Bachelor of Science

Actuarial Science and Financial Mathematics

Bachelor of Science – Actuarial Science and Financial Mathematics

MISSION STATEMENT

The Actuarial Science and Financial Mathematics program at Springfield Research University equips students with the theoretical foundations and practical skills needed to analyze risk data, make informed decisions, and manage risk in financial and government sectors. Our mission is to produce competitive graduates who excel in critical thinking, problem-solving, and societal impact. By integrating mathematics, statistics, finance, and insurance, we prepare our students to navigate complex financial markets and contribute meaningfully to risk management.

Within the **Bachelor of Science in Actuarial Science and Financial Mathematics** program at Springfield Research University, students have exciting research opportunities. They delve into risk modeling, analyzing real-world data to predict and manage risks in insurance and finance. Additionally, they explore financial derivatives pricing, quantitative finance, and interdisciplinary projects that apply mathematical techniques to solve practical financial problems. The mission of SRU's actuarial science and financial mathematics degree is equip graduates to apply analytical, statistical and mathematical skills to financial and business problems. This is especially valuable when facing problems involving uncertain future events or financial risks in insurance, retirement, investments and risk management environments.

The Bachelor of Science in Actuarial Science and Financial Mathematics program at Springfield Research University is dedicated to providing a comprehensive education that prepares students for successful careers in the dynamic fields of actuarial science and financial mathematics. Our mission rests on three fundamental pillars:

1. **Academic Excellence:**
    - We maintain rigorous standards, fostering critical thinking and intellectual growth. Through engaging coursework, quantitative analysis, and practical training, we empower students to excel in the complex world of actuarial science and financial modeling.
2. **Cutting-Edge Research:**
    - Our faculty and students actively contribute to the forefront of actuarial and financial research. By addressing real-world challenges, exploring innovative methodologies, and shaping industry practices, we drive positive change within these fields.
3. **Societal Impact:**
    - We recognize our responsibility to society. Our graduates are not only skilled professionals but also ethical leaders who advocate for fairness, risk management, and financial stability. We empower them to make meaningful contributions to their communities and the global financial landscape.

At Springfield Research University (SRU), our Bachelor of Science in Actuarial Science and Financial Mathematics program is dedicated to fostering quantitative excellence, ethical practice, and positive contributions to the financial world. We equip students with a comprehensive understanding of mathematical principles, analytical thinking skills, and valuable practical

experience. As graduates, they emerge as competent professionals, poised to contribute significantly to risk management, financial modeling, and data-driven decision-making.

Key Areas of Study:

1. **Probability and Statistics:**
    - Students delve into foundational concepts of probability theory, statistical inference, and risk assessment. These skills are essential for actuarial analysis and financial modeling.
2. **Financial Mathematics:**
    - This area focuses on mathematical techniques applied to financial markets, investment valuation, and risk management. Students learn about interest rates, annuities, and portfolio optimization.
3. **Actuarial Science:**
    - Understanding actuarial principles is crucial for professionals in insurance, pensions, and risk assessment. Students explore mortality tables, pricing models, and reserving methods.
4. **Quantitative Risk Management:**
    - Students learn to quantify and manage risk in various contexts, including insurance, investments, and corporate finance. Topics include value-at-risk, stress testing, and hedging strategies.
5. **Data Analytics and Modeling:**
    - Mastery of data analysis tools and statistical software is essential. Students apply these skills to real-world financial data, making informed decisions based on empirical evidence.
6. **Financial Economics:**
    - This area covers economic theories related to financial markets, asset pricing, and behavioral finance. Students explore market efficiency, portfolio theory, and market anomalies.
7. **Business Ethics and Professionalism:**
    - We emphasize ethical conduct, integrity, and professional responsibility. Students learn about ethical dilemmas in financial decision-making and the importance of transparency.
8. **Applied Projects and Internships:**
    - Practical experience is integral. Students engage in projects, internships, and industry collaborations, applying their knowledge to real-world scenarios.

Our graduates are well-prepared to excel in actuarial roles, financial institutions, and data-driven sectors, contributing to economic stability and informed financial practices.

