

- **SCANDINAVIAN AREA STUDIES**
Major in Scandinavian Area Studies
 40 semester hours.

A cross-disciplinary approach to the study of Scandinavia.

See the *Scandinavian Area Studies* section of this catalog, page 99. To view course offerings, go to page 213.

Latin

To view curriculum requirements, please go to Department of Languages & Literature, page 75.

To view Latin (LATN) courses, go to the PLU Directory of Approved Courses beginning on page 191.

Legal Studies

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Legal Studies is an interdisciplinary minor program of study focusing on the nature of law and judicial process. Consistent with the purposes of the American Legal Studies Association, the Legal Studies Program at PLU provides alternative approaches to the study of law from the academic framework of the Divisions of Social Sciences and Humanities and the Schools of Communication and Art and of Business. The faculty teaching within the program emphasize the development of a critical understanding of the functions of law, the mutual impacts of law and society, and the sources of law. Students completing a minor in Legal Studies pursue these objectives through courses, directed research, and internships in offices and agencies involved in making, enforcing, interpreting, and communicating “the law” in contemporary American civil society.

Faculty: Jobst, *Chair*; Dwyer-Shick, Kaurin, Klein, Lisosky, MacDonald, Rowe.

MINOR

20 semester hours including PHIL 328, POLS 170, and 12 additional semester hours, selected in consultation with the program’s chair.

ANTH 376: Nation, State, and Citizen
 BUSA 303: Business Law and Ethics
 BUSA 304: Business Law and Ethics for Financial Professionals
 BUSA 408: International Business Law and Ethics
 COMA 421: Communication Law
 ECON 325: Industrial Organization and Public Policy
 PHIL 328: Philosophical Issues in the Law
 POLS 371: Judicial Process
 POLS 372: Constitutional Law
 POLS 373: Civil Rights and Civil Liberties
 POLS 374: Legal Studies Research
 POLS 381: Comparative Legal Systems
 POLS 471: Internship in Legal Studies

Mathematics

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Mathematics is a many-faceted subject that is not only extremely useful in its application, but at the same time is fascinating and beautiful in the abstract. It is an indispensable tool for industry, science, government, and the business world, while the elegance of its logic and beauty of form have intrigued scholars, philosophers, and artists since earliest times.

The mathematics program at PLU is designed to serve five main objectives: (1) to provide backgrounds for other disciplines, (2) to provide a comprehensive pre-professional program for those directly entering the fields of teaching and applied mathematics, (3) to provide a nucleus of essential courses which will develop the breadth and maturity of mathematical thought for continued study of mathematics at the graduate level, (4) to develop the mental skills necessary for the creation, analysis, and critique of mathematical topics, and (5) to provide a view of mathematics as a part of humanistic behavior.

Faculty: M. Zhu, *Chair*; Benkhalti, Dorner, Edgar, Heath, Meyer, Munson, Simic-Muller, Sklar, Stuart.

Beginning Classes

Majors in mathematics, computer science and engineering, and other sciences usually take MATH 151 and MATH 152 (calculus). Math 151 is also appropriate for any student whose high school mathematics preparation is strong. Those who have had calculus in high school may omit MATH 151 (see Advanced Placement section) and enroll in MATH 152 after consultation with a mathematics faculty member. Those who have less mathematics background may begin with MATH 140 before taking MATH 151. MATH 115 provides preparation for MATH 140.

Business majors may satisfy the requirement for the business degree by taking MATH 128, 151, or 152. (Math 115 provides preparation for MATH 128.)

Elementary education majors may satisfy the requirement for the education degree by taking Math 123. (Math 115 provides preparation for MATH 123.)

For students who plan to take only one mathematics course, a choice from MATH 105, 107, 123, 128, 140, or 151 is advised, depending on interest and preparation.

Placement Test

A placement test and background survey are used to help insure that students begin in mathematics courses that are appropriate to their preparation and abilities. Enrollment is not permitted in any of the beginning mathematics courses (MATH 105, 107, 115, 123, 128, 140, 151, and 152) until the placement test and background survey are completed. The placement exam is available at www.plu.edu/~math/

The policy of the Mathematics Department regarding mathematics credit for students who have taken the AP Calculus exams (AB or BC) or the International Baccalaureate Higher Level Mathematics Exam (IBHL) is as follows:

<i>Exam</i>	<i>Score</i>	<i>Credit</i>
AB	3*	MATH 151*
AB	4,5	MATH 151
BC	3	MATH 151
BC	4,5	MATH 151 and 152
IBHL	4,5	MATH 151
IBHL	6,7	MATH 151 and 152

*Consult with instructor if planning to take MATH 152.

