# Actuarial Science (AS)

Course information contained within the Bulletin is accurate at the time of publication in June 2025 but is subject to change. For the most up-to-date course information, please refer to the Course Catalog.

**AS 1501. Actuarial Probability. 3 Credit Hours.**
The course discusses probability theory and its application to insurance and risk management problems. Topics covered include: probability laws, combinatorics, conditional probability and independence, Bayes' Theorem, discrete and continuous random variables, common discrete and continuous distributions and their applications, multivariate discrete random variables, distribution of order statistics, linear combinations of independent random variables, and basic insurance concepts of deductibles, coinsurance, benefit limits, and inflation. Prior to spring 2016, the course title was "Introduction to Actuarial Science." Prior to fall 2022, the course title was "Actuarial Probability and Statistics I."

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:** Minimum grade of C- in (MATH 1042 (may be taken concurrently), MATH 1942 (may be taken concurrently), any MATH course numbered 2043 to 3080 (may be taken concurrently), or 'Y' in MATW)

**AS 1601. Introduction to Actuarial Spreadsheets and Programming. 1 Credit Hour.**
The course introduces students to the use of spreadsheets and to the fundamentals of programming, as these skills are becoming crucial for entry-level actuarial positions. Topics covered include: managing workbooks, preparing workbooks for collaboration, cell filling, formatting, data validation, advanced conditional formatting and filtering, logical operations in formulas, advanced lookups, advanced date and time functions, data analysis through what-if analysis and forecasting, formula troubleshooting, advanced charting, Pivot Tables, Pivot Charts, create and modify macros, and an introduction to programming concepts.

**Repeatability:** This course may not be repeated for additional credits.

**AS 2101. Actuarial Probability and Statistics II. 3 Credit Hours.**
In this course, probability theory and its application to insurance and risk management problems are discussed in the context of continuous random variables. Among the topics to be covered are: Random variables, probabilities, and percentiles on a continuum; specific continuous distributions such as Uniform, Gamma and Exponential, Normal, and Beta; moments and moment generating functions; conditional and marginal distributions; transformations of one or two random variables; order statistics; and the Central Limit Theorem.

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:** Minimum grade of C in (MATH 2043 (may be taken concurrently), 'Y' in MA08, or 'Y' in CRMA12) and (AS 1501, AS 1901, or 'Y' in CRAS01)

**AS 2502. Theory of Interest. 3 Credit Hours.**
This course covers one of the foundational concepts of actuarial science: the time value of money. Students learn about simple, compound, and effective interest rates, and use them to calculate present values and future values of deterministic cash flows, both discrete and continuous. These techniques are then applied to value annuities, loans and bonds. The course also includes a thorough discussion of interest rate risk, how it can be measured, and how insurers can mitigate this risk through asset-liability management.

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:** Minimum grade of C (except where noted) in (MATH 1042, MATH 1942, MATH 2043 (C- or higher; may be taken concurrently), 'Y' in MA07, 'Y' in MATW, 'Y' in CRMA09, or 'Y' in CRMA11)

**AS 2503. Actuarial Corporate Finance. 3 Credit Hours.**
The course develops the conceptual framework for corporate finance and option pricing from an actuarial perspective. Topics include capital budgeting, project analysis, efficient market hypothesis, capital asset pricing model, cost of capital, behavioral finance, capital structure, equity financing and debt financing. The course also provides an introduction to financial options, including option strategies, put-call parity, Binomial trees, the Black-Scholes model and Delta hedging, along with their applications to insurance products. NOTE: This course should be taken in place of Finance 3101. Prior to fall 2022, the course title was "Corporate Finance for Actuarial Science."

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:** Minimum grade of C (except where noted) in (MATH 1042, MATH 1942, MATH 2043 (C- or higher; may be taken concurrently), 'Y' in MA07, 'Y' in MATW, 'Y' in CRMA09, or 'Y' in CRMA11), (AS 1501 or 'Y' in CRAS01), (ACCT 2101, ACCT 2901, ACCT 2103, ACCT 2903, 'Y' in ACC1, 'Y' in CRAC01, or 'Y' in CRAC03), and (AS 2502 or 'Y' in CRAS03)

**AS 2505. Actuarial Statistics. 3 Credit Hours.**
The course covers advanced probability concepts and the fundamentals of mathematical statistics, as well as their insurance applications. Topics include multivariate continuous distribution, sampling and central limit theorem, estimation methods, construction of confidence interval, hypothesis testing, analysis of variance, and analysis of categorical data.