RATIONALE FOR THE BACHELOR OF SCIENCE IN ACTUARIAL SCIENCE AND FINANCIAL MATHEMATICS

At Springfield Research University, our Bachelor of Science in Actuarial Science and Financial Mathematics program is purposefully designed to address critical financial challenges at both national and regional levels. Rooted in academic excellence, it equips students with essential mathematical knowledge, analytical skills, and valuable practical experience. By emphasizing cutting-edge research and data-driven decision-making, our graduates emerge as competent professionals poised to contribute significantly to risk management, financial modeling, and economic stability.

1. **National Needs (Eswatini):**
    - **Quantitative Expertise:** Eswatini requires skilled professionals who can navigate complex financial landscapes. The program aims to equip students with mathematical proficiency, critical thinking abilities, and ethical grounding to address national financial complexities.
    - **Risk Management:** Our graduates advocate for fairness, uphold financial stability, and ensure equitable risk assessment. By enhancing financial risk management, they contribute to a more resilient economy.
    - **Policy and Decision-Making:** The program fosters critical analysis, enabling graduates to engage in financial research, policy formulation, and informed decision-making at national levels.
2. **Regional Needs (SADC):**
    - **Harmonization of Financial Practices:** SADC member states face shared financial challenges. The program aligns with SADC's goal of harmonizing financial frameworks across borders, promoting regional cooperation, trade, and investment.
    - **Human Capital Development:** Financial professionals play a pivotal role in regional integration. The program contributes to building a skilled workforce capable of navigating cross-border financial complexities.
    - **Economic Stability:** SADC's prosperity relies on informed financial practices. Our graduates contribute to maintaining financial order, resolving economic challenges, and fostering regional growth.
3. **Purpose of the Program:**
    - **Quantitative Leadership:** The program educates ethical leaders who champion data-driven decision-making, fairness, and financial integrity. Graduates not only analyze financial data but also shape economic discourse and policy.
    - **Cutting-Edge Research:** Students engage in specialized financial research, addressing contemporary issues. Their findings contribute to financial scholarship, risk assessment, and practical solutions.
    - **Community Impact:** The program prepares graduates to drive positive change through financial practice, risk management, and economic analysis.

PROGRAM LEARNING OBJECTIVES

Upon completion of the program, students will:

1. **Actuarial and Probability Knowledge:**
    - Demonstrate a solid understanding of actuarial concepts, probability theory, and the standard statistical distributions. This includes assessing risk, modeling uncertainty, and applying statistical tools to real-world scenarios.
2. **Statistical Estimation Properties:**
    - Understand fixed-sample and large-sample statistical properties related to point and interval estimators. Students will be proficient in estimating parameters and quantifying uncertainty.
3. **Testing Procedures Expertise:**
    - Grasp the properties of parametric, semi-parametric, and nonparametric testing procedures. This includes hypothesis testing, model selection, and robust statistical methods.
4. **Data Management and Analysis Skills:**
    - Acquire the ability to handle complex data sets, perform data cleaning, and conduct exploratory data analysis. Students will be adept at using statistical software for practical applications.

5. **Modeling Techniques:**
    - Apply linear, nonlinear, and generalized linear models to financial and actuarial problems. Students will understand model assumptions, interpret coefficients, and assess model fit.
6. **Experimental Design and Efficiency:**
    - Understand principles of experimental design and survey methodology. Students will learn how to optimize data collection, minimize bias, and enhance efficiency in research.
7. **Multivariate Methods and Computational Tools:**
    - Gain knowledge of classical and repeated measures multivariate methods. Additionally, students will be proficient in using computational tools for statistical analysis.

These learning objectives equip graduates with the skills needed to excel in actuarial roles, financial analysis, and data-driven decision-making.