If a student has taken calculus in high school and did not take an AP exam or IBHL exam, then the student may enroll in MATH 152 after consultation with a mathematics faculty member. In this case no credit is given for MATH 151.

Minimum Entrance Requirements

The Registrar's Office determines whether a student meets the minimum entrance requirements by following the above rules. When a student has a deficiency, after taking the Math Placement Test, the student will receive a recommendation about how to remove the deficiency based on the test results.

If the test result shows that a student is qualified to take MATH 115 or a higher numbered math course at PLU, then the deficiency will be removed when the student successfully passes such a course. In addition, the student will receive Math Reasoning (MR) GUR credit. Please be aware that credit from taking MATH 105 or MATH 107 does not remove a math deficiency.

If the Math Placement Test result shows that the student is not qualified to take MATH 115 or a higher numbered math course, the student will have to take a course at a community college to remove the deficiency in his or her minimum mathematics entrance requirement. The course content should be equivalent to or more difficult than high school algebra or geometry, and it must be approved by the Mathematics Department.

MATHEMATICS AND GENERAL EDUCATION ELEMENTS

All mathematics courses will satisfy the mathematical reasoning (MR) element of the General Education Program. At least four semester hours are needed. All mathematics courses will satisfy the natural sciences, computer science, mathematics (NS) of the General Education Program. At least four semester hours are needed. A course cannot simultaneously satisfy mathematical reasoning (MR) and science and scientific method (SM) GenEd elements.

In fulfilling the Math Reasoning Requirement, students with documented disabilities will be given reasonable accommodations as determined by the Director of Disability Support Services and the appropriate faculty member in consultation with the student.

MATHEMATICS AND THE COLLEGE OF ARTS AND SCIENCES REQUIREMENT

(see *College of Arts and Sciences Requirements*)

All mathematics courses will satisfy the logic, mathematics, computer science or statistics part of Option III of the College of Arts and Sciences requirement. A course cannot simultaneously satisfy Option III of the College of Arts and Sciences requirement and a GenEd element.

MATHEMATICS MAJOR REQUIREMENTS

- The foundation of the mathematics program for majors includes:
MATH 151, 152, 253: Three-semester sequence of calculus
MATH 331 (Linear Algebra)

Students with a calculus background in high school may receive advanced placement into the appropriate course in this sequence.

Students who have taken calculus in high school but do not have credit for MATH 151 do not need to take MATH 151 for the mathematics major or minor. However, they still need to complete the number of hours in mathematics as stated in the requirements.

Upper-division work includes courses in introduction to proof, linear algebra, abstract algebra, analysis, geometry, differential equations, statistics and numerical analysis. See the description of the courses and the major (either Bachelor of Arts or Bachelor of Science) for more detail. Students majoring in mathematics should discuss scheduling of these courses with their advisors. For example, MATH 499 extends over two semesters beginning with MATH 499A in the fall semester. May graduates begin this capstone course in the fall semester of the senior year, while December graduates must begin this course in the fall semester of their junior year. MATH 499A is only offered in fall semester and must be taken before MATH 499B which is only offered in the spring.

BACHELOR OF ARTS MAJOR

- Mathematics**
34 semester hours of mathematics, four hours supporting
Required: MATH 151, 152, 253, 317, 331, 341, 433, 455, 499A, 499B
Required Supporting: CSCE 144
Also **strongly recommended** is one of the following:
CSCE 371; ECON 345; PHYS 153, 163

BACHELOR OF SCIENCE MAJOR

- Mathematics**
42 semester hours of mathematics, eight or nine hours supporting
Required:
MATH 151, 152, 253, 317, 331, 341, 433, 455, 499A, 499B
Eight semester hours from:
MATH 321, 342, 348, 351, 356, 381, 411, 480
Required supporting: CSCE 144 and one of the following:
CSCE 348, 371; ECON 345; PHYS 153, 163