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:** Minimum grade of C in (MATH 1042, MATH 1942, any MATH course numbered 2043 to 3080, 'Y' in MATW, 'Y' in CRMA09, or 'Y' in CRMA11) and (AS 1501 or 'Y' in CRAS01)

**AS 3501. Long-Term Actuarial Modeling. 3 Credit Hours.**
The heart of the traditional actuarial science curriculum, this course examines the pricing of life insurance products by integrating concepts from probability and interest theory. It introduces random variables measuring the future lifetime of a person - from distributions or life tables - and the present values of life insurance and life annuity products, in both discrete-time and continuous-time settings. Students learn to calculate and interpret the mean, variance and probability functions for these random variables. In addition, students learn to determine actuarially fair premiums and reserves for long-term insurance products. Prior to fall 2022, the course title was "Actuarial Modeling I."

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:** Minimum grade of C in (AS 2502 or 'Y' in CRAS03) and (AS 1501 or 'Y' in CRAS01)

**AS 3502. Advanced Long-Term Actuarial Modeling. 3 Credit Hours.**
The course introduces Markov Chains to extend the pricing and reserving concepts of AS 3501 to multiple lives (e.g. life insurance for a married couple or business partners) and multiple decrements (e.g. modeling different health statuses). The course also includes actuarial applications to pension valuation and profit testing, as well as embedded options in life insurance and annuity products. Prior to fall 2022, the course title was "Actuarial Modeling II."

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:** Minimum grade of C in (AS 3501 or 'Y' in CRAS05)

**AS 3503. Short-Term Actuarial Modeling. 3 Credit Hours.**
Focusing on short-term actuarial modeling, the course introduces a variety of frequency, severity, and aggregate loss models. Students learn to select suitable models for a given data set, to parameterize the models to the data, to assess the predictive quality of the models through various measures of confidence, and to estimate losses using credibility theory. Pricing and reserving techniques for short-term insurance products will also be discussed. Prior to fall 2022, the course title was "Actuarial Modeling III."

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:** Minimum grade of C in (AS 2505 or STAT 2512)

**AS 3504. Actuarial Analytics. 3 Credit Hours.**
Predictive analytics is a key component of actuarial work. It helps improve solutions to traditional actuarial problems such as forecasting mortality, setting loss reserves, predicting policyholder behavior, and establishing classification ratemaking schemes. Actuaries also use these techniques for improving insurance operations through data-driven decision making. This course introduces students to statistical learning and linear models, with a focus on applying these tools to actuarial business decisions in an insurance or consulting environment. Topics covered include: types of modeling problems, methods of assessing model accuracy, exploratory data analysis, exponential family of distributions, parameter estimation, diagnostic tests of model fit and assumptions, model selection and interpretation, calculation of predicted values and confidence/prediction intervals in the context of ordinary least squares regression, k-nearest neighbors, and generalized linear models. In addition, the course aims to enhance students' programming skills.

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:** Minimum grade of C in (AS 2505 or STAT 2512)

**AS 3580. Special Topics: Actuarial Science. 3 Credit Hours.**
Special topics in current developments in the field of Actuarial Science and exam preparation.

**Repeatability:** This course may be repeated for additional credit.

**AS 3582. Independent Study. 1 to 6 Credit Hour.**
Readings and/or research paper under the supervision of a faculty member.

**Repeatability:** This course may be repeated for additional credit.

**AS 3596. Actuarial Practice: Property and Liability. 3 Credit Hours.**
This highly participative course is designed to broaden perspectives on the business environment in which actuaries work. In addition to analyzing the issues behind daily events, several continuing issues will be analyzed including insurance pricing cycles, regulatory developments, the role of the actuary as an educator, advisor, objective information source and problem solver, insurance company financial rating and solvency issues, accounting fraud and questionable financial transactions, insurance and the financial markets managing insurance operations, professional ethics, and the impact of current developments in underwriting, and reinsurance on the actuarial function. NOTE: This is the writing-intensive course for Actuarial Science majors. Students must earn a grade of C- or better in this course if they are using it to fill the writing intensive course requirement for their degree. Also note: Prior to fall 2017, the course title was "Casualty Contingencies."

