applications, as well as systems of linear and non-linear equations and inequalities. This course also covers analytic geometry, conic sections, vectors, parametric equations, and polar equations.

Student Learning Outcomes
Upon completion of this course, the student will be able to:

- apply the basic concepts of the complex and real number systems to solve equations and inequalities

- perform operations of arithmetic and composition on various functions

- use analytic methods to determine roots, domain, and range, both with and without a graphing utility

- solve and apply equations involving linear, polynomial, rational, radical, exponential, logarithmic, trigonometric, and absolute value functions

- solve linear, nonlinear, and absolute value inequalities

- solve linear and nonlinear systems of equations and inequalities

- state and apply the Remainder Theorem, Factor Theorem, Rational Root Theorem, and the Fundamental Theorem of Algebra

- use analytic methods, including transformations, to graph polynomial, rational, exponential, logarithmic, and trigonometric functions, as well as relations without the aid of a graphing utility

- graph functions and relations in rectangular and polar coordinates

- recognize the relationship between functions and their inverses graphically and algebraically

- identify special triangles and their related angle and side measures

- evaluate the trigonometric function of an angle given in degree and radian measure

- graph the basic trigonometric functions and apply changes in period, phase, and amplitude to generate new graphs

- prove trigonometric identities

- state and appropriately apply the Law of Sines and the Law of Cosines to solve triangles in various applications

- analyze the geometry of lines and conic sections

- solve word problems using methods from algebra, analytical geometry, and trigonometry

MATH 372 College Algebra for Calculus

Units:	4
Hours:	72 hours LEC
Prerequisite:	MATH 120, 129, or 133 with a grade of "C" or better, or placement through the assessment process.
Transferable:	CSU; UC
General Education:	AA/AS Area II(b); CSU Area B4; IGETC Area 2

This course provides a rigorous treatment of college-level algebra and its applications, with a particular focus on preparing students for the calculus sequence for Science, Technology, Engineering, and Mathematics (STEM) majors. Topics include polynomial, rational, radical, exponential, absolute value, and logarithmic functions, graphs, and equations; systems of equations; the theory of polynomial equations; analytic geometry including conics; and an introduction to sequences and series. Emphasis is given to analytical reasoning and problem-solving.

This course may be taken concurrently with MATH 373, Trigonometry for Calculus. Completion of both MATH 372 AND MATH 373 with grades of "C" or better meets the prerequisite for MATH 400, Calculus I.

Student Learning Outcomes
Upon completion of this course, the student will be able to:

- analyze and investigate properties of functions

- synthesize connections between equations of functions and their graphs

- apply transformations to the graphs of functions

- recognize the relationship between a function and its inverse both graphically and algebraically

- solve equations and applications involving rational, linear, polynomial, radical, absolute value, exponential, and logarithmic equations

- solve systems of equations and inequalities

- apply techniques for determining zeros of polynomials and roots of equations

- apply functions and other algebraic techniques to model real world STEM applications

- analyze conics algebraically and graphically

- use formulas to find the sum of both finite and infinite series

MATH 373 Trigonometry for Calculus

Units:	4
Hours:	72 hours LEC
Prerequisite:	MATH 120, 129, or 133 with a grade of "C" or better, or placement through the assessment process.
Advisory:	MATH 110; or completion of high school geometry
Transferable:	CSU
General Education:	AA/AS Area II(b); CSU Area B4

This course provides a rigorous treatment of trigonometry and its applications, with a particular focus on preparing students for the calculus sequence for science, technology, engineering, and mathematics (STEM) majors. Emphasis is given to the study of trigonometric functions from numerical, graphical, and

algebraic descriptions. Topics include functions and their graphs, transformations of functions, geometric properties of circles and triangles, degree and radian measurements of angles, right triangle trigonometry, reference angle trigonometry, unit circle trigonometry, graphs and transformations of trigonometric functions, verifying and applying trigonometric identities, inverse trigonometric functions, solving trigonometric equations, solving triangles using the Law of Sines and the Law of Cosines, vectors, the polar coordinate system, and roots and powers of complex numbers including De Moivre's Theorem. This course may be taken concurrently with MATH 372, College Algebra for Calculus. Completion of both MATH 372 AND MATH 373 with grades of "C" or better meets the prerequisite for MATH 400, Calculus I.