- **Financial Mathematics Major**

47 to 49 semester hours

Required semester hours

Business: nine semester hours
 Economics: four to eight semester hours
 (not including ECON 101 and 102)
 Mathematics: 28 to 32 semester hours
 (not including capstone hours)
 Capstone: two to four semester hours
 (Directed Research or Internship)

Prerequisites

Business: BUSA 302 or permission of instructor for business courses
 Economics: ECON 101; ECON 102 or permission of instructor of ECON 345
 Mathematics: MATH 140 or placement into MATH 151 or higher
 Co-Requisite strongly recommended: PHIL 225: Business Ethics (satisfies Philosophy GUR)

- **Following Courses Required**

Within the groups of alternative courses listed below, highly recommended courses are marked by an **.

BUSA 335: Financial Investments (3)
 BUSA 437: Financial Analysis and Strategy (3)
 ECON 345: Math Topics in Economics (4)
 MATH 151: Calculus I (4)
 MATH 152: Calculus II (4)
 MATH 253: Multivariate Calculus (4)
 MATH 331: Linear Algebra (4)
 MATH 341: Introduction to Mathematical Statistics (4)
 (STAT 231 may be substituted with math department permission)
 MATH 411: Mathematics of Risk (4)

**Two of following courses required:
 (may only count either ECON 344 or MATH 348)**

ECON 344: Econometrics (4)**
 MATH 342: Probability & Statistical Theory (4)**
 MATH 348: Applied Regression Analysis & ANOVA (4)
 MATH 351: Differential Equations (4)
 MATH 356: Numerical Analysis (4)

One of the following courses required:

BUSA 337: International Finance (3)
 BUSA 438: Financial Research and Analysis (3)

Capstone Experience required: (Either MATH 495A or both MATH 499A and 499B)

MATH 495A: Financial Mathematics Internship (2-4)
 MATH 499A: Capstone - Senior Seminar I (1)
 MATH 499B: Capstone - Senior Seminar II (1)

- **Mathematics Education Major**

46 to 47 semester hours

Required Courses

- MATH 151, 152, 203, 253, 317, 321, 331, 341, 433, 499A, 499B and MATH/EDUC 446
- One of: PHYS 125/135; PHYS 153/163; or CHEM 115

Strongly Recommended: MATH 455

All courses counted toward a Mathematics Education major just be completed with grades of C or higher in each course.

A minimum of 128 semester hours must be completed with a GPA of 2.50 or higher.

MATH/EDUC 446 must be completed with a B- or better.

Note: The B.S. Degree with a major in Mathematics Education together with either a B.A.E. degree in secondary education or a Master's Degree in Education provides a path to teacher certification in secondary mathematics in Washington State. Passing the West-E exam in mathematics is also required for teacher certification in secondary mathematics. Completion of the required math courses listed for the degree gives adequate preparation for the West-E exam.

MINORS

- **Actuarial Science**

A minimum of 24 semester hours chosen from the following courses:

BUSA 302, 304, 335
 ECON 101, 301, 323, 343
 MATH 331, 342, 348, 356

Also strongly recommended: MATH 253

At least 12 hours must be from mathematics and at least four from economics.

- **Mathematics**

20 semester hours of mathematics courses, including:

MATH 151, 152, and either 253 or 245 and eight hours of upper-division mathematics courses, excluding MATH 446.

- **Statistics**

A minimum of 16 semester hours to include:

CSCE 120 or 144; STAT 341
 And at least eight hours from among the other statistic courses (MATH 342 and 348 are strongly recommended).

See the Statistics section of this catalog for more detail. Statistics courses taken for the statistics minor may not be simultaneously counted as elective credit for the Bachelor of Science major.

BACHELOR OF ARTS IN EDUCATION

See Department of Instructional Development and Leadership on page 65.

To view Mathematics (MATH) courses, go to the PLU Directory of Approved Courses on page 191.



Latin (LATN)

LATN 101, 102: Elementary Latin

Basic skills in reading Latin; an introduction to Roman literature and culture. (4, 4)

LATN 201, 202: Intermediate Latin – C

Review of basic grammar; selected readings from Latin authors. (4, 4)

Mathematics (MATH)

<i>Term</i>	<i>Courses</i>
Fall	MATH 105, 115, 123, 128, 140, 151, 152, 253, 317, 331, 341, 381, 433, 446, 499A
January Term	MATH 107, 203
Spring	MATH 105, 115, 128, 140, 151, 152, 245, 253, 317, 321, 331, 342, 348, 351, 356, 455, 480, 449B
Alternate Years	Odd Years: MATH 203, 348, 351 Even Years: MATH 342, 356

A grade of C or higher is required in all prerequisite courses. A placement test and background survey are required before registering for beginning mathematics courses if prerequisites have not been completed at PLU.

