

# Actuarial Science (M.S.)

---

## About The Program:

Specializing in evaluation of insurance and financial risks to distinguish themselves through a combination of analytical skills, business acumen, and professionalism.

- Can be tailored to students' interests and backgrounds
- Recognized as a Center of Actuarial Excellence (CAE) by the Society of Actuaries

**Career Options:** Actuaries hold positions of responsibility with consulting firms, government insurance programs, government regulatory organizations, insurance companies, and investment banks.

**Prerequisites for Admission:** Applicants are expected to have earned grades of at least a "B" in each of their college-level calculus (differential, integral, and multivariate) courses. Prior coursework in mathematical probability and statistics is strongly recommended.

**Affiliation(s):** Research is supported by Fox School of Business and Management's Advanta Center for Research in Financial Institutions, Center for Healthcare Research and Management, Innovation and Entrepreneurship Institute, and Institute of Global Management Studies. Research interests of the Fox School faculty are also supported by numerous centers and institutes throughout Temple University.

---

## Requirements of Programs:

- **Total Credit Hours:** 30
- **Culminating Events:** Successful completion of coursework is required to earn the M.S. degree in Actuarial Science

### *Core Courses:*

**Theory of Interest** – In this course, simple, compound and effective interest functions are analyzed and used in the calculation of present value and future values of various investments. Annuities, loan amortization and bonds are discussed and techniques for computing their values at various dates are explored.

**Actuarial Modeling I** – This course introduces the discrete and continuous random variables measuring the future lifetime of a person. Among the topics covered are calculation of the mean, variance and probability functions for these random variables, introduction of a present value random variable measuring the present value of a life insurance and annuity benefit, calculation of premiums for life insurance and annuities using interest rates and calculation of reserves for insurance companies, examining future liabilities and inflow.

**Actuarial Modeling III** – Estimation and fitting of survival, frequency and severity, and compound distribution loss models; credibility methods.

**Advanced Theory of Interest** – This course develops the theoretical basis of certain actuarial models and the application of those models to insurance and other financial risks. It prepares students for SOA

Exam MFE or CAS Exam 3F. Topics covered in this course include Vasicek and Cox-Ingersoll-Ross bond price models, Black-Derman-Toy binomial model, Black-Scholes option-pricing model, exotic options, Itô's lemma in the one-dimensional case. Simulation of lognormal stock prices and variance reduction techniques will be discussed and delta-hedging in risk management will be demonstrated.

**Actuarial Analytics** – The course introduces students to linear regression models and time series analysis, with a focus on applying these tools to actuarial business decisions in an insurance or consulting environment. Statistical analyses have quickly become part of the modern actuary's day-to-day responsibilities as they help improve solutions to traditional actuarial problems such as estimating mortality, setting loss reserves, predicting policyholder behavior, and establishing classification ratemaking schemes. In addition, actuaries have started to use predictive modeling techniques to improve insurance operations and business processes that have traditionally relied largely on the managers' judgement. The course aims to prepare students for and beyond the data analytics needs of entry level actuarial positions. Since programming skills are vital to conduct statistical analyses - and are thus highly valued by the insurance industry - they are also a focus of this course. In particular, students will learn two of the most common statistical languages used by actuaries: SAS and R. No prior knowledge of these languages is required. Students will be introduced to both languages and will apply them throughout the course to various real-world insurance and financial data sets. Furthermore, the course will feature hands-on guest lectures by alumni of the Temple actuarial science program who will present students with examples of their work with data analytics.

**Managing Human Capital** – Analysis of the major areas in non-pension employee benefits. Reviews overall considerations in employee benefit design including federal and state regulation, group insurance and the group insurance technique, sources of healthcare benefits, HMOs, PPOs, managed care systems and disability income benefits. Considers flexible benefits plans and funding considerations. Income tax implications and healthcare cost containment issues are also examined. Group and individual life insurance theory and practice and their use in employee benefits plans. Note: Prior to fall 2017, the course title was "Life and Health Insurance and Employee Benefits".

