

CAS CURRICULUM GUIDE



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This guide has been developed to help students and faculty build a stronger understanding of the academic strengths, technical tools and personal skills successful actuaries possess. Students can use the guide to identify experiences to seek out while in college to help them prepare for a future career as an actuary, specifically as they embark on the path to earning actuarial credentials through the Casualty Actuarial Society. To that end, the guide makes references to preparing for and taking professional actuarial examinations and other requirements for earning CAS credentials. The complete set of requirements for earning CAS credentials, which are recognized as the gold standard for property/casualty actuaries by employers and regulators, can be found as an appendix of the guide.

For faculty, this guide provides an overview of the key academic topics to cover in an actuarial curriculum and can help identify experiences that can be worked into a classroom to help their students develop the skills needed to hit the ground running in the business world. Links to examples of existing actuarial science courses and curricula offered at various types of universities are included in the appendix.

The guide is separated into three main sections:

1. **Academic Foundation:**

The academic subjects that are the building blocks of actuarial work

2. **Technical Toolkit:**

Important tools that help actuaries solve challenging business problems

3. **Workplace Readiness:**

The skills that help new employees make an impact on the job day one

Each main section is comprised of several subject/skill subsections that include:

1. **Description and Importance:**

What it is and why it's important for an actuary

2. **On the Job:**

An example of where the subject/skill is needed in the workplace.

3. **Experiences:**

Experiences a student can seek out or faculty can provide that will help prepare students for success as an actuary

This guide was developed by the University Engagement Committee. Any questions or comments pertaining to the guide can be sent to: office@casact.org

Academic Foundation

Mathematical Base
Probability Theory
Financial Mathematics
Statistics
Core Actuarial
Economics
Finance
Risk & Insurance

Technical Toolkit

Statistical Analysis
Data Manipulation
Programming Skills
Microsoft Office

Workplace Readiness

Presentation Skills
Teamwork Skills
Project Management
Business Writing
Ethics & Professionalism
Business Etiquette
Exam Study Skills

ACADEMIC FOUNDATION

Mathematical Base

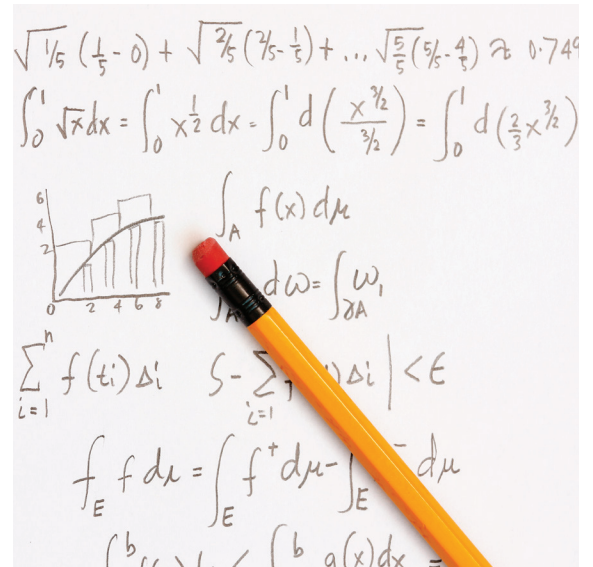
Calculus

Description and importance

Calculus is the base of all actuarial studies. One cannot understand continuous probability without a solid foundation in calculus. Within financial mathematics, calculus concretely establishes the fact that the derivative represents the rate of change and the concept of the integral captures the accumulation function. Professional actuaries and statisticians all have a solid background in calculus. All higher level actuarial and statistical courses presume several background courses in calculus.

On the job

Sally works for a company that accepts payments now in exchange for taking on a future liability. She is in charge of periodically reviewing the company's surplus and quantifying the potential impact future interest rate changes might have on that surplus. Surplus can generally be defined as the difference between the present value of the assets and the present value of the liabilities. To evaluate the companies' control over the asset cash flows and their liability cash flows, she often uses mathematical concepts such as duration, which is derived from higher order derivatives in calculus.



Experiences

- Take courses in univariate and multivariate calculus to build a strong understanding of fundamental concepts and applications.
- Read newspaper and magazine articles to look for applications of calculus in various fields such as finance, economics and sociology.

Linear Algebra

Description and importance

Linear algebra, which focuses on the solving of linear equations through matrix manipulation techniques, prepares a student for future studies in differential equations. Both linear algebra and differential equations have many applications in economics and business. Actuaries often have to model systems with many equations and many unknowns which can only realistically be handled by computers using linear algebra techniques.

On the job

Phillip is a casualty actuary. In his day-to-day work he is usually working with large amounts of data in spreadsheets or databases. This data takes on the form of very large matrices. His prior

work and background in linear algebra has prepared him to work with large datasets and helps him understand the complex data manipulations required to solve business problems. In his statistical analysis he often employs linear regression, a common tool that he uses for predictive modeling which is based on matrix manipulation techniques.

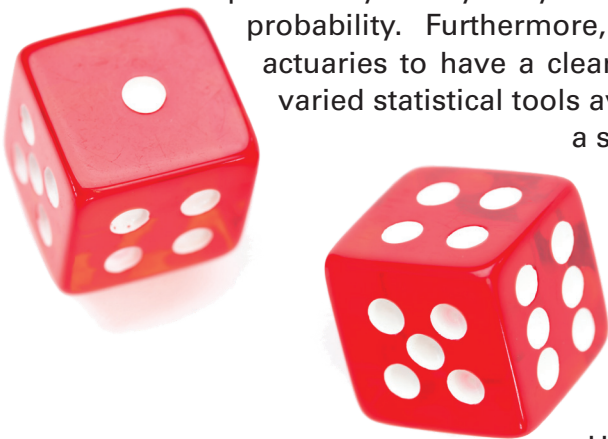
Experiences

- Take a course in the basic theory and techniques of linear algebra.
- Take at least one additional course that builds upon introductory material; in particular, regression and time series techniques are critical in actuarial science, finance, and economics.
- In other classes, or even in extracurricular activities, look for opportunities to do simple studies and projects which examine relationships between variables. For example, it is simple to study relationships and correlations between economic or financial variables, such as changes in interest rates and stock prices.
- Research real world applications of linear algebra in engineering, computer science, finance and economics.