MATH 105: Mathematics of Personal Finance – MR, NS

Emphasizes financial transactions important to individuals and families: annuities, loans, insurance, interest, investment, time value of money. **Prerequisite:** PLU math entrance requirement. (4)

MATH 107: Mathematical Explorations – MR, NS

Mathematics and modern society. Emphasis on numerical and logical reasoning. Designed to increase awareness of applications of mathematics, to enhance enjoyment of and self-confidence in mathematics, and to sharpen critical thought in mathematics. Topics selected by the instructor. **Prerequisite:** PLU math entrance requirement. (4)

MATH 115: College Algebra and Trigonometry - MR, NS

A review of algebra emphasizing problem solving skills. The notion of function is introduced via examples from polynomial, rational, trigonometric, logarithmic and exponential functions. We also explore inverse trigonometric functions, identities, graphing and solution of triangles. Appropriate as preparation for MATH 123, 128 and 140. **Prerequisites:** PLU math placement exam and two years of high school algebra. (4)

MATH 123: Modern Elementary Mathematics – MR, NS

Concepts underlying traditional computational techniques; a systematic analysis of arithmetic; an intuitive approach to algebra and geometry. Intended for elementary teaching

majors. **Prerequisites:** A qualifying score on the math placement test or a grade of C or higher in MATH 115. (4)

MATH 128: Linear Models and Calculus, An Introduction – MR, NS

Matrix theory, linear programming, and introduction to calculus. Concepts developed stressing applications, particularly to business. **Prerequisites:** Two years of high school algebra or MATH 115. Cannot be taken for credit if MATH 151 (or the equivalent) has been previously taken with a grade of C or higher. (4)

MATH 140: Analytic Geometry and Functions – MR, NS

Different types of functions, their properties and graphs, especially trigonometric functions. Algebraic skill, problem solving, and mathematical writing are emphasized. Prepares students for calculus. **Prerequisites:** MATH 115 or equivalent high school material. (4)

MATH 151: Introduction to Calculus – MR, NS

Functions, limits, derivatives and integrals with applications. Emphasis on derivatives. **Prerequisites:** Math analysis or pre-calculus in high school or MATH 140. (4)

MATH 152: Calculus II – MR, NS

Continuation of 151. Techniques and applications of integrals, improper integrals, ordinary differential equations and power series, with applications. **Prerequisite:** MATH 151. (4)

MATH 203: History of Mathematics - NS

A study in the vast adventure of ideas that is mathematics from ancient cultures to the 20th century. The evolution of the concepts of number, measurement, demonstration, and the various branches of mathematics in the contexts of the varied cultures in which they arose. **Prerequisites:** MATH 152 or consent of instructor. (4)

MATH 245: Discrete Structures - NS

Topics of relevance to computer scientists and computer engineers, including quantified logic, sets, relations, functions, recursion, combinatorics, and probability. Tools of logical reasoning, such as induction, proof by contradiction, and predicate calculus will be taught and applied. **Prerequisite:** MATH 152 (4)

MATH 253: Multivariable Calculus - NS

An introduction to vectors, partial derivatives, multiple integrals, and vector analysis. **Prerequisite:** MATH 152. (4)

MATH 291: Directed Study

Supervised study of topics selected to meet the individual's needs or interests; primarily for students awarded advanced placement. Admission only by departmental invitation. (1–4)

MATH 317: Introduction to Proof in Mathematics - NS

Introduces the logical methods of proof and abstraction in modern mathematics. Explores mathematical topics, including discrete mathematics, while familiarizing students with proof-related concepts such as mathematical grammar, logical equivalence, proof by contradiction, and proof by induction. **Prerequisite:** MATH 152. (4)

MATH 321: Geometry - NS

Foundations of geometry and basic theory in Euclidean, projective, and non-Euclidean geometry. **Prerequisites:** MATH 152 or consent of instructor. (4)