**The Role of Property and Casualty Insurance Sector in Enterprise Risk Management** – Provides a graduate level introduction to the property-liability insurance industry. Attention given to structure of marketplace, regulatory framework, and relationship between the property-liability insurance industry and the firms which it protects. Discusses issues effecting the industry from an economic, legal, and public policy. Applications include product liability, environmental impairment liability, and worker's compensation issues. Note: Prior to fall 2017, the course title was "Property and Liability Insurance"

***Electives:***

**Accounting for Managerial and Investment Analysis and Planning** – This course presents the concepts of financial and managerial accounting with a "user" (investor or manager) orientation. The course has three parts. The first part provides the accounting cycle and the reporting process, with an emphasis on the valuation bases and structure of the financial statements. The second part focuses on the interpretation and analyses of the financial statements, including analyses of cash flows and cross-sectional and time-series trends in financial ratios. The role of managerial accounting choices in determining the nature of financial reporting and quality of earnings is also examined. The third part

examines the role of accounting information for managerial planning and control. Costing for inventory and pricing, cost-volume-profit analyses, and budgeting issues are covered.

**Actuarial Modeling II** – This course introduces multiple life functions that require the use of joint probability functions and the calculation of marginal probability distributions. Additional topics include the calculation of mean and variance for these joint random variables and multiple decrement theory. Various topics from Loss Models are also discussed including computation of mixed distributions through compounding of frequency distributions with severity distributions and the calculation of premiums for insurance policies with deductibles, limits and coinsurance.

**Actuarial Economics** – This course develops the conceptual framework of microeconomics and macroeconomics with some applications in actuarial science. It offers the VEE credit for Economics as required by the Society of Actuary. 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.

**Actuarial Corporate Finance** – This course introduces students to the fundamental principles of accounting, corporate finance, and financial derivatives, from an actuarial perspective. It offers students VEE credit for accounting and finance, as required by the actuarial societies. It also covers the corporate finance material of actuarial Exam IFM. The course covers basic accounting principles and regulations, financial statements, investment decision making, the risk-return tradeoff, capital structure, long-term financing, investment risk, and an introduction to both financial and real options.

**Microeconomic Analysis** – Microeconomic theory for graduate students with little preparation in economics. This course offers detailed analysis of the behavior of households and firms in a variety of market settings.

**Macroeconomic Analysis** – Macroeconomic theory for graduate students with little preparation in economics. This course is a survey of theories and evidence bearing on growth and cycles in output, employment, interest rates, and prices. The course includes sector details and considers the scope for control of cycles.

**Econometrics I** – This course is the first in a two-semester sequence. The materials begin with the classical linear regression model, including hypothesis testing. Such traditional topics as multicollinearity, heteroscedasticity, and autocorrelation are included. Problems of pooled data and simultaneous equations are also considered.

**Time Series Econometrics** – This course is designed to teach students advanced econometric techniques necessary to conduct original empirical research in macroeconomics. The course focuses on techniques appropriate for the analysis of time-series data. Students will learn the theoretical underpinnings of such topics as stationarity, ARMA processes, and vector autoregression (VAR) models and how to apply this theory to economic data.

**Panel Data Econometrics** – This course is designed to teach students advanced econometric techniques necessary to conduct original empirical research using micro-level data. The course focuses on techniques appropriate for the analysis of cross-section and panel data. Students will learn the

theoretical underpinnings of such topics as instrumental variables, selection bias, and regression discontinuity, and quantile regression. We will pay particular attention to how to apply these techniques to economic data.

**Marketing Management/Strategy** –This course is designed to provide students with an understanding of how firms develop marketing strategies to create and manage the creation of meaningful offers that are valued by consumers for the purpose of developing and maintaining customer relationships. Initially, we will address the evolution of market systems at the macroeconomic level and the role that marketing plays in bridging the gap between the production and consumption sectors of the economy. Subsequently, we will explore how firms develop strategies to create customer value through product management, pricing, marketing channels, supply chain management, customer relationship management and communications directed to buyers and also develop an understanding of how buyers acquire, consume and dispose of these goods and services.