Student Learning Outcomes
Upon completion of this course, the student will be able to:

- convert between degree measure and radian measure of angles

- graph angles in the coordinate plane and identify the reference angle

- define the six trigonometric functions in terms of right triangles, the rectangular coordinate system, and the unit circle

- apply the right triangle definitions of the six trigonometric functions to solve right triangles

- evaluate trigonometric functions of angles in both degrees and radians

- evaluate trigonometric functions of special angles in both degrees and radians without a calculator

- recognize and create the graphs of the basic trigonometric functions

- graph transformations of the basic trigonometric functions by thinking about amplitude, period, phase shift, and vertical shift

- simplify expressions using trigonometric identities

- find function values by making use of identities

- prove a variety of identities

- evaluate and graph inverse trigonometric functions

- evaluate compositions of trigonometric and inverse trigonometric functions

- solve a variety of trigonometric equations

- use the Laws of Sines and Cosines to solve oblique triangles

- solve application problems that involve right and oblique triangles

- represent a vector both graphically and in ai+bj form

- perform basic vector operations: addition, subtraction, and scalar multiplication, as well as represent these operations graphically and algebraically

- calculate powers and roots of complex numbers using De Moivre's Theorem

- convert between polar and rectangular coordinates and equations

- graph polar equations

MATH 400 Calculus I

Units:	5
Hours:	90 hours LEC
Prerequisite:	MATH 370 (Pre-Calculus Mathematics), OR MATH 372 (College Algebra for Calculus) AND MATH 373 (Trigonometry for Calculus) with grades of "C" or better, or placement through the assessment process.

Transferable:	CSU; UC (UC credit limitation:MATH 340, 350 & 400 combined: maximum credit, one course)
General Education:	AA/AS Area II(b); CSU Area B4; IGETC Area 2
C-ID:	C-ID MATH 210; Part of C-ID MATH 900S

This course is an introduction to differential and integral calculus. It covers limits, continuity, differentiation and integration of algebraic, trigonometric, logarithmic, exponential, and other transcendental functions. Some applications are also covered.

Student Learning Outcomes
Upon completion of this course, the student will be able to:

- evaluate limits graphically, analytically, and by using L'Hopital's Rule.

- compute derivatives using the definition of derivative.

- apply differentiation rules to various types of functions.

- recognize and solve application problems that require use of derivatives.

- apply antidifferentiation rules to various types of functions.

- compute definite integrals using the Fundamental Theorem of Calculus.

- recognize and solve application problems that require use of antiderivatives.

MATH 401 Calculus II

Units:	5
Hours:	90 hours LEC
Prerequisite:	MATH 400 with a grade of "C" or better
Transferable:	CSU; UC (UC credit limitation: MATH 351 & 401 combined: maximum credit, one course)
General Education:	CSU Area B4; IGETC Area 2
C-ID:	C-ID MATH 220; Part of C-ID MATH 900S

This course is a continuation of MATH 400. It builds on the methods of integration learned in MATH 400, and also covers improper integrals, sequences, infinite series, power series, polar coordinates, and parametric and polar equations. Many calculus applications are also included.

Student Learning Outcomes
Upon completion of this course, the student will be able to:

- identify and use properties of logarithmic, exponential, and inverse trigonometric functions to evaluate integrals.

- evaluate integrals using the techniques of integration by parts, trig substitution, partial fractions, and rationalizing substitutions.

- recognize and evaluate limits in indeterminate forms and improper integrals.

- determine the convergence or divergence of sequences and series, find power series representations for certain transcendental functions, and apply appropriate Calculus techniques to evaluate derivatives and integrals of power series.

- rewrite, analyze and graph equations in three forms: rectangular, parametric, and polar; using appropriate calculus techniques.

- use various integration techniques to solve applications, including area, volume, and arc length.

- solve separable differential equations to determine growth and decay functions.