MATH 331: Linear Algebra - NS

Vectors and abstract vector spaces, matrices, inner product spaces, linear transformations. Proofs will be emphasized. **Prerequisites:** MATH 152 and one of MATH 245, 253, or 317. (4)

MATH 341: Introduction to Mathematical Statistics - NS

Data description, probability, discrete and continuous random variables, expectation, special distributions, statements of law of large numbers and central limit theorem, sampling distributions, theory of point estimators, confidence intervals, hypothesis tests, regression (time permitting). Cross-listed with STAT 341. **Prerequisite:** MATH 152. (4)

MATH 342: Probability and Statistical Theory

Continuation of MATH 341. Topics may include: joint and conditional distributions, correlation, functions of random variables, moment generating functions, inference in regression and one-way ANOVA, Bayesian and non-parametric inference, convergence of distributions. Cross-listed with STAT 342. **Prerequisite:** MATH 341. (4)

MATH 348: Applied Regression Analysis and ANOVA

Linear and multiple regression with inference and diagnostics; analysis of variance; experimental design with randomization and blocking. Substantial use of statistical software and emphasis on exploratory data analysis. Cross-listed with STAT 348. **Prerequisites:** MATH 341 or consent of instructor. (4)

MATH 351: Differential Equations - NS

An introduction to differential equations emphasizing the applied aspect. First and second order differential equations, systems of differential equations, power series solutions, non-linear differential equations, numerical methods. **Prerequisite:** MATH 253. (4)

MATH 356: Numerical Analysis - NS

Numerical theory and application in the context of solutions of linear, nonlinear, and differential equations, matrix theory, interpolation, approximations, numerical differentiation and integration and Fourier transforms. **Prerequisites:** MATH 152 and CSCE 144. (4)

MATH 381: Seminar in Problem Solving

Designed to improve advanced problem solving skills. A goal is participation in the Putnam Competition. Pass/Fail only. May be taken more than once for credit. **Prerequisites:** MATH 152 or consent of instructor. (1)

MATH 411: Mathematics of Risk

This non-GUR course introduces students to the mathematics underpinning financial investment in the presence of uncertainty. Students will investigate the employ probability models to assign values to individual financial instruments and to portfolios over short and long term time frames. both analytic solutions and numerical solutions via software will

be developed. Case studies will play a role in the course.

Prerequisites: MATH 152, 341 and 342; ECON 101 or 301; BUS 335; or consent of the instructor (4)

MATH 433 Abstract Algebra

The algebra of axiomatically defined objects, such as groups, rings and fields with emphasis on theory and proof.

Prerequisites: MATH 317, 331. (4)

MATH 446: Mathematics in the Secondary School

Methods and materials in secondary school math teaching. Basic mathematical concepts; principles of number operation, relation, proof, and problem solving in the context of arithmetic, algebra, and geometry. Cross-listed with EDUC 446. **Prerequisites:** MATH 253 or 331. (4)

MATH 455: Mathematical Analysis

Theoretical treatment of topics introduced in elementary calculus. **Prerequisite:** MATH 253, 331; 317 or 433 (with consent of instructor MATH 433 may be taken concurrently). (4)

MATH 480: Topics in Mathematics

Selected topics of current interest or from: combinatorics, complex analysis, differential geometry, dynamical systems chaos and fractals, graph theory, group representations, number theory, operations research, partial differential equations, topology, transform methods, abstract algebra, analysis. May be taken more than once for credit. Prerequisites vary depending on the topic. (1-4)

MATH 495A: Financial Mathematics Internship

A research and writing project in conjunction with a student's approved off-campus activity. An oral presentation comparable in length with those required for MATH 499 is obligatory.

Prerequisites: Senior (or second semester junior) financial mathematics major; and approval from the department prior to the commencement of the internship.

MATH 499A: Capstone: Senior Seminar I – SR

Preparation for oral and written presentation of information learned in individual research under the direction of an assigned instructor. Discussion of methods for communicating mathematical knowledge. Selection of topic and initial research. With Math 499B meets the senior seminar/project requirement. **Prerequisite:** Senior (or second semester junior) math major. (1)

MATH 499B: Capstone: Senior Seminar II – SR

Continuation of MATH 499A with emphasis on individual research and oral and written presentation. With MATH 499A meets the senior seminar/project requirement.

Prerequisite: MATH 499A. (1)