PROGRAM LEARNING OUTCOMES

Upon completion of the program, graduates will reliably demonstrate the ability to:

1. **Quantitative Skills for Actuarial Science:**

    - Develop proficiency in mathematical and statistical techniques relevant to actuarial science. This includes understanding probability theory, stochastic processes, and risk modeling.
    - Apply quantitative methods to analyze risk, insurance pricing, and financial data. Graduates will be adept at assessing probabilities, modeling loss distributions, and evaluating investment strategies.
2. **Data Analysis Proficiency:**

    - Acquire skills in data manipulation, visualization, and interpretation. Graduates will be proficient in using statistical software (such as R or Python) to analyze large datasets.
    - Understand the principles of data mining, machine learning, and predictive modeling. This knowledge enables informed decision-making based on historical data and future projections.
3. **Business Acumen and Communication:**

    - Gain insights into the business and financial environment where actuaries operate. Graduates will understand economic trends, regulatory frameworks, and industry dynamics.
    - Develop problem-solving abilities, effective communication skills, and the capacity to collaborate within multidisciplinary teams.
4. **Risk Assessment and Management:**

    - Evaluate long-term financial implications of decisions using actuarial models. Graduates will assess risks related to insurance portfolios, pension funds, and investment portfolios.
    - Apply data analytics techniques to assess and manage risks in insurance, pensions, and other financial sectors. This includes stress testing, scenario analysis, and risk mitigation strategies.
5. **Technical Competence in Financial Modeling:**

- Use industry-standard software (such as Excel, SAS, or MATLAB) to manipulate and analyze realistic financial datasets. Graduates will build and validate actuarial models.
- Explore advanced data analytics topics, including neural networks, time series analysis, and predictive modeling. This technical competence enhances their ability to make informed financial decisions.

6. **Professional Qualification and Ethical Considerations:**

- Prepare for actuarial exams, potentially earning exemptions from Core Principles subjects. Graduates will be on the path to becoming certified actuaries.
- Understand the regulatory requirements and ethical considerations in actuarial practice. Upholding professional integrity and ethical standards is essential in their roles.

ENTRY REQUIREMENTS

The student must have 6 passes in SGCSE/GCE/IGCSE O' level including a pass with Grade C or better in English Language and Mathematics. Special: A' level from any of Accounting, Business Studies, and Mathematics.

CAREER OPPORTUNITIES

Students graduating in Actuarial Science and Financial Mathematics have open to them a wide range of career choices including asset management, commercial banking, corporate finance, financial planning, investment banking, money management, life insurance, research and planning, retirement funding, and real estate or pursue. This program is also an excellent choice for students who wish to continue their education with graduate study.

ASSESSMENT

Assessment in the Bachelor of Science in Actuarial Science and Financial Mathematics program is a dynamic blend of various methods, ensuring a comprehensive evaluation of students' quantitative knowledge and skills. These methods include:

1. **Coursework:**
    - Rigorous coursework forms the foundation of assessment. Students engage in assignments, quizzes, and active class participation. This assesses their understanding of mathematical and statistical concepts relevant to actuarial science and financial modeling.
2. **Research Projects:**
    - Through research projects, students delve into specialized topics, analyze financial data, and present well-reasoned arguments. This hones their research and analytical abilities, preparing them for real-world applications.
3. **Quantitative Modeling and Analysis:**
    - The program includes practical assessments related to quantitative modeling. Students apply mathematical techniques to solve actuarial and financial problems, demonstrating their ability to manipulate data and interpret results.

4. **Application of Financial Models:**
    - Participation in financial modeling contests and simulations sharpens students' skills. They develop risk models, assess investment strategies, and simulate market scenarios. This practical experience prepares them for financial roles.

This multifaceted assessment approach ensures that graduates are well-prepared for quantitative roles in actuarial practice, risk management, and financial analysis.

The Bachelor's Degree shall:

The Bachelor's degree program in Bachelor of Science in Actuarial Science and Financial Mathematics at Springfield Research University is designed to equip students with the skills and knowledge necessary for a successful career in this dynamic field. Here are the key features of our program:

1. **Duration**:
    - The program spans **four years** for full-time students or **six years** for part-time students, including an industrial attachment or internship period.
2. **Semester Structure**:
    - Each academic year consists of **two semesters**.
    - **Semester Duration**: Each semester runs for **20 weeks**.
        - **Orientation Week**: One week dedicated to orientation.
        - **Teaching Weeks**: A minimum of **14 weeks** for instruction.
        - **Mid-Semester Break**: A one-week break for students.
        - **Examination Period**: Two weeks for final exams.
        - **Results Processing**: Two weeks allocated for marking and result processing.

Our program ensures a rigorous academic experience while allowing flexibility for part-time students. Students engage in hands-on learning, theoretical coursework, and practical projects, preparing them for the exciting challenges of the Actuarial Science and Financial Mathematics industry.