**Course Attributes:** WI

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:** Minimum grade of C in (ACCT 2101, ACCT 2901, ACCT 2103, ACCT 2903, 'Y' in CRAC01, or 'Y' in CRAC03), (AS 1501, AS 1901, or 'Y' in CRAS01), (RMI 2101, RMI 2901, 'Y' in RM01, 'Y' in CRRM01, or 'Y' in CRRM02), and (BA 2196, BA 2996, 'Y' in CRBA01, or 'Y' in CRBA02)

**AS 3597. Actuarial Practice: Group & Health Benefits. 3 Credit Hours.**
This highly participative and writing intensive course is designed to expose students to certain group health and welfare benefits, the legal and regulatory environment in which they operate, and the fundamentals of group insurance pricing, rating and funding. Benefits examined include traditional benefits such as medical and disability insurance in addition to dental and prescription drug plans, HMOs, PPOs, ACOs, and other managed care systems. Emphasis will be on the design and structure of these plans, development and pricing of group products, experience rating and funding methods, and current problems and issues associated with the provision of these benefits. The salient features of state and federal regulation will be examined, along with an examination of the Affordable Care Act (ACA) major provisions of interest to practicing actuaries and employers. Students must earn a grade of C- or better in this course if they are using it to fill the writing intensive course requirement for their degree.

**Course Attributes:** WI

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:** Minimum grade of C in (ACCT 2101, ACCT 2901, ACCT 2103, ACCT 2903, 'Y' in CRAC01, or 'Y' in CRAC03), (AS 1501, AS 1901, or 'Y' in CRAS01), (RMI 2101, RMI 2901, 'Y' in CRRM01, or 'Y' in CRRM05), and (BA 2196, BA 2996, 'Y' in CRBA01, or 'Y' in CRBA02)

**AS 4503. Advanced Short-Term Actuarial Modeling. 3 Credit Hours.**
Building on AS 3503, the course continues the discussion of short-term actuarial modeling. It introduces students to advanced frequency, severity, and aggregate claim models, as well as concepts of pricing and reserving. Topics covered include: commonly used severity, frequency distributions, aggregate risk models, coverage modifications, construction and selection of parametric models, estimate losses using advanced credibility procedures, and pricing and reserving methods for short-term insurance contracts.

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:** Minimum grade of C in AS 3503.

**AS 4504. Advanced Actuarial Analytics. 3 Credit Hours.**
This course continues the discussion of AS 3504. Statistical analysis has become part of the modern actuary's day-to-day responsibilities as they help improve solutions to traditional actuarial problems and quantify insurance operations and business processes that have traditionally relied largely on managers' judgment. Topics to be covered include: ridge regression, LASSO regression, weighted/partial least squares models, KNN regression, stochastic time series processes, common time series models including predictions, confidence intervals, and interpretation, principal components analysis, decision trees, including classification trees, bagging, boosting, and random forests, k-means and hierarchical clustering, and simulation. The course will further develop students' programming skills in data analytics.

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:** Minimum grade of C in AS 3504.

**AS 5001. Actuarial Probability. 3 Credit Hours.**
The course discusses probability theory and its application to insurance and risk management problems. Topics covered include: probability laws, combinatorics, conditional probability and independence, Bayes' Theorem, discrete and continuous random variables, common discrete and continuous distributions and their applications, multivariate discrete random variables, distribution of order statistics, linear combinations of independent random variables, and basic insurance concepts of deductibles, coinsurance, benefit limits, and inflation.

**Repeatability:** This course may not be repeated for additional credits.

**AS 5015. Introduction to Actuarial Spreadsheets and Programming. 1 Credit Hour.**
The course introduces students to the use of spreadsheets and to the fundamentals of programming, as these skills are becoming crucial for entry-level actuarial positions. Topics covered include managing workbooks, preparing workbooks for collaboration, cell filling, formatting, data validation, advanced conditional formatting and filtering, logical operations in formulas, advanced lookups, advanced date and time functions, data analysis through what-if analysis and forecasting, formula troubleshooting, advanced charting, Pivot Tables, Pivot Charts, create and modify macros, and an introduction to programming concepts.