Probability Theory

Description and importance

Probability theory constitutes a core section of actuarial mathematics. In fact, probability permeates most analyses in the world of actuarial science. Certainly, probability theory is used as a foundation for analyzing and evaluating the financial costs of risk and uncertainty. Actuaries help their companies and clients develop strategies to minimize risk and manage costs utilizing probability theory. Any analysis of risk and risk theory is an expansion of mathematical probability. Furthermore, all statistical inference is rooted in probability theory. For actuaries to have a clear understanding of any advanced statistical analysis or the varied statistical tools available to them to help solve business problems, they need a strong foundation in probability theory.



On the job

Rafael works for a large insurer where his responsibilities include building predictive models to help determine the risk of hurricanes. Those predictive models are used to help determine a reasonable amount to charge for that hurricane risk in the insurance products his company sells.

He first uses his knowledge of statistical distributions to select a curve that best fits his company's hurricane severity data.

From there, he may choose to credibility weight that curve with a curve based on industry data. The combined curve could be used to determine the relationship between how severe a storm is and the probability of that storm occurring. Rafael can interpolate to get smoothed values, or extrapolate to understand what could be happening in extreme situations. Rafael might calculate the severity of the 99th percentile hurricane to determine what type of catastrophe load should be built into the price of a product. To be more conservative, he might instead calculate the average severity of a hurricane given that it is worse than the 99th percentile. Without Rafael's strong understanding of probability theory, his company may set the price of a product too low and then won't have generated enough revenue to cover losses when a hurricane strikes. Conversely, if the risk is over estimated, the price of the product might be set too high and no longer be competitive in the marketplace.

Experiences

- Take courses in basic probability and more advanced applications of probability, especially centering on probability distributions.
- Take several statistical courses that are calculus based.
- Prepare for and take a professional actuarial exam that tests this material and introduces you to its many real-world applications (e.g., P of the Society of Actuaries or CT3 of the Institute and Faculty of Actuaries).
- Reflect on how the rules of probability impact the games you play and the decisions you make.

Financial Mathematics

Theory of Interest

Description and importance

In a typical university actuarial science curriculum, the first course dealing with the mathematics of finance that students take is a “Theory of Interest” course. Such a course could also rightly be called “Financial Mathematics I,” since the material provides the foundation for all advanced quantitative work in finance. Basically, the theory of interest involves an understanding of the time value of money, and its implications for economic and financial values of assets and liabilities. Particular concepts and techniques include the nature and definitions of different types of interest rates, valuations of annuities or other streams of cash flows, determining rates of return, calculating payments on mortgages and other types of loans, valuing stocks and bonds, and estimating the risk associated with financial processes. Taken as a whole, the theory of interest material represents the basis upon which all quantitative measures of risk – policy premiums, insurer liabilities, investment uncertainty, etc. – are determined.

On the job

George works in the enterprise risk management unit of a large insurer, and is responsible for building and maintaining a model of potential future economic and financial conditions. Such a model provides the ability to simulate (i.e., analyze different scenarios of) the financial condition of the insurer under a variety of possible future conditions. George uses his theory of interest skills to model how future changes in the economic and financial environment such as investment yields will affect the current value of his insurer.

Experiences

- Take a Theory of Interest class to build a strong base of skills and techniques which will be leveraged in more advanced actuarial, economic, and financial courses.
- Prepare for and take a professional actuarial exam that tests this material and introduces you to its many real-world applications (e.g., FM of the Society of Actuaries or CM1 of the Institute and Faculty of Actuaries).
- Observe closely when you, your family, or friends engage in financial transactions such as loans, investments, or installment payments.
- Try to observe the activity in the financial markets each day. Notice how different sets of prices or variables move relative to each other – for example, stock prices versus interest rates, or inflation versus interest rates.



Models for Financial Economics

Description and importance

After learning and absorbing the material in a Theory of Interest (or “Financial Mathematics I”) course, a student is prepared to move on to a second course in this sequence such as Models for Financial Economics or Financial Mathematics II. This material, covered on the MFE or CT8 exams, involves developing and analyzing financial and economic models of relevance to actuarial science and risk management. In particular, the focus is on the mathematics and economics underlying the pricing of financial options. This involves understanding stochastic processes, which involve the evolution of random variables over time, including Brownian motion as a modeling framework. Ultimately, this leads to ideas and techniques critical for understanding advanced actuarial and financial risk management material, such as the Black-Scholes option pricing model, and delta-hedging. Other important topics in this area include stochastic simulation of economic and financial variables, and the modeling of interest rates.



It is important for actuaries to understand the mathematics underlying the pricing of financial options because an insurance policy is an option. It has basically the same structure, and is thus governed and modeled by the same mathematical underpinnings as a financial option.

On the job

Sheri works for a large commercial lines insurer, which provides liability insurance policies for large corporate organizations. She works in a pricing role, where she helps determine appropriate premiums for the insurer’s corporate customers. Among other approaches, she uses an option-based approach to pricing insurance policy premiums. By understanding the dynamics of the stochastic loss process which underlies the risk associated with an insurance customer, Sheri can use option pricing techniques to estimate an appropriate value, or premium, for an insurance policy.

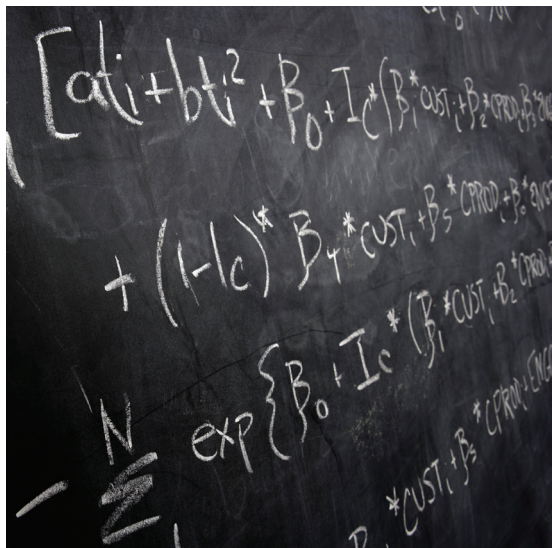
Experiences

- Take a financial mathematics class, and continue to use and exercise your skills and techniques in actuarial, economic, and financial courses.
- Prepare for and take a professional actuarial exam that tests this material and introduces you to its many real-world applications (e.g., IFM of the Society of Actuaries or CT8 of the Institute and Faculty of Actuaries).
- Take advantage of a project opportunity, either extracurricular or in an advanced economics or finance course, to look at possible future paths for economic or financial variables. Even a simple stochastic process model can help enlighten you to the amount of future uncertainty involved in the financial markets.
- Try to observe the activity in the financial markets each day, and try to understand how options and other financial derivatives work.
- Take an opportunity to look at historical economic and financial data. These data are often good bases for observing and understanding the historical dynamics of time series variables. A good source of historical data is the U.S. Federal Reserve’s FRED database, at <http://research.stlouisfed.org/fred2/>.