MATH 402 Calculus III

Units:	5
Hours:	90 hours LEC
Prerequisite:	MATH 401 with a grade of "C" or better
Transferable:	CSU; UC
General Education:	CSU Area B4; IGETC Area 2
C-ID:	C-ID MATH 230

This course is a continuation of MATH 401. It extends the concepts of limits, derivatives, and integrals to vector-valued functions and multivariate functions. The topics include multivariate functions, partial derivatives, extrema of multivariate functions, iterated integrals, development of vector calculus, line integrals, three-dimensional analytic geometry, and Green's, Gauss' (Divergence), and Stokes' Theorems. Many applications of calculus are also covered.

Student Learning Outcomes
Upon completion of this course, the student will be able to:

- analyze and graph two- and three-dimensional functions, vectors, vector-valued functions, and geometric surfaces and solids in order to solve for various geometric quantities and to represent motion in space.

- perform vector operations: addition, subtraction, scalar multiplication, dot products, and cross products.

- determine the equations of lines and planes in space, including tangent planes to a surface.

- find the limit of a multivariate function at a point and determine the differentiability of a multivariate function.

- evaluate partial derivatives and apply them to find local extrema and test for saddle points of multivariate functions.

- apply Lagrange multipliers to solve optimization problems with constraints.

- compute the arc length of a curve.

- set up and evaluate iterated integrals in rectangular, cylindrical, and spherical coordinates to calculate the area, volume, mass, and center of mass for a surface or solid.

- find the gradient of a scalar field and the divergence and curl of a vector field.

- set up and evaluate line and surface integrals using Green's, Gauss', and Stokes' Theorems and use results to solve application problems involving vector fields.

MATH 410 Introduction to Linear Algebra

Units:	3
Hours:	54 hours LEC
Prerequisite:	MATH 401 with a grade of "C" or better
Advisory:	MATH 402
Transferable:	CSU; UC
General Education:	CSU Area B4; IGETC Area 2
C-ID:	C-ID MATH 250; Part of C-ID MATH 910S

This course provides an introduction to linear algebra including matrices, determinants, vector spaces, inner product spaces, linear transformations, and eigenvectors. It is intended for majors in mathematics, engineering, economics, science, and related fields. This course emphasizes cogent reasoning, mathematical proof, and problem solving.

Student Learning Outcomes
Upon completion of this course, the student will be able to:

- solve systems of linear equations by reducing an augmented matrix to row-echelon or reduced row-echelon form.

- determine whether a linear system is consistent or inconsistent; for consistent systems, characterize solutions as unique or infinitely many and write parametric solutions for systems with infinitely many solutions.

- evaluate matrix expressions using properties of matrix algebra.

- compute the transpose, determinant, adjoint, and inverse of matrices if defined for a given matrix.

- determine if a subset of a vector space is a vector space, and if so, prove that the subset is a subspace.

- determine if a given set of vectors is linearly independent, and if so, prove that this determination is correct.

- determine if a given set of vectors is a basis for a vector space, and if so, prove that this determination is correct and find the basis and dimension of spaces such as those associated with matrices and linear transformations or the intersection of two subspaces.

- calculate inner products, use properties of inner products to determine angle and orthogonality, and use an orthonormal basis to to find the projection of a vector on a space.

- determine if a function that maps two vectors from a vector space to a scalar is an inner product on that vector space.

- construct orthogonal and orthonormal bases using the Gram-Schmidt Process for a given basis.

- construct the orthogonal diagonalization of a symmetric matrix.

- determine the matrix for a linear transformation on Euclidean 2-space or 3-space, and for a given linear transformation, determine kernel, range, rank, nullity, and whether the linear transformation is an isomorphism.

- compute the characteristic polynomial, eigenvalues, eigenvectors, and eigenspaces for both matrices and linear transformations.

- use eigenvalues and eigenvectors in applications and diagonalization.

- prove basic results in linear algebra using accepted proof-writing techniques including linear independence of vectors, properties of subspaces, linearity, injectivity, surjectivity, properties of eigenvectors, and proper Definition of eigenvalues.

MATH 420 Differential Equations

Units:	4
Hours:	72 hours LEC
Prerequisite:	MATH 401 with a grade of "C" or better
Advisory:	MATH 402
Transferable:	CSU; UC
General Education:	CSU Area B4; IGETC Area 2
C-ID:	C-ID MATH 240; Part of C-ID MATH 910S

This course is a study of ordinary differential equations, including linear equations, systems of equations, equations with variable coefficients, existence and uniqueness of solutions, series solutions, singular points, transform methods, boundary value problems, and applications.