**Managing Risk** – Risk Management requires the firm to identify opportunities for gain and exposures to unexpected loss. The firm must then assess the potential consequences, and plan to finance the consequences of the adverse event if it happens. This course is designed to introduce the risk management process in the context of general corporate management. Each step in the process will be reviewed in detail, including setting the risk management context, identification of risk, measurement and analysis of potential impact, and appropriate treatment techniques. Risk financing options will be discussed in the context of global insurance and alternative capital markets. While the risk management process encompasses all types of risks, we will focus our identification discussion on the class of risks known as pure risk events; those that pose the threat of a loss if they happen, but no possibility of a gain.

**Visualization: The Art of Numbers and the Psychology of Persuasion** – Organizations are collecting an unprecedented volume of data, and analysts are producing information from data using analytics and models. None of the information that is extracted from the data is usable unless it can be effectively communicated. In this course, we will begin with the fundamental questions of communication: Who is the audience? What is the information? What is the goal? Using these questions to focus our thoughts, we will explore the techniques that allow you to select appropriate information and to craft a narrative that clearly and effectively communicates this information using visual elements. Producing good visual displays is a combination of art and science and compromise between function and form. We will discuss how humans process and encode visual and textual information in relation to selecting an appropriate visual display, and we will cover topics including: exploratory data analyses, charts, tables, graphics, static and dynamic displays, effective presentations, multimedia content, animation, and dashboard design. Examples and cases will be used from a variety of industries.

**Statistical Learning and Data Mining** – This course is designed to change the way you think about data. Numerous firms have demonstrated that the ability to reliably extract managerially-relevant information from data is a potent and enduring source of competitive advantage, a realization that transforms data into an asset that can be a primary source of competitive advantage. Competition is pushing organizations to "mine" (or extract) these insights faster, with greater reliability, and in ways that maximize the probability of implementation. In this course we will explore how statistical learning and data mining techniques can be used to improve decision-making and profitability. The course will

provide an overview of the fundamental principles and techniques of data mining, and we will use real-world examples, cases, and "hands-on" techniques to demonstrate data-mining techniques in context, to develop your analytic thinking, and to develop your model building acumen.

**Advanced Business Analytics** – This course builds upon the foundation in Business Analytics. In previous courses, we saw that data by itself is useless, and that it must be transformed into information in order to have value to decision makers. This course will extend your understanding of the art and science of extracting information from data into increasingly complex and "real world" data. Specifically, we will cover extensions to regression, logistic regression, hierarchical modeling, model selection, and other topics spanning the process of building and evaluating models. In addition, we will practice drawing intuition and insight from models and effectively communicating that insight in a format that can help decision-makers to make better decisions.

**Stochastic Processes** – This is a first course in stochastic processes, with an emphasis on continuous-time models that support applications in financial mathematics and derivative evaluation. The course covers: fundamentals of probability, limit theorems, conditional expectation, change of measures, Markov chains, random walks, martingales, Brownian motion, the Ito integral, stochastic differential equations, the Black-Scholes model and its use in evaluating a variety of financial derivatives.

**Applied Multivariate Analysis I** – Multivariate normal distribution; marginal and conditional distributions; estimation of population mean vector and dispersion matrix; correlation, partial correlation, and multiple correlation coefficients; Hotelling's T<sup>2</sup>; MANOVA; discriminant function; repeated measurements analysis; principal components and canonical correlation; factor analysis; and multidimensional scaling.

**Nonparametric Methods** – A thorough course in nonparametric statistics. Estimation and testing of hypothesis when the function form of the population distribution function is not completely specified.

---

## Courses:

Click [HERE](#) for more information on the courses below.

- Theory of Interest
- Actuarial Modeling I
- Actuarial Modeling II
- Actuarial Modeling III
- Actuarial Economics
- Actuarial Corporate Finance
- Advanced Theory of Interest
- Actuarial Analytics
- Special Topics
- Independent Study
- Special Topics in Actuarial Science
- Casualty Contingencies
- Independent Study