Special Departmental Regulations

1. **Course Completion Requirements**:
    - All **Core**, **Prerequisite**, **Required**, **General**, and **Elective** courses within the degree program are compulsory. Students must pass these courses with a minimum grade of **50%** to graduate.
    - However, during the fourth and fifth years, all courses must be passed with a minimum grade of **60%** (equivalent to a CGPA of **3.00**) to qualify for graduation.
2. **Optional Courses**:

- Optional courses do not contribute to the final grade. Their marks are excluded from the computation of the overall grade.

3. **Externalization of Courses**:
    - All courses within the degree programs must be completed internally. Externalization is not permitted.
4. **Quality Control and Evaluation**:
    - Regular academic audits and reviews occur every four years, overseen by external moderators. Internal program evaluation is ongoing.
5. **Competence and Preparation**:
    - The courses offered in the Bachelor of Science in Actuarial Science and Financial Mathematics program provide adequate competences, preparing students for professional practice at the required academic level.
6. **Core and Prerequisite Courses**:
    - Students must pass all Core and Prerequisite courses with a minimum grade of **50%** before progressing to the next level or enrolling in additional courses.

Degree Award and Classification

- Upon successful completion of all **Core**, **Required**, and **Education** courses, as well as meeting the program requirements, a student will be awarded the degree of **Bachelor of Science in Actuarial Science and Financial Mathematics at** the end of the final year.
- The **normal classification** of a bachelor's degree is determined based on the academic performance during the third and fourth years of study.

Rationale to Course Numbering

At Springfield Research University, we meticulously design our Bachelor of Science in Actuarial Science and Financial Mathematics curriculum to empower students with the knowledge and skills needed to thrive in this dynamic field. Our course numbering system serves as a roadmap, guiding students through their academic journey - ****100-level courses**** introduce foundational concepts. - ****200-level courses**** build on those foundations. - ****300-level courses**** explore more specialized topics. - ****400-level courses**** are advanced and often include research or project components. Let's delve into the reasons behind our thoughtful approach:

1. **Logical Progression**: Our course numbers reflect a logical progression. Foundational concepts begin with the "100" series, followed by deeper explorations in the "200" and "300" levels. Advanced topics and research opportunities reside in the "400" series.
2. **Prerequisites and Coherence**: Clear numbering helps students understand prerequisites and co-requisites. For instance, a 200-level course assumes knowledge from related 100-level courses, ensuring a coherent learning experience.

3. **Specialization and Depth**: As students advance, higher-level courses delve into specialized areas such as derivatives and investments management. The numbering system communicates this depth of study.
4. **Alignment with Program Goals**: Each course number aligns with our program's learning outcomes. Whether it's mastering derivatives or diving into investments management, students can track their progress.
5. **Transferability**: Consistent numbering facilitates credit transfer between institutions, supporting seamless academic mobility.

In summary, our course numbering isn't just a sequence—it's a deliberate framework that enhances learning, fosters curiosity, and prepares our students for impactful careers in Actuarial Science and Financial Mathematics industry. Bachelor of Science in Actuarial Science and Financial Mathematics courses simplify the course numbering system.

100-Level Courses:

1. **FAS 101:** Introduction to Actuarial Science and Financial Mathematics
2. **FAS 110:** Mathematical Foundations for Actuarial Studies
3. **FAS 120:** Probability and Statistics

200-Level Courses:

1. **FAS 201:** Financial Mathematics and Time Value of Money
2. **FAS 210:** Risk Management and Insurance Principles
3. **FAS 220:** Investment Analysis and Portfolio Management

300-Level Courses:

1. **FAS 301:** Actuarial Models and Life Contingencies
2. **FAS 310:** Derivatives and Financial Engineering
3. **FAS 320:** Computational Methods in Finance

400-Level Courses:

1. **FAS 401:** Advanced Topics in Actuarial Science
2. **FAS 410:** Stochastic Processes and Financial Modeling
3. **FAS 420:** Capstone Project in Actuarial Science and Financial Mathematics

CREDIT TRANSFER, ACCUMULATION AND DISTRIBUTION OF NOTIONAL HOURS

The Bachelor of Science in Actuarial Science and Financial Mathematics is a four (4) year program. The student is expected to accumulate 495 credit points to be considered to have met the requirements of the Bachelor of Science in Actuarial Science and Financial Mathematics must pass each module by at least 50%.