**Repeatability:** This course may not be repeated for additional credits.

**AS 5022. Actuarial Statistics. 3 Credit Hours.**
The course covers advanced probability concepts and the fundamentals of mathematical statistics, as well as their insurance applications. Topics include multivariate continuous distribution, sampling and central limit theorem, estimation methods, construction of confidence interval, hypothesis testing, analysis of variance, and analysis of categorical data.

**Repeatability:** This course may not be repeated for additional credits.

**AS 5101. Theory of Interest. 3 Credit Hours.**
This course covers one of the foundational concepts of actuarial science: the time value of money. Students learn about simple, compound, and effective interest rates, and use them to calculate present values and future values of all forms of deterministic cash flows, both discrete and continuous. These techniques are then applied to value annuities, loans, stocks, and bonds. The course also includes a thorough discussion of interest rate risk, how it can be measured, and how insurers can mitigate this risk through asset-liability management.

**Repeatability:** This course may not be repeated for additional credits.

**AS 5102. Long-Term Actuarial Modeling. 3 Credit Hours.**
The heart of the traditional actuarial science curriculum, this course examines the pricing of life insurance products by integrating concepts from probability and interest theory. It introduces random variables measuring the future lifetime of a person - from distributions or life tables - and the present values of life insurance and life annuity products, in both discrete-time and continuous-time settings. Students learn to calculate and interpret the mean, variance, and probability functions for these random variables. In addition, students learn to determine actuarially fair premiums and reserves for long-term insurance products. Prior to fall 2022, the course title was "Actuarial Modeling I."

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:** Minimum grade of C in AS 5101 (may be taken concurrently)

**AS 5103. Advanced Long-Term Actuarial Modeling. 3 Credit Hours.**
The course introduces Markov Chains to extend the pricing and reserving concepts of AS 5102 to multiple lives (e.g. life insurance for a married couple or business partners) and multiple decrements (e.g. modeling different health statuses). The course also includes actuarial applications to pension valuation and profit testing, as well as embedded options in life insurance and annuity products. Prior to fall 2022, the course title was "Actuarial Modeling II."

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:** Minimum grade of C in AS 5102.

**AS 5104. Short-Term Actuarial Modeling. 3 Credit Hours.**
Focusing on short-term actuarial modeling, the course introduces a variety of frequency, severity, and aggregate loss models. Students learn to select suitable models for a given data set, to parameterize the models to the data, to assess the predictive quality of the models through various measures of confidence, and to estimate losses using credibility theory. Pricing and reserving techniques for short-term insurance products will also be discussed. Prior to fall 2022, the course title was "Actuarial Modeling III."

**Repeatability:** This course may not be repeated for additional credits.

**AS 5105. Actuarial Economics. 3 Credit Hours.**
This course develops the conceptual framework of microeconomics and macroeconomics with some applications in actuarial science. Topics in microeconomics include interaction between supply and demand, consumer behavior, production choices, different types of competition, factor markets, and market failure. Topics in macroeconomics include business cycles, inflation, unemployment, monetary and fiscal policy, balance of payments, international economics, and economic growth.

**Repeatability:** This course may not be repeated for additional credits.

**AS 5106. Actuarial Corporate Finance. 2 Credit Hours.**
This course introduces students to the fundamental principles of accounting and corporate finance, from an actuarial perspective. It covers basic accounting principles and regulations, financial statements, investment decision making, the risk-return trade-off, capital structure, long-term financing and investment risk. This provides students with an understanding of how (insurance) companies and financial markets function. The course develops the conceptual framework for corporate finance from an actuarial perspective. Topics include capital budgeting, project analysis, efficient market hypothesis, capital asset pricing model, cost of capital, behavioral finance, capital structure, equity financing and debt financing. Prior to fall 2022, the course title was "Corporate Finance for Actuarial Science."