Student Learning Outcomes
Upon completion of this course, the student will be able to:

- formulate and analyze mathematical models using ordinary differential equations.

- categorize a given differential equation by type, order, and linearity.

- determine existence and uniqueness of solutions of an initial value problem for the first-order ordinary differential equation.

- solve elementary first-order and second-order ordinary differential equations (linear and nonlinear) using analytical methods.

- solve ordinary differential equations using power series.

- solve higher order ordinary differential equations with constant coefficients using analytical techniques.

- solve systems of linear ordinary differential equations with constant coefficients using analytical methods.

- assess situations in which a differential equation can be solved more efficiently with the Laplace Transform or the Inverse Laplace Transform and apply the transform to the equation when appropriate.

MATH 480 Honors Seminar in Mathematics

Units:	1
Hours:	18 hours LEC
Prerequisite:	MATH 370 with a grade of "C" or better
Transferable:	CSU; UC

Honors Seminar in Mathematics is a one-unit intensive course. The course is taught in a seminar format where work is done independently in pursuit of solutions to challenging problems in mathematics in consultation with the instructor. Seminar participants will explore strategies and techniques for solving problems and present their solutions to the class.

Student Learning Outcomes
Upon completion of this course, the student will be able to:

- perform critical analysis and exploration when confronted with a nonstandard challenging mathematics problem by constructing models and developing cogent strategies to find a solution.

- demonstrate mastery and understanding of various mathematical topics from pre-calculus.

- present work in a seminar to a critical audience.

- explore and attack mathematics problems with depth and significance.

MATH 495 Independent Studies in Mathematics

Units:	1 - 3
Hours:	54 - 162 hours LAB
Prerequisite:	None.
Transferable:	CSU

Independent Study is an opportunity for the student to extend classroom experience in this subject, while working independently of a formal classroom situation. Independent study is an extension of work offered in a specific class in the college catalog. To be eligible for independent study, students must have completed the basic regular catalog course at American River College. They must also discuss the study with a professor in this subject and secure approval. Only one independent study for each catalog course will be allowed.

Mathematics Support (MATHS)

MATHS 45 Support for Business Mathematics

Units:	2
Hours:	36 hours LEC
Prerequisite:	None.
Corequisite:	MATH 340 or 342

This course provides intensive instruction and practice in the core mathematical skills, competencies, and concepts necessary for success in Calculus for Business and Economics (MATH 340) and Modern Business Mathematics (MATH 342). Students taking this course must be concurrently enrolled in the corresponding section of MATH 340 or MATH 342. The content of this course is designed to provide arithmetic and algebraic support to students as they learn related concepts in their corequisite course. Topics and homework assignments are often connected to students' assignments in the corequisite course. This course is graded Pass/No Pass.

Student Learning Outcomes
Upon completion of this course, the student will be able to:

- apply learning strategies to achieve success in Calculus for Business and Economics or Modern Business Mathematics.

- use real numbers to perform arithmetic operations in the evaluation of algebraic functions.

- simplify expressions and solve equations involving polynomial, rational, radical, exponential, and logarithmic functions.

- analyze the structure of multivariable equations utilizing graphs, tables, and algebraic methods.

- utilize algebraic techniques and problem solving strategies to solve application problems.

MATHS 72 Support for College Algebra for Calculus

Units:	2
Hours:	36 hours LEC
Prerequisite:	None.
Corequisite:	MATH 372

This course provides intensive instruction and practice in the core mathematical skills, competencies, and concepts necessary for success in MATH 372 (College Algebra for Calculus). Students taking this course must be concurrently enrolled in the corresponding section of MATH 372. The content of this course is designed to provide arithmetic and algebraic support to students as they learn related concepts in their corequisite course. Topics and homework assignments are often connected to assignments in the corequisite course. This course is graded Pass/No Pass.

Student Learning Outcomes
Upon completion of this course, the student will be able to:

- use mathematics support skills to solve equations and inequalities and manipulate expressions.

- use mathematics support skills to solve systems of equations and inequalities.

- use mathematics support skills to demonstrate a deep understanding of functions and their properties.

- apply learning strategies to achieve success in College Algebra for Calculus.