- Level 1 = minimum of credits 124 (1240 notional hours of study)
- Level 2 = minimum of credits 124 (1240 notional hours of study)
- Level 3 = minimum of credits 124 (1240 notional hours of study)

- Level 4 = minimum of credits 124 (1240 notional hours of study)

TOTAL credit points 496 (4960 notional hours of study)

Credit Transfer and Accumulation

1. Credits are derived from engagement of students in learning activities during lectures, seminars, tutorials, micro or macro field trips, directed and self-directed learning and writing examination tests and assignments.
2. Modules from the health and medical faculty are worth 12 credit. Lecture attendance is compulsory. Students who attend less than 80% of lessons will not be allowed to sit for their sessional examinations.

Weighting

The degree class shall be based on weighting the results from part 1, 2, 3 and 4, the Degree weighting shall be as follows:

Level 1	20%
Level 2	20%
Level 3	30%
Level 4	30%

Distribution of Notional Hours

Module	Lecture Hrs	Tutorials/ Seminars	Self-Directed Study	Assignment Tests/Exams	Notional Hrs	Credits
FAS000	50	20	25	25	120	12
PROJECT	0	0	40	100	140	14

ASSESSMENT METHODS

1. **Formative Assessment (30%):**
    - Formative assessments provide ongoing feedback to enhance student learning during the course.
    - **Class Participation:** Active engagement in discussions, seminars, and activities.
    - **Quizzes and Short Tests:** Regular assessments of specific topics.
    - **Draft Assignments:** Feedback on early assignment drafts.
    - **Peer Review:** Reviewing peers' work.
2. **Summative Assessment (60%):**
    - Summative assessments evaluate overall performance at the end of a course.
    - **Final Examinations:** Comprehensive exams covering course content.
    - **End-of-Semester Papers:** Assessing knowledge and analytical skills.

- **Oral Presentations:** Evaluating communication and quantitative understanding.

3. **Continuous Assessment (10%):**
    - Ongoing evaluation combining formative and summative elements.
    - **Assignments and Projects:** Regular tasks contributing to the overall grade.
    - **Application of Financial Models:** Practical projects related to actuarial practice and financial modeling.
    - **Attendance and Participation:** Active engagement in lectures and workshops.

These assessment methods align with our commitment to academic excellence and practical skills development within the BScFM program.

Teaching Methods

At Springfield Research University (SRU), we are committed to employing a diverse array of teaching methods to ensure a comprehensive and engaging learning experience for our students. Our teaching methods are carefully selected to align with the programme's objectives and to meet the needs of our diverse student body. The following are the key teaching methods utilized across all SRU programmes:

1. Lectures:

- Lectures are used to introduce and explain key concepts, theories, and principles. They provide a structured and systematic approach to delivering content, allowing students to gain a solid foundation in their respective fields. Lectures are often supplemented with visual aids, multimedia presentations, and interactive elements to enhance understanding and engagement.

2. Seminars:

- Seminars are interactive sessions that promote critical thinking and in-depth discussion on specific topics. Students are encouraged to actively participate, share their perspectives, and engage in debates. Seminars provide an opportunity for students to develop their analytical and communication skills.

3. Workshops:

- Workshops are hands-on sessions that focus on practical skills and applications. These sessions allow students to engage in experiential learning, apply theoretical knowledge to real-world scenarios, and collaborate with peers on projects and activities. Workshops are designed to foster creativity, problem-solving, and teamwork.

4. Problem-Based Learning (PBL):

- Problem-Based Learning is a student-centered approach that involves presenting students with complex, real-world problems to solve. Students work in small groups to research, discuss, and propose solutions, developing critical thinking and collaborative skills in the process. PBL encourages independent learning and active engagement.

5. Case Studies:

- Case studies are used to analyze real-life situations and decision-making processes. Students examine and discuss case studies to understand the context, identify key issues, and evaluate possible solutions. This method helps students develop their analytical and problem-solving abilities while relating theoretical concepts to practical situations.