Statistics

Description and importance

Statistics is the study of numerical data. More specifically, statistics involves analyzing and learning from a data sample, and inferring from this the probabilistic tendencies and relationships in the larger population. Statistics is thus a core discipline underlying actuarial science, which looks at historical risk-related data in order to understand and model the dynamics of future loss processes.



The field of statistics can be categorized into “descriptive statistics” and “analytical statistics.” Descriptive statistics involves those measures which describe the nature of the data sample that is being analyzed. Metrics such as mean, median and mode are measures of where the data is “centered.” Metrics such as standard deviation and variance help us to understand the “spread” of the sample – i.e., the degree to which sample values may potentially differ from the central values.

Analytical statistics involves taking the data sample and its descriptive statistics, and inferring from them the nature and shape of the distribution from which the data came. Often, various types of theoretical statistical distributions are speculated to be consistent with the data observed, and then specific parameter values for the distributions are then estimated from the data. With this mathematical structure, the future behavior of processes and data samples can be explored.

On the job

Christine is an actuary for a large personal lines insurance company responsible for pricing automobile insurance. She has a large sample of losses by dollar size that occurred last year under her company’s portfolio of auto insurance policies, and she is attempting to use that data to estimate a statistical distribution that represents the relative likelihoods of losses of different sizes for next year. She calculates a number of descriptive statistical measures of the data, to get a feel for the dispersion of the actual losses. She then uses techniques – both graphical and analytical – to estimate an appropriate type of distribution and its possible specific parameter values. Finally, by adjusting her selected distribution for inflation and possible other exogenous variables, she has a theoretical distribution of losses which she believes will be representative of the possible losses which may emerge next year.

Experiences

- Take at least one statistics class. A basic statistics class should provide you with an opportunity to calculate descriptive statistics for a variety of sample data sets, as well as to estimate parameter values from the data for a variety of different theoretical distributions.
- Prepare for and take a professional actuarial exam that tests this material and introduces you to its many real-world applications (e.g., MAS-I and MAS-II of the Casualty Actuarial Society).
- Take advantage of a project opportunity, either extracurricular or in a statistics course, to analyze and draw conclusions from actual datasets. Working with real world data provided by companies or organizations is challenging and any experience in this gained in college will be beneficial.
- Observe how statistics are used in the media to add credibility to ideas and arguments. In particular take note of ways people improperly use statistics to support their ideas and arguments.

Core Actuarial

Actuarial Adjustments and Techniques

Description and importance

Actuarial science is one of the most interdisciplinary of professions. This is because, in order to analyze either quantitative or qualitative data, it is necessary to understand the source of that data, and the entire environment surrounding the emergence of the data. This means that data is impacted by the totality of the socioeconomic, financial, technological, and cultural climate, and can only be fully understood in that context.

Within this environment, mathematical and statistical techniques represent the core skill set for actuaries (with interpretations of data and of results made within the relevant climate). Specific examples of the core actuarial skills and techniques include:

- Reserving and Ratemaking, projections of historical loss and premium data into the future. Many factors can result in the same risk producing different results over time: inflation, evolving judicial interpretations and societal standards, new laws and statutes, changes in the processes by which claims are handled and settled, etc. Specialized quantitative techniques have been, and continue to be, developed to accommodate these situations.
- Analysis of situations where there are modifications to the data, such as deductibles and policy limits. Often basic statistical techniques need to be adjusted for common insurance-related situations, such as when an insurer does not have access to complete data resulting from a risk exposure.



On the job

Jerry is an actuary for a large reinsurance company. His job involves looking at historical underwriting and financial data, and helping the company to make operational and strategic decisions by projecting historical variables into the future. He uses a technique called simulation, which allows him to project next year's company profitability thousands of times, in order to model the expected value and potential volatility of next year's financial results based upon certain operating assumptions. By changing the operating assumptions and re-simulating, he can see how the company's potential results change under different operational and strategic decisions.

Experiences

- Take a solid base of math and statistics courses. Even subject matter that doesn't appear to be actuarial in nature can help with one's quantitative knowledge and creativity.
- Take a wide range of courses across multiple disciplines. Actuarial science is inherently interdisciplinary, and the best actuaries are those who can connect ideas and techniques across disciplines, and who are sensitive to the environment in which the data they are analyzing emerged.
- Prepare for and take a professional actuarial exam that puts statistics into a specific insurance and risk management context (e.g., MAS-I and MAS-II of the Society of Actuaries or CT6 of the Institute and Faculty of Actuaries).

- Introduce yourself to the basic reserving and ratemaking techniques that are commonly used in the property and casualty industry. Free online textbooks covering this material are available from the CAS
 - o Ratemaking: http://www.casact.org/library/studynotes/Werner_Modlin_Ratemaking.pdf
 - o Reserving: http://www.casact.org/library/studynotes/Friedland_estimating.pdf
- Learn what practicing actuaries do, and how they leverage their college experiences in their careers. Listen to their presentations to university classes and actuarial clubs, and/or take advantage of field trips to companies or job shadowing opportunities.

Life Contingencies

Description and importance

Life contingencies course work blends the topics of risk theory and interest theory. Although the models that are often studied apply directly to life insurance products, many of the techniques are applicable to property and casualty insurance as well. For example, asset share pricing involves the basic premise that a piece of business can be written even though it may be unprofitable in the first year. It could be expected to be profitable in future years. Life contingency ideas can be applied to retention rates, and the probability that the customer will renew their business in the future more profitable year. Similar thinking can be applied to investment theory, and evaluating whether an investment will become insolvent. The course should deepen the students' awareness of insight as to how insurance models as a whole are constructed. The similarities between discrete models and continuous models should be made evident.