MATHS 73 Support Course for Trigonometry for Calculus

Units:	2
Hours:	36 hours LEC
Prerequisite:	None.

Corequisite:	MATH 373

This course provides intensive instruction and practice in the core mathematical skills, competencies, and concepts necessary for success in Trigonometry for Calculus (MATH 373). Students taking this course must be concurrently enrolled in the corresponding section MATH 373. The course content is designed to provide arithmetic, algebra, geometry and learning skills support to students as they learn related concepts in their corequisite course. Topics and homework assignments are often connected to students' assignments in the corequisite course. This course is graded Pass/No Pass.

Student Learning Outcomes
Upon completion of this course, the student will be able to:

- recall the methods from arithmetic necessary to be successful in Trigonometry for Calculus

- review the methods from algebra necessary to be successful in Trigonometry for Calculus

- demonstrate an understanding of the methods from geometry necessary to be successful in Trigonometry for Calculus

- apply learning strategies to achieve success in Trigonometry for Calculus

MATHS 95 Support for Introduction to Mathematical Ideas

Units:	2
Hours:	36 hours LEC
Prerequisite:	None.
Corequisite:	MATH 300

This course provides intensive instruction and practice in the core mathematical skills, competencies, and concepts necessary for success in MATH 300 (Introduction to Mathematical Ideas). Students taking this course must be concurrently enrolled in the corresponding section of MATH 300. The content of this course is designed to provide arithmetic and algebraic support to students as they learn related concepts in their corequisite course. Topics and homework assignments are often connected to assignments in the corequisite course. This course is graded Pass/No Pass.

Student Learning Outcomes
Upon completion of this course, the student will be able to:

- apply learning strategies to achieve success in Introduction to Mathematical Ideas (MATH 300).

- use support mathematics skills to identify appropriate procedures and solve exercises from selected mathematical topics.

- use support mathematics skills to apply critical thinking skills to solve exercises in new settings.

- use support mathematics skills to explain the process and results of several mathematical procedures.

Statistics (STAT)

STAT 10 Support for Introduction to Probability and Statistics

Units:	2
Hours:	36 hours LEC
Prerequisite:	None.
Corequisite:	STAT 300

This course provides intensive instruction and practice in the core mathematical skills, competencies, and concepts necessary for success in STAT 300 (Introduction to Probability and Statistics). Students taking this course must be concurrently enrolled in the corresponding section of STAT 300. The content

of this course is designed to help students develop effective learning strategies, and to provide arithmetic, algebraic, and geometric support as they learn concepts in the statistics course. Topics and homework assignments are often connected to assignments in the statistics course. Support using the required statistical technology package is also included. This course is graded Pass/No Pass.

Student Learning Outcomes
Upon completion of this course, the student will be able to:

- apply learning strategies to achieve success in statistics.

- use problem solving techniques in the context of data analysis and statistical methods.

- demonstrate relevant arithmetic, algebraic, and geometric skills in the context of statistics.

- apply mathematical and statistical skills in real-world settings and interpret the results in context.

STAT 105 Statway, Part I

Units:	6
Hours:	108 hours LEC
Prerequisite:	MATH 32 or 42 with a grade of "C" or better, or placement through the assessment process.
Advisory:	Eligible for ENGRD 310 or ENGRD 312 AND ENGWR 300; OR ESLR 340 AND ESLW 340.
Transferable:	CSU

This is the first semester of a two-semester course that introduces the concepts of probability and statistics with requisite arithmetic and algebraic topics integrated throughout. It is structured to serve students planning to transfer and continue studies in humanities or social sciences. Statistics topics emphasize data analysis and include methods for collecting data, graphical and numerical descriptive statistics, correlation, linear regression, simple exponential regression, and introduction to probability. Algebra topics include proportional relationships (including variation) with applications, expressions, linear equations and systems with applications, functions, quadratic and exponential equations, and linear and exponential models. Learning strategies for success with an emphasis on study skills, resource acquisition, and maintaining a positive perspective towards learning are also discussed and applied.

Student Learning Outcomes
Upon completion of this course, the student will be able to:

- identify methods of obtaining data and related advantages and disadvantages of each.

- organize and display data using appropriate tables and graphs.

- summarize a given data set using appropriate numerical summaries.