6. Clinical Practice:

- For programmes that include a clinical component, such as Health and Medical Sciences, clinical practice is an integral part of the curriculum. Students gain hands-on experience in clinical settings, working under the supervision of qualified professionals. This method provides valuable opportunities for students to apply their knowledge, develop clinical skills, and gain insights into professional practice.

7. Research Projects:

- Research projects are designed to cultivate a culture of inquiry and innovation. Students engage in independent or group research projects, exploring topics of interest and contributing to the body of knowledge in their field. Research projects develop students' research skills, critical thinking, and ability to communicate findings effectively.

8. Online Learning:

- Online learning is incorporated to provide flexible and accessible education. SRU utilizes online platforms to deliver lectures, conduct discussions, and facilitate collaborative projects. Online learning allows students to access course materials, participate in virtual classrooms, and engage with peers and instructors remotely.

9. Continuous Assessment:

- Continuous assessment methods, such as quizzes, assignments, and presentations, are used to monitor students' progress and provide ongoing feedback. These assessments help identify areas for improvement and ensure that students are meeting learning objectives throughout the course.

10. Peer Learning:

- Peer learning encourages students to collaborate and learn from each other. Group projects, study groups, and peer review sessions provide opportunities for students to share knowledge, offer feedback, and support each other's learning journey.

At SRU, our commitment to employing diverse and effective teaching methods ensures that our students receive a well-rounded education that prepares them for success in their chosen fields. We continuously review and enhance our teaching practices to provide the best possible learning experience for our students.

Delivery Methods

At Springfield Research University (SRU), we utilize a variety of delivery methods to ensure that our educational programmes are accessible, engaging, and effective. Our delivery methods are designed to cater to the diverse needs of our students and to provide flexible learning opportunities. The following are the key delivery methods employed across all SRU programmes:

1. In-Person Delivery:

- **Classroom Lectures:** Traditional classroom lectures provide a structured and interactive environment where students can engage with instructors and peers. These sessions often include discussions, presentations, and multimedia resources to enhance learning.
- **Laboratory Sessions:** For programmes that require practical and experimental learning, laboratory sessions are conducted in specialized labs equipped with the necessary tools and equipment. These hands-on sessions allow students to apply theoretical knowledge in a controlled environment.
- **Clinical Placements:** Health and Medical Sciences programmes include clinical placements in hospitals, clinics, and healthcare facilities. These placements provide students with real-world experience under the supervision of qualified professionals.

2. Online Delivery:

- **Virtual Classrooms:** Online platforms are used to deliver lectures, conduct discussions, and facilitate collaborative projects. Virtual classrooms enable students to access course materials, participate in live sessions, and engage with peers and instructors from remote locations.
- **Recorded Lectures:** Recorded lectures are made available for students to access at their convenience. This flexible approach allows students to review and revisit course content as needed.
- **Online Assessments:** Online assessments, including quizzes, assignments, and exams, are conducted through secure online platforms. These assessments provide timely feedback and help monitor students' progress.

3. Blended Learning:

- **Hybrid Courses:** Blended learning combines in-person and online delivery methods to provide a flexible and comprehensive learning experience. Hybrid courses may involve alternating between classroom sessions and online activities.
- **Flipped Classroom:** In the flipped classroom model, students access instructional content online before class and use in-person sessions for interactive, application-based activities. This approach encourages active learning and deeper engagement with the material.

4. Independent Study:

- **Self-Paced Learning:** Self-paced learning allows students to progress through course materials at their own speed. This method is ideal for students who prefer to learn independently and manage their own schedules.
- **Research Projects:** Independent research projects provide students with the opportunity to explore topics of interest, develop research skills, and contribute to the body of knowledge in their field. Faculty advisors provide guidance and support throughout the research process.

5. Collaborative Learning:

- **Group Projects:** Group projects foster teamwork and collaboration among students. These projects often involve problem-solving, research, and presentations, allowing students to learn from each other and develop interpersonal skills.
- **Peer Review:** Peer review sessions encourage students to provide and receive constructive feedback on each other's work. This method promotes critical thinking, reflection, and improvement.