On the job

Lena is the actuary that calculates the workers compensation loss reserves. It is her job to use statistical projections to determine how much money her company needs to set aside to pay for losses they have already incurred. A worker who is injured seriously enough will receive insurance payments for the rest of his life. In order to most accurately reflect the true liability, Lena needs to use her knowledge of life contingencies to discount the future annuity payments of these special claims by taking into account both time value of money as well as the probability that the worker may die at any given year. Determining the proper discount is crucial to assure that senior management can make its best business

decisions, regulators are comfortable the insurer will remain solvent, and the IRS can collect appropriate taxes.

Experiences

- Take a basic course in life contingencies to build a strong understanding of fundamental concepts and applications in insurance.
- Read newspaper and magazine articles to look for applications of life contingencies in various fields such as finance, economics and engineering.

Economics

Description and importance

Economics is the study of how people behave and make decisions to fulfill their needs and desires in a world of limited resources. The subject is typically broken down into two sub-areas:

- Microeconomics involves economic behavior and decisions at a “micro” level – i.e., typically at the level of the individual, the family, or the firm. Common topics in microeconomics include product supply and demand, rational utility maximizing behavior, and competition and profit maximization.
- Macroeconomics deals with economics at the “macro” or aggregate level – across all agents in a society, taken in totality. Common topics in macroeconomics include societal production (e.g., GDP, GNP), monetary policy, interest and inflation rates, international trade, and exchange rates.



Both sub-areas of economics have profound relevance for actuarial science, insurance, and risk management. When individuals or corporations make decisions about purchasing insurance or implementing another risk management technique, they are making economic decisions that affect their balance sheets and their potential future earnings. Furthermore, those decisions are often dependent upon the specific economic conditions both at the time of the decision and anticipated in the future. Similarly, insurance company decisions regarding whether to accept or reject risks, and how much premium to charge for those risks, are largely dependent upon economic conditions and outlooks.

On the job

Jennifer is a workers compensation actuary for a commercial property/casualty insurance company. She is working on a project to understand the future supply and demand in the national workers compensation insurance market, and the potential consequences for her company's business. Since the premium volume for this type of insurance is a function of payroll, there will be greater demand for workers compensation insurance policies if the business environment and production are relatively strong. Jennifer uses her knowledge of economics, supply and demand, and monetary and tax policies to help understand the potential market for workers compensation insurance policies.

Experiences

- Take courses in both microeconomics and macroeconomics. Such courses may also fulfill the VEE (Validation by Educational Experience)-Economics requirement for actuarial certification by the Casualty Actuarial Society.
- Try to observe the activity in the economic and financial markets each day.
- Subscribe to and regularly read a newspaper and/or magazine that reports on the economy.
- Take an opportunity to look at historical economic and financial data. These data are often good bases for observing and understanding the historical dynamics of time series variables. A good source of historical data is the U.S. Federal Reserve's FRED database, at <http://research.stlouisfed.org/fred2/>.

Finance

Description and importance

Finance, an area of study which is closely related to economics, is an area of growing relevance to actuarial science. Finance involves understanding how the prices of assets and liabilities are obtained, and how individuals and firms make decisions in the context of those prices. Sub-areas of the field of finance include investments, corporate finance, financial derivatives, and financial risk management. Financial risk management overlaps significantly with actuarial science since an insurance policy is a technique by which a firm or individual may choose to manage the potential financial consequences of risks, and the premium for such a policy must accurately and adequately reflect the quantitative nature of those risks.

Financial projects in which actuaries might get involved include optimizing an investment portfolio, determining an insurer's most appropriate capital structure, and using financial models of risk-versus-return to estimate appropriate premiums for insurance policies.

On the job

Jeremy is a pricing actuary for a large property/casualty insurance company. He is responsible for overseeing the development of prices to be charged future policyholders for homeowners insurance in New England. He is also responsible for preparing the rate filings to be submitted to each state's insurance regulator, which explain and rationalize the proposed prices. As is common in an actuarial project, Jeremy uses several different techniques to analyze historical data and make projections of the costs of future risks. Among possible other techniques, he may use several financial techniques to estimate appropriate rates. In particular, these techniques may include a capital asset pricing model framework, a cash flow model, and an option pricing approach.



Experiences

- Take courses in finance. These might include a general overview course, and/or specific courses in investments, corporate finance, financial derivatives, or financial risk management. Such courses may also fulfill the VEE (Validation by Educational Experience)-Finance requirement for actuarial certification by the Casualty Actuarial Society.
 - Try to observe the activity in the economic and financial markets each day, paying particular attention to the interplay between asset prices (e.g, stock market and bond prices) and economic variables such as interest rates.
- Subscribe to and regularly read a newspaper and/or magazine that reports on the economy.
 - Read annual reports, earnings releases and other publically available financial statements for an insurance company.
 - Participate in a simulation exercise offered by college finance courses and departments whereby an investment "game" is played between individuals and groups.
 - Take an opportunity to look at historical economic and financial data. These data are often good bases for observing and understanding the historical dynamics of time series variables. A good source of historical data is the U.S. Federal Reserve's FRED database, at <http://research.stlouisfed.org/fred2/>.

Risk & Insurance

Description and importance

Actuaries analyze and evaluate the financial costs of risk and uncertainty and help their companies and clients develop strategies to help minimize and manage those costs. Successful actuaries have a solid understanding of the potential risks, how those risks interact and the environment in which those risks occur. Introductory courses in risk management and insurance help provide a background

in property and casualty risk exposures and describe the various tools available to individuals and businesses to manage those risk exposures, such as insurance. A firm understanding of the various types of property casualty insurance, including workers compensation, automobile, property, general liability and umbrella coverage, is essential.

Successful actuaries have a solid understanding of the potential risks, how those risks interact and the environment in which those risks occur.

On the job

Richard is a consulting actuary specializing in self-insurance programs of corporations, governmental entities, and healthcare institutions. He frequently works directly with risk managers, CFOs, and Boards of Directors. In order for him to completely understand his client's insurance program and needs, it is critical that Richard master the different types of

insurance exposures that a company may face and that he can effectively communicate in "risk management" terms, in addition to "actuarial" terms. Richard is often relied upon by his client's management team to provide insight about better controlling insurance risks and bridging the gap between actuarial analysis and financial results on the balance sheet and income statement.

Experiences

- Take an introductory course in risk management and insurance
- Read the daily news and try to identify different risks individuals and businesses face and the tools they use to manage them.
- Talk to your insurance agent or conduct research on the internet about property casualty insurance coverages

TECHNICAL TOOLKIT

Statistical Analysis

Description and importance

“Statistical analysis” refers to the ability to apply statistical concepts and techniques to data, to understand the key results, and to provide guidance to business decision making. Actuaries with strong statistical analysis skills leverage statistical software packages to help organize, analyze, and test large amounts of data, looking for patterns in the data and evaluating their credibility, strength and relevance. Results are often summarized and communicated to a non-technical audience in order to influence key business decisions.