- analyze data by computing measures of central tendency, measures of dispersion, and measures of position.

- make meaningful and appropriate comparisons of distributions of data collected from two or more different groups.

- analyze bivariate data for linear trends using the least-squares regression model and the correlation coefficient.

- develop and apply the concept of numeracy to investigate and describe quantitative relationships and solve problems in a variety of contexts.

- solve problems that require the use of ratios, rates, proportions, and scaling.

- express real-world and quantitative situations with equations, inequalities, expressions, tables, verbal descriptions, symbols, and graphs.

- solve application problems involving equations, systems of equations, and inequalities and explain how results relate to the original context.

- apply functions as a way of modeling a correspondence between two variables in linear, quadratic, exponential, and logarithmic situations.

- solve problems involving exponential growth and decay in formulas, graphs, tables, and applications.

- calculate and interpret probabilities.

- estimate probabilities (including conditional probabilities) empirically and using simulation.

- use statistical software or graphing calculator to calculate single variable and analyze the results.

- apply learning strategies to achieve success in mathematics.

STAT 300 Introduction to Probability and Statistics

Units:	4
Hours:	72 hours LEC
Prerequisite:	MATH 120, 125, 129, or 133 with a grade of "C" or better, or placement through the assessment process.
Transferable:	CSU; UC (UC credit limitation: STAT 300, 305, and PSYC 330 combined: maximum credit, one course)
General Education:	AA/AS Area II(b); CSU Area B4; IGETC Area 2
C-ID:	C-ID MATH 110

This course is an introduction to probability and statistics. Topics include elementary principles and applications of descriptive statistics, counting principles, elementary probability principles, probability distributions, estimation of parameters, hypothesis testing, linear regression and correlation, and Analysis of Variance (ANOVA). Applications use data from various disciplines including business, social sciences, psychology, life and health sciences, and education. Statistical analysis using a computer statistics package or graphing calculator is required.

Student Learning Outcomes
Upon completion of this course, the student will be able to:

- identify methods of obtaining data and related advantages and disadvantages of each.

- distinguish between types of data as well as their different scales of measurement and corresponding implications.

- organize and display data appropriately using tables and graphs.

- analyze data by computing measures of central tendency, measures of dispersion, and measures of position.

- analyze bivariate data for linear trends using the least-squares regression model and the correlation coefficient.

- distinguish between probability models appropriate to different chance events and calculate probability according to these methods.

- analyze both discrete and continuous probability distributions, including binomial probability, normal distributions, and t-distributions by examining and interpreting areas under the graph of a histogram or a normal curve.

- apply inferential statistical methods to compare population parameters, make predictions, and draw conclusions about hypotheses.

- select the appropriate hypothesis test, perform the necessary computations and comparisons for the test (including significance of p-values and type I/II errors), and explain the conclusion of the test.

- test the significance of correlation and make predictions based on linear trends using the least-squares regression model.

- create and interpret confidence interval estimates for population parameters based on appropriate probability models.

- analyze and interpret applications using data from various disciplines including business, social sciences, psychology, life sciences, health science, and education.

- use statistical software or graphing calculator to calculate single-variable and two-variable statistics and analyze the results.

STAT 305 Statway, Part II

Units:	6
Hours:	108 hours LEC
Prerequisite:	STAT 105 with a grade of "C" or better
Transferable:	CSU; UC (UC credit limitation: STAT 300, 305, and PSYC 330 combined: maximum credit, one course; Maximum credit limitation: 4 semester/6 quarter units. STAT 105 and 305 must both be completed w/ "C" or better.)
General Education:	AA/AS Area II(b); CSU Area B4; IGETC Area 2

This is the second semester of a two-semester course that introduces the concepts of probability and statistics with requisite arithmetic and algebraic topics integrated throughout. It is structured to serve students planning to transfer and continue studies in humanities or social sciences. Statistics topics emphasize data analysis and include basic concepts of probability; confidence intervals; hypothesis tests for means, proportions, and variance; chi-squared tests; and ANOVA (Analysis of Variance). Algebra topics include proportional relationships (including variation) with applications, expressions, linear equations and systems with applications, functions, quadratic and exponential equations, and linear and exponential/logarithmic models. Learning strategies for success with an emphasis on study skills, resource acquisition, and maintaining a positive perspective towards learning are also discussed and applied. Both parts of Statway must be completed with a grade of "C" or better to receive credit for transfer-level statistics.