6. Experiential Learning:

- **Internships and Work Placements:** Internships and work placements provide students with practical experience in their chosen field. These opportunities allow students to apply their knowledge in real-world settings, develop professional skills, and build industry connections.
- **Field Trips and Excursions:** Field trips and excursions offer experiential learning opportunities outside the classroom. These activities provide students with firsthand exposure to relevant sites, industries, and practices.

7. Continuous Assessment:

- **Formative Assessments:** Formative assessments, such as quizzes, assignments, and in-class activities, provide ongoing feedback to students and help track their progress. These assessments are designed to support learning and identify areas for improvement.
- **Summative Assessments:** Summative assessments, including final exams, projects, and presentations, evaluate students' overall performance and mastery of course content.

At SRU, our diverse delivery methods ensure that students receive a well-rounded and flexible education that caters to their individual learning preferences. We are committed to continuously enhancing our delivery methods to provide the best possible learning experience for our students.

COURSE MODULES AND SYNOPSIS

Year 1 Semester 1

Code	Course	Lectures	Practical	Credits
FAS101	Accounting	100	0	10
FAS102	Macroeconomics	100	0	10
FAS103	Discrete Mathematics	100	0	10
FAS104	Probability and distributions	100	0	10
FAS105	Economics for Actuaries	100	0	10
FAS106	Mathematical Statistics	100	0	10
	Total			60

Year 1 Semester 2

Code	Course	Lectures	Practical	Credits
FAS106	Investment and Financial Markets	100	0	10
FAS107	Microeconomics	100	0	10
FAS108	Statistics for Risk Modeling	100	0	10
FAS109	Calculus I	100	0	10
FAS110	Corporate Finance	100	0	10

FAS111	Financial Economics	100	0	10
	Total			60

Year 2 Semester 3

Code	Course	Lectures	Practical	Credits
FAS211	Calculus II	100	0	10
FAS212	Linear Algebra	100	0	10
FAS213	Regression Analysis	100	0	10
FAS214	Data Science Fundamentals	100	0	10
FAS215	Financial Accounting	100	0	10
FAS216	Survival Analysis	100	0	10
	Total			60

Year 2 Semester 4

Code	Course	Lectures	Practical	Credits
FAS216	Theory of Interest	100	0	10
FAS217	Differential Equations	100	0	10
FAS218	Statistical Programming with Excel	20	80	10
FAS219	Principles of Management	100	0	10
FAS220	Numerical Methods	100	0	10
FAS221	Derivatives	100	0	10
	Total			60

Year 3 Semester 5

Code	Course	Lectures	Practical	Credits
FAS321	Financial Mathematics	100	0	10
FAS322	Time Series Analysis	100	0	10
FAS323	Sampling Techniques	100	0	10
FAS324	Categorical Data Analysis	100	0	10
FAS325	Financial Management	100	0	10
FAS326	Multiples Variables	100	0	10
	Total			60

Year 3 Semester 6

Code	Course	Lectures	Practical	Credits
FAS326	Mathematical Modeling	100	0	10
FAS327	Operation Research	100	0	10
FAS328	Design and Analysis of Experiments	100	0	10
FAS329	Actuarial Mathematics	100	0	10
FAS330	Financial Reporting	100	0	10
FAS331	Industrial Training	0	200	20
FAS332	Seminar – Professional Development	40	10	5
	Total			75

Year 4 Semester 7

Code	Course	Lectures	Practical	Credits
FAS433	Multivariate Data Analysis	100	0	10
FAS434	Stochastic Processes	100	0	10
FAS435	Strategic Finance	100	0	10
FAS436	Loss Models	100	0	10

FAS437	Actuarial Investigations: Financial	100	0	10
FAS438	Financial Statements Analysis	100	0	10
	Total			60

Year 4 Semester 8

Code	Course	Lectures	Practical	Credits
FAS439	Stochastic Calculus	100	0	10
FAS440	Econometrics	100	0	10
FAS441	Statistical Learning	100	0	10
FAS442	Big Data Analytics	100	0	10
FAS443	Actuarial Research Project	0	200	20
	Total			60

COURSE DESCRIPTIONS

FMS101 ACCOUNTING

Accounting is the recording of financial transactions such as profits, losses, credits and debits plus storing, sorting, retrieving, summarizing and presenting the information in various reports and analyses. By the end of this workshop, participants will be able to: Understand basic accounting terminology, identify the differences between the cash and accrual accounting methods, keep track of your business by becoming familiar with accounts payable and accounts receivable, use a journal and general ledger to document business financials, utilize the balance sheet and identify different types of financial statements.