On the job

Sally works for a large insurer who wants to know if detailed driving data collected from policyholder cars (telematics data) will improve the accuracy of the insurer’s rating plans. Sally loads the telematics data combined with premium and loss experience into a commonly used statistical package to evaluate which, if any, variables can be used to differentiate high vs. low cost policyholders.

To begin, Sally applies variable reduction techniques to 50 telematics variables, selecting the eight variables that provide the greatest differentiation based on key statistical metrics while considering the correlations among them. She then develops factors and weights for each variable and builds a model that best fits the data. Sally must then communicate to senior management how using the model will improve the profitability of the insurer.

Experiences

- Develop an understanding of statistical concepts and techniques, including correlation, hypothesis testing and multiple regression.
- Solve problems which involve ranking the importance of multiple pieces of information.
- Take a course in SAS, R, Excel or another statistical software package.
- Use data to influence a decision in a student club or organization.

Data Manipulation

Description and importance

“Data manipulation” refers to the ability to summarize, move, join, sort, arrange, and clean data from various sources to efficiently and effectively provide the information necessary to solve business problems. Actuaries with strong data manipulation skills are able to quickly provide answers to urgent inquiries from key business partners and build robust datasets to serve as the basis for important analyses.

On the job

Harry works for a large insurer that just completed a multi-division project to create an Enterprise Risk Management (ERM) data warehouse. As part of the project, Harry’s area identified claims,



policy issuance, collections, and investment information available in various systems throughout the company. He assisted in selecting and moving the most important data from each source to the new warehouse environment. Along the way he clearly documented data sources and definitions, cleaned up data issues and inconsistencies, improving the usability of the data. Harry was able to join together and summarize information from various tables within the warehouse to create prototype exhibits related to corporate risk management for review by his business partners.

Experiences

- Learn computer languages for manipulation of data, such as SQL.
- Take a course in SAS, R, Excel, Access or another software package that is commonly used for data manipulation.
- Study data structure and data warehouse concepts.
- Combine data from two or more sources as part of a class analysis.
- Download publicly available data (i.e., census, social security, etc.) to explore and identify potential data issues.

Programming Skills



Description and importance

“Programming skills” refers to the ability to understand various types of computer languages, logically apply the most relevant commands to the problem at hand, and create a sequence of statements which instruct the computer to efficiently solve a business problem. Actuaries with strong programming skills are able to leverage various software packages to help solve business problems and can effectively collaborate with computer programmers to implement more technical business initiatives.

On the job

Leah works for a large insurer where she is assigned a project to improve the effectiveness of the insurer’s claims fraud model. In the process of her study, Leah reads in *The Actuarial Review* how key words in claim notes, such as “hit-and-run” can be used to identify potentially fraudulent claims. Leah provides specifications to IT for the creation of a claims data file containing text notes, and loads the file onto an actuarial server. Leah then

builds text mining queries using SQL code to identify potentially fraudulent activity and forwards the identified claims list over to the insurer’s special investigative unit (SIU). In this case, 10% of the claims Leah identified were fraudulent. Leah is asked to expand her fraud detection approach to be used for all auto claims on the insurer’s existing claims system.

Experiences

- Take computer programming (C, Python, SAS, R, SQL, VBA) courses in college.
- Write out step-by-step directions for completing a class project.
- Study logic and mathematical proofs.

Microsoft Office

Description and importance

Office software suites such as Microsoft Office are collections of software packages that typically include a spreadsheet, word processor, presentation manager, and a database manager. The names of these in Microsoft Office are Excel, Word, PowerPoint, and Access. Actuaries with strong Microsoft Office skills are able to perform quick calculations (Excel), work with large data sets (Access), prepare engaging presentations (PowerPoint), and create professional looking documents (Word). This software suite is in use in most businesses, and the skills involved translate well to its substitutes. It is very similar to open source suites such as LibreOffice and OpenOffice.



On the job

Bob just started his first actuarial job for a small insurance company. His first project is to convert the company's rate indication system from Access to Excel. Bob took a Visual Basic programming course in college and creates macros to assist in the transition of the system from Access to Excel. He uses pivot tables in Excel to quickly summarize results and perform data balancing. Bob creates a PowerPoint presentation to help communicate both the key transition steps and the expected completion dates during a department meeting. He documents all of his project steps using Microsoft Word.

Experiences

- Take Microsoft Office courses in college.
- Use Excel/Access to solve problems in your Math/Statistics.
- Leverage PowerPoint to develop a presentation for a class or organization.
- Learn Visual Basic for Applications, which expands the potential use of the suite.

WORKPLACE READINESS

Presentation Skills

Description and importance

“Presentation skills” refers to the ability to orally convey key points effectively to other people, whether in a formal setting such as a lecture, a planned meeting to address a business issue, or an informal meeting with a co-worker or client. Actuaries with strong presentation skills are able to successfully communicate the results and implications of their work to groups of people with varied backgrounds influencing key business decisions. Presentation software is commonly used to organize key ideas/findings and tailor presentations to the target audience – but it is equally important to be able to share your ideas without the support of visual aids.



On the job

Jane works for a large insurer, where she is responsible for performing reserve analysis on the general liability line of business. In the process of her quarterly review she notices a significant increase to the average case reserves on open claims in the past two accident years when compared to historical levels. Jane first discusses her findings informally with her manager who asks her to reach out to the claims department to determine if the increase could be driven by a change in claims handling process. In preparation for the meeting with claims, Jane develops a PowerPoint that summarizes her observations to help facilitate the discussion. She learns that the claims department is actively trying to settle smaller claims more quickly, which helps explain her observations. Jane is able to leverage this key finding in her reserve analysis and formally present her final results to the lead actuary at the end of the quarter.

Experiences

- Present key results of a class project to peers.
- Participate in a group presentation.
- Give a short talk – perhaps without notes – on a subject about which you are passionate or an expert.
- Explain complex concepts to someone less familiar with the topic.
- Leverage presentation software to effectively engage the target audience.
- Use visual aids and props to successfully demonstrate a complex concept.
- Prepare and use a graph and/or a table of numbers to convey an interesting result of a school project.
- Interview someone about his/her work, and organize your notes to share with a third party.
- Participate in a practice or actual job interview for an actuarial job that you are seeking.
- Attend a lecture and afterwards summarize the most important points to someone else. Also consider: What did the lecturer do that was effective? What could have been more effective?
- Gain experience answering questions about your work.
- Participate in a debate.