Student Learning Outcomes
Upon completion of this course, the student will be able to:

- identify methods of obtaining data and related advantages and disadvantages of each.

- distinguish between types of data as well as their different scales of measurement and corresponding implications.

- organize and display data appropriately using tables and graphs.

- analyze data by computing measures of central tendency, measures of dispersion, and measures of position.

- analyze bivariate data for linear trends using the least-squares regression model and the correlation coefficient.

- analyze both discrete and continuous probability distributions, including binomial probability and normal distribution, by examining and interpreting areas under the graph of a histogram or a normal curve.

- apply inferential statistical methods to compare population parameters, make predictions, and draw conclusions about hypothesis.

- apply the concept of numeracy to investigate and describe quantitative relationships and solve problems in a variety of contexts.

- select the appropriate hypothesis test, perform the necessary computations and comparisons for the test (including significance of p-values and type I/II errors), and explain the conclusion of the test.

- test the significance of correlation and make prediction based on linear trends using the least-squares regression model.

- create and interpret confidence interval estimates for population parameters based on appropriate probability models.

- analyze and interpret applications using data from various disciplines including business, social sciences, psychology, life sciences, health science, and education.

- use statistical software or graphing calculator to calculate single variable and two-variable statistics and analyze the results.

- make conjectures about the behavior of a function in a given context.

- apply learning strategies to achieve success in mathematics.

STAT 480 Introduction to Probability and Statistics - Honors

Units:	4

Hours:	72 hours LEC
Prerequisite:	MATH 120, 125, 129, or 133 with a grade of "C" or better, or placement through the assessment process.
Advisory:	Placement into ENGWR 300.
Transferable:	CSU
General Education:	AA/AS Area II(b) (effective Summer 2019)

This course is an introduction to probability and statistics designed for students in the honors program. Topics include elementary principles and applications of descriptive statistics, counting principles, elementary probability principles, probability distributions, estimation of parameters, hypothesis testing, linear regression and correlation, and Analysis of Variance (ANOVA). Applications use data from various disciplines including business, social sciences, psychology, life and health sciences, and education. Statistical analysis using a computer statistics package is required. This honors section uses an intensive instructional methodology designed to challenge motivated students, and includes a capstone project. This course is not open to students who have completed STAT 300.

Student Learning Outcomes
Upon completion of this course, the student will be able to:

- identify methods of obtaining data and related advantages and disadvantages of each.

- distinguish between types of data as well as their different scales of measurement and corresponding implications.

- organize and display data appropriately using tables and graphs.

- analyze data by computing measures of central tendency, measures of dispersion, and measures of position.

- analyze bivariate data for linear trends using the least-squares regression model and the correlation coefficient.

- distinguish between probability models appropriate to different chance events and calculate probability according to these methods.

- analyze both discrete and continuous probability distributions, including binomial probability, normal distributions, and t-distributions by examining and interpreting areas under the graph of a histogram or a normal curve.

- apply inferential statistical methods to compare population parameters, make predictions, and draw conclusions about hypotheses.

- select the appropriate hypothesis test, perform the necessary computations and comparisons for the test (including significance of p-values and type I/II errors), and explain the conclusion of the test.

- test the significance of correlation and make predictions based on linear trends using the least-squares regression model.

- create and interpret confidence interval estimates for population parameters based on appropriate probability models.

- analyze and interpret applications using data from various disciplines including business, social sciences, psychology, life sciences, health science, and education.

- use statistical software or graphing calculator to calculate single-variable and two-variable statistics and analyze the results.

STAT 495 Independent Studies in Statistics

Units:	1 - 3
Hours:	54 - 162 hours LAB
Prerequisite:	None.
Transferable:	CSU

Independent Study is an opportunity for the student to extend classroom experience in this subject, while working independently of a formal classroom situation. Independent study is an extension of work offered in a specific class in the college catalog. To be eligible for independent study, students must have completed the basic regular catalog course at American River College. They must also discuss the study with a professor in this subject and secure approval. Only one independent study for each catalog course will be allowed.

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