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:** Minimum grade of C in AS 5101 (may be taken concurrently)

**AS 5108. Actuarial Analytics. 3 Credit Hours.**
Predictive analytics is a key component of actuarial work. It helps improve solutions to traditional actuarial problems such as forecasting mortality, setting loss reserves, predicting policyholder behavior, and establishing classification ratemaking schemes. Actuaries also use these techniques for improving insurance operations through data-driven decision-making. This course introduces students to statistical learning and linear models, with a focus on applying these tools to actuarial business decisions in an insurance or consulting environment. Topics covered include types of modeling problems, methods of assessing model accuracy, exploratory data analysis, exponential family of distributions, parameter estimation, diagnostic tests of model fit and assumptions, model selection and interpretation, calculation of predicted values and confidence/prediction intervals in the context of ordinary least squares regression, k-nearest neighbors, and generalized linear models. In addition, the course aims to enhance students' programming skills.

**Repeatability:** This course may not be repeated for additional credits.

**AS 5114. Advanced Short-Term Actuarial Modeling. 3 Credit Hours.**
Building on AS 5104, the course continues the discussion of short-term actuarial modeling. It introduces students to advanced frequency, severity, and aggregate claim models, as well as concepts of pricing and reserving. Topics covered include commonly used severity, frequency distributions, aggregate risk models, coverage modifications, construction and selection of parametric models, estimate losses using advanced credibility procedures, and pricing and reserving methods for short-term insurance contracts.

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:** Minimum grade of C in AS 5104.

**AS 5116. Financial Reporting for Actuaries. 1 Credit Hour.**
This course introduces students to the fundamental principles of accounting and financial reporting from an actuarial perspective. Topics covered include basic accounting concepts and principles, financial statements, and corporate taxation.

**Repeatability:** This course may not be repeated for additional credits.

**AS 5118. Advanced Actuarial Analytics. 3 Credit Hours.**
This course continues the discussion of AS 5108. Statistical analysis has become part of the modern actuary's day-to-day responsibilities as they help improve solutions to traditional actuarial problems and quantify insurance operations and business processes that have traditionally relied largely on managers' judgment. Topics to be covered include ridge regression, LASSO regression, weighted/partial least squares models, KNN regression, stochastic time series processes, common time series models including predictions, confidence intervals, and interpretation, principal components analysis, decision trees, including classification trees, bagging, boosting, and random forests, k-means and hierarchical clustering, and simulation. The course will further develop students' programming skills in data analytics.

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:** Minimum grade of C in AS 5108.

**AS 5126. Option Pricing. 1 Credit Hour.**
Financial options are a part of many modern life insurance products. In this course, students learn the fundamentals of option pricing and their risk management. Topics covered include basic call and put options, option strategies, put-call parity, Binomial trees, the Black-Scholes model, and Delta hedging, along with their applications to insurance products.

**Repeatability:** This course may not be repeated for additional credits.

**Pre-requisites:** Minimum grade of C in AS 5101 (may be taken concurrently)

**AS 5170. Special Topics. 3 Credit Hours.**
Special Topics. Content varies.

**Repeatability:** This course may be repeated for additional credit.

**AS 5180. Special Topics. 3 Credit Hours.**
Special Topics. Content varies.

**Repeatability:** This course may be repeated for additional credit.

**AS 5182. Independent Study. 1 to 6 Credit Hour.**
Special study in a particular aspect of actuarial science under faculty supervision. Maximum of six hours may be counted toward degree requirements.

**Repeatability:** This course may be repeated for additional credit.

**AS 5190. Special Topics in Actuarial Science. 3 Credit Hours.**
Special Topics - Actuarial Science. Content varies.

**Repeatability:** This course may be repeated for additional credit.

**AS 5191. Mentored Research. 1 to 6 Credit Hour.**
The student conducts research - broadly related to actuarial science or insurance economics - under the supervision of a faculty member. A maximum of six hours may be counted toward degree requirements.

**Repeatability:** This course may be repeated for additional credit.

**AS 5282. Independent Study. 1 to 3 Credit Hour.**
Independent Study. Focus to be determined by instructor and student.

**Repeatability:** This course may be repeated for additional credit.

**AS 5685. Actuarial Internship. 1 to 3 Credit Hour.**
The student participates in an actuarial internship to gain relevant practical work experience. The internship must be for at least 240 work hours over the course of one semester.

**Repeatability:** This course may be repeated for additional credit.