Teamwork Skills

Description and importance

“Teamwork skills” refers to the ability to work collaboratively with a group of people to accomplish a common goal or objective. Actuaries with strong teamwork skills are able to partner with other actuaries, finance and information technology specialists, business leaders and clients to achieve key business initiatives. Strong members of teams not only contribute with their individual skills and expertise but also build relationships, deliver constructive feedback, and manage conflict while focusing on a common goal.

On the job

Viktor is part of an actuarial team that manages property rates for a large insurer. The annual rate adequacy analysis conducted by Viktor’s team indicates that significant rate increases are warranted in several key states. A working group is put together comprised of representatives from actuarial, information technology, regulatory, and underwriting management and charged



with implementing the rate increases as soon as possible. Viktor collaborates with the regulatory department to submit updated rate filings to the state insurance departments. He also works with the IT group to plan how the updated rates, once approved, will be implemented in the computer systems and pricing tools. Viktor partners closely with underwriting management to educate the underwriting staff on the upcoming rate changes in order to minimize confusion, ease concerns over the potential loss of business, and ensure the rate increases are appropriately

communicated to the impacted customers. The working group meets on a weekly basis to update each other on progress and work together to overcome obstacles that have presented themselves. Over the course of the project the working group leverages the individual expertise of its diverse members, continuously seeking the opinions and concerns of all impacted parties in order to develop a solution that works for everyone in accomplishing the overall objective.

Experiences

- Participate in a complex group project.
- Take on a leadership role in a student club or organization.
- Create a study group to help prepare for an actuarial exam or a challenging class.
- Participate in student government.
- Join a volunteer organization.

Project Management

Description and importance

“Project management” refers to the process and skills to plan, coordinate, monitor, and adjust the various information, work steps, people, tools, and other resources that will be needed to complete and deliver a project successfully and within agreed constraints, such as scope, budgets, and deadlines. In the work environment, effective management of actuarial projects is essential in order to deliver the key results of analyses clearly, correctly, and in time to provide relevant input to important business decisions. Furthermore, effective management of projects reduces the risk of wasting resources, such as people’s time. Actuaries who apply good project management skills are more likely to establish a track record of delivering quality work on time, whether working on a project alone or with other team members.

On the job

Fred is part of a team evaluating the extent to which a recent law change regarding injured worker medical care is affecting the cost of workers compensation claims in Tennessee, one of the most important markets for his insurance company employer. The results of the analysis will be used in an important meeting that is scheduled with the insurance regulator in Tennessee. In addition to performing part of the technical actuarial analysis, Fred is asked to serve as the project manager. He begins by outlining a project plan, reviewing it with key experts and participants, and adjusting it based on their discussions. Next Fred assembles the team and resources needed to complete the outlined work steps. Over the course of the project, Fred and his team meet weekly to discuss the status of key work steps, adjusting the overall project plan as needed. The team successfully delivers the results of its analysis in advance of the meeting with the regulator.

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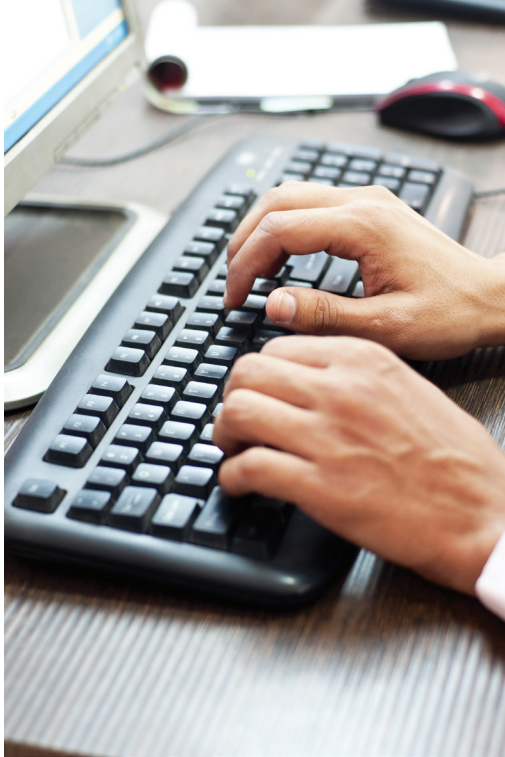
Experiences

- Write down the steps and resources that you think will be required for a complex project you are leading for a class or student organization you participate in. Ask others to review your plan. At the end of the project, review and critique the plan again with a classmate or advisor.
- Plan a weekend trip for your family or friends.
- Take a course or mini-seminar on project management at your university, or on-line.
- Interview someone who has project management as an important element of their job (for example, someone who works for a construction company, an IT expert, or an actuary introduced to you by a mentor).
- Prepare a talk on project management tips and techniques, and present the talk to the members of your local actuarial club.

Business Writing

Description and importance

Business writing refers to the ability to effectively convey key points to other people in writing, whether as part of a formal report or through less formal correspondence such as email. Actuaries with strong business writing skills are able to clearly and concisely communicate the objectives, results, and implications of their work to key stakeholders with varied backgrounds.



On the job

Beth is a consultant currently working on an independent analysis of loss reserve adequacy for her client, a small regional insurance company. Several questions around the quality of the underlying data arise during the analysis. Beth documents her concerns and sends a list of questions to her contact at the insurance company to try to get some answers. After several emails back and forth she has gathered the information she needs to be comfortable with the quality of the data she is using for her analysis. Ultimately, Beth determines that the loss reserves carried by her client are adequate. She writes a detailed formal report documenting the results and conclusions of her analysis and identifying the data relied upon, the methods used, and the key assumptions made. In addition, Beth develops a memo to be sent to the insurer's management team that summarizes the results of her analysis and clearly discusses relevant business observations and implications (such as trends in the number and cost of claims, and changes in profitability levels) of her analysis.

Experiences

- Write a formal report of an analysis summarizing key results and recommendations as part of a class project.
- Ask a business person to review a report you submit for a university course and to provide comments to you regarding how your report stacks up against high-quality business writing.
- Create handouts that go along with a classroom presentation.
- Write an editorial in the local paper.
- Develop a funding proposal for a student club or organization.
- Write a business-related letter (could be a letter to a potential employer) and ask a business person or advisor to review it.

Ethics and Professionalism

Description and importance

“Ethics and professionalism” has a general meaning, but also has some very specific meanings in actuarial work. Generally, this phrase refers to working honestly and carefully; working only on projects that you are qualified to perform and that do not present any conflicts of interest; acting in a manner that is fair to all concerned, as well as being in compliance with relevant laws, regulations, and rules; and communicating fully and clearly with relevant parties. The actuarial profession has adopted Codes of Conduct that describe the application of these concepts to actuarial work generally; has adopted Standards of Practice that set forth more specific details that are applicable to specific types of actuarial projects; and has defined review, counseling and disciplinary processes that are invoked when the professionalism of an actuary’s behavior or work is called into question.

On the job

Joe’s consulting firm has a long-standing “peer review” process whereby another colleague who did not work on a project must check the technical accuracy, assumptions and conclusions; clarity of communication; and other project elements before any actuarial reports or actuarial results can be communicated to a client. On an urgent project for the XYZ Manufacturing Company, Joe is debating following these peer review steps because he is the leading expert on the particular actuarial techniques used in the project, and because he is concerned that the extra steps involved in the peer review will result in his missing the client’s deadline. Joe ultimately decides to have his work peer reviewed and calls his client to inform them that their deadline will not be met. During the peer review, Joe’s colleague Sara discovers that an error was made in applying an important assumption and that correcting this error altered the recommendation that should be made to the client. As a result, Joe was able to deliver accurate recommendations to his client and did not risk both his and his firm’s credibility.

Experiences

- Read the “Honor Code” (or similar) in place at your university.
- Participate in a class or club discussion of real or hypothetical situations that might run afoul of the Honor Code.
- Serve as a member of the Honor Court (or similar) at your university.
- Read the Code of Conduct that is used by the actuarial association(s) in your country.
- Ask an experienced actuary to discuss ethics and professionalism with you and/or your actuarial club.
- Write a short report based on interviewing an actuarial consultant about some of the steps and tools in place to assure that her firm’s work is ethical and professional.
- Participate in a skit in which several classmates encounter a situation with unclear ethical implications and each person makes different choices about how to behave; lead a class discussion about those various choices and their implications.





Business Etiquette

Description and importance

“Business etiquette” refers to general standards of behavior that are appropriate in the business environment in which you work. Broadly, many elements of business etiquette are specific examples of how you are expected to demonstrate honesty, respect, and courtesy to other people in the workplace such as your manager, employees, your peers, customers and suppliers. Some basic elements of “business etiquette” include: timeliness in starting and finishing meetings, timeliness of meeting deadlines, speed of responding to emails and other inquiries, formality of written and verbal communication, acceptable types of socializing with co-workers and business contacts, dress codes, body language, and the use of company resources for non-work purposes.

Actuaries who do not practice appropriate business etiquette are putting themselves at risk of being viewed as people who are not taken very seriously and who cannot be put into situations where they will have to handle sensitive issues or interact with important business partners. Successful actuaries are attuned to the variations in business etiquette practices of different environments and different people.

On the job

Tim and Ingrid are part of a large team tasked with designing and implementing a new pricing tool for their company. They represent their actuarial department at weekly status meetings for the project. Tim often arrives late for the meeting and during the meeting multitasks, using his phone to respond to new emails that come in. Ingrid is fully engaged during the meeting, listening attentively to those speaking and taking notes on key follow-up items allowing her to meet important deadlines. At the end of the project the project leader requests that Ingrid represent the actuarial department on a special working group to evaluate the companies’ overall pricing tool strategy. Tim is not given this great opportunity.

Experiences

- Send formal emails that use full words, sentences, and paragraphs.
- Attend a networking or business etiquette event hosted by your career services department.
- Attend an on-campus recruiting event.
- Set up a job shadow to observe how meetings are run and dress codes are followed at a local company.
- Discuss your university’s code of conduct for employees with one of your professors.

Exam Study Skills

Description and importance

“Exam study skills” refers to the ability to identify and learn the key concepts required for a particular exam. A major challenge new actuarial candidates face is successfully balancing exam preparation with work and personal commitments. Actuarial candidates with strong study skills are able to adequately prepare for their exams while meeting demands at work and in their personal lives. Successful candidates develop study techniques tailored to their personal learning styles to help them prepare for exams that are often broader in scope and more rigorous than those encountered in college. There is no “one size fits all” approach, but many successful candidates develop a structured plan of how to cover the material, form study groups with fellow exam takers, work to create personal study materials such as notecards and sample problems, leverage professionally developed study guides and exam review seminars, and practice past exam problems repeatedly.


On the job

Tom currently works for a large insurer in their commercial lines reserving department. He is preparing to sit for CAS Exam 5: Basic Techniques for Ratemaking and Estimating Claim Liabilities. Tom first develops a study plan outlining how many hours he will study each day and establishing the order that he will go through the syllabus material. He completes a “first pass” of the material by reading each of the papers on the syllabus. He then uses a professionally developed study guide to do a “second pass,” creating note cards and practicing sample problems for each paper. He develops his own condensed study guide containing the concepts he feels are most relevant and a sample problem for each. Tom attends a review seminar where he has the opportunity to ask the presenters questions on the particular topics he has been having trouble with. About a month before the exam, Tom starts taking the practice exams provided in his study guide and the past exams published on the CAS website, making sure to abide by the time constraints he will face on exam day. He regularly discusses the problems he gets wrong with the other employees at his company who are also taking CAS Exam 5. The week before the exam Tom takes his final practice test and completes several passes through his note cards and the condensed study guide he developed. Throughout his exam preparation, he tracks his hours vs. his original plan and makes adjustments when necessary as work and personal commitments come up. Tom successfully passes the exam on his first try. At work he is able to leverage one of the techniques he learned for adjusting loss data for changing claims department practices in his latest reserve review.

Experiences

- Develop a structured plan for how you will prepare for your next final exam.
- Reflect on how you learn concepts most efficiently (reading, creating diagrams, discussions with a teacher or fellow student, etc.) and develop study techniques that leverage that knowledge.
- Take advantage of your university’s “learning center” to learn about different study techniques.





The Casualty Actuarial Society would like to thank the University Engagement Committee's Academic Working Group for writing the CAS Curriculum Guide. Thank you Rick Gorvett and Thomas Whitcomb for spearheading this undertaking and to working group writers Bob Conger, Richard Frese, Kristin Kennedy, Tom Struppeck and Mark Wenger.

Edition Updated 2019

APPENDIX 1

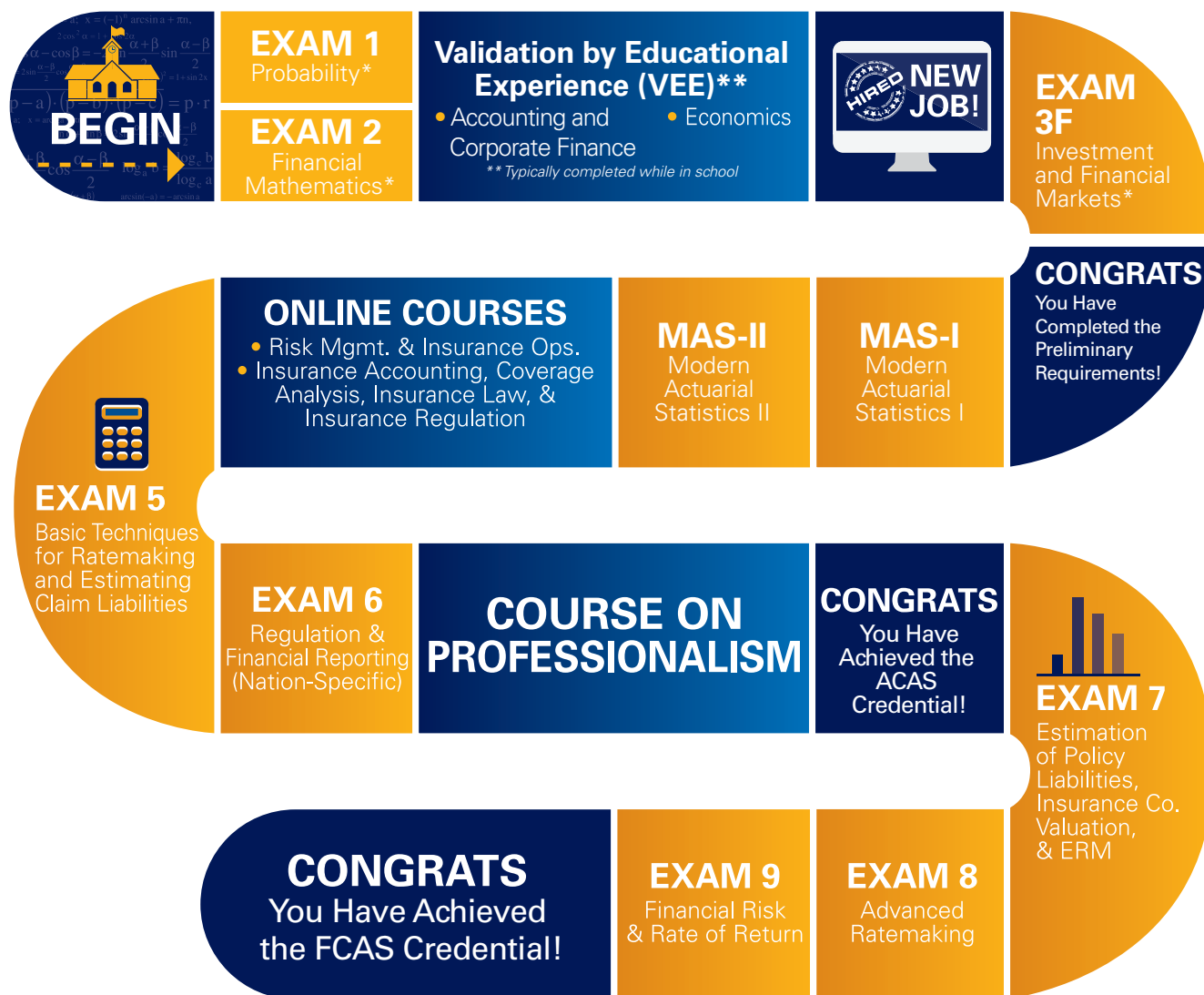


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Solutions.**

2019 CAS BASIC EDUCATION GUIDE

In principle and in practice, the CAS is the gold standard for the property and casualty actuarial profession. With more than 100 years of experience and expertise, the CAS continues to focus on comprehensive exams and education that are uniquely relevant to property and casualty actuaries. Our CAS credentialing program is *the* program of choice for attracting top candidates and meeting employers' needs.

THE CAS PATH TO SUCCESS:



*The CAS will grant waivers for candidates who pass examinations offered by other organizations that cover our CAS learning objectives. These organizations include but are not limited to: Society of Actuaries, Canadian Institute of Actuaries, Institute and Faculty of Actuaries (UK), Actuaries Institute (Australia), Actuarial Society of South Africa, Institute of Actuaries of India, and China Association of Actuaries. Please note that the path as outlined is intended to illustrate a typical sequence through the requirements; candidates are not restricted to the path as depicted.

Visit CASstudentcentral.org and casact.org for more information on the CAS Education System

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APPENDIX 2

SAMPLES OF ACTUARIAL SCIENCE COURSES AND CURRICULA

The CAS Curriculum Guide has outlined the academic subjects that are the building blocks of actuarial work. In addition to this information, academics interested in starting actuarial science programs at their colleges and universities will find it beneficial to research established actuarial science programs. To help you get started, we have included samples of actuarial science courses, curricula, and requirements from three different types of universities: a mid-size public institution, a large public university, and a private university, respectively.

Ball State University

This page has links to possible four-year schedules, as well as courses required for the actuarial science major.

<https://www.bsu.edu/academics/undergraduatstudy/catalog/current-year/collegesdeptprog/csh/mathematical>

University of Illinois at Urbana-Champaign

The link below provides a set of advising notes for actuarial science majors. This document includes information about degree requirements, course descriptions, a sample four-year schedule, and various other advice.

<http://catalog.illinois.edu/undergraduate/las/academic-units/math/actuarial/>

University of St. Thomas (MN)

This link provides a sample four-year schedule, along with several alternative schedules. Other links on this page refer to pages describing course offerings and other aspects of the actuarial science program.

<https://www.stthomas.edu/mathematics/actuarialscience/academics/sample/>

No CAS endorsement is provided relative to these three links; they are simply samples of curricular information for reference by schools and academics.