FMS102 CALCULUS I

Involves a study of limits, continuity, derivatives and integrals; computations of derivatives—sum, product, and quotient formulas, chain rule, implicit differentiation, applications of derivatives to optimization problems and related rate problems; mean-value theorem; definite integrals and fundamental theorem of calculus; application of definite integrals to computations of areas (length, surface) and volumes.

FMS103 DISCRETE MATHEMATICS

This course enables students to strengthen and increase the understanding of discrete mathematics with special emphasis on computer science applications. Topics include sets, number systems, the nature of proof, formal logic, functions and relations, combinatorics, recurrence relations, trees and Boolean algebra.

FMS104 PROBABILITY AND DISTRIBUTIONS

This course will cover basic probability principles, random variables and univariate probability distributions, moments and an introduction to moment generating functions, introduction to sampling distributions and the Central Limit Theorem, and introduction to interval estimation and hypothesis testing.

FMS105 ACTUARIAL ECONOMICS

The aim of this course is to introduce students major in actuarial science to the core economic principles and how these can be used in a business environment to help decision making and behavior. It provides microeconomic and macroeconomic foundations, both from the point of view of individuals and firms, particularly focusing on topics covered in Business Economics.

FMS106 INVESTMENT AND FINANCIAL MARKETS

This course aims to introduce participants to essential concepts and techniques in Investment and Finance and aims to provide an understanding of financial institutions and investment parameters. The course aims to improve the level of competency of financial practitioners, investors and participants.

FMS107 MICROECONOMICS

Microeconomics is an introductory undergraduate course that teaches the fundamentals of microeconomics. This course introduces microeconomic concepts and analysis, supply and demand analysis, theories of the firm and individual behavior, competition and monopoly, and welfare economics. Students will also be introduced to the use of microeconomic applications to address problems in current economic policy throughout the semester.

FMS108 STATISTICS FOR RISK MODELING

This course introduces various statistics learning methods for analyzing insurance data. The main objective is to prepare actuarial science students for the Exam SRM: Statistics for Risk Modeling of the Society of Actuaries.

FMS109 MATHEMATICAL STATISTICS

This course teaches the foundations of mathematical statistics, focusing on methods of estimation such as the method of moments and maximum likelihood estimators (MLEs), evaluating estimators by their bias, variance, and efficiency, and explore asymptotic statistics, including the central limit theorem and confidence intervals.

FMS110 CORPORATE FINANCE

This course presents the foundations of finance with an emphasis on applications vital for corporate managers. We discuss most of the major financial decisions made by corporate managers both within the firm and in their interactions with investors. Essential in most of these decisions is the process of valuation, which will be emphasized throughout the course.

Topics include criteria for making investment decisions, valuation of financial assets and liabilities, relationships between risk and return, capital structure choice, payout policy, the effective use and valuation of derivative securities (futures, options, and convertible securities), and risk management.

FMS211 CALCULUS II

This is the second of a three-course sequence in the differential and integral calculus of functions of one independent variable. Topics include the basic and advanced techniques of integration, analytic geometry of graphs of functions, and their limits, integrals and derivatives, including the Fundamental Theorem of Calculus. Also, some applications of the integral, like arc length and volumes of solids with rotational symmetry, are discussed. Applications to the physical sciences and engineering will be a focus of this course, as this sequence of courses is designed to meet the needs of students in these disciplines.

FMS212 LINEAR ALGEBRA

This course covers the following topics: solving systems of linear equations; matrices and linear transformations; image and kernel of a linear transformation; matrices and coordinates relative to different bases; determinants; eigenvalues and eigenvectors; discrete and continuous dynamical systems; least-squares approximation; applications, differential equations, and function spaces.

FMS213 REGRESSION ANALYSIS

Students will be introduced to multivariate statistics, with a special emphasis on methods for studying change and effects of context. Topics will include general linear hypothesis testing, logistic regression, multilevel models, cluster analysis, principal component analysis, exploratory data analysis and structural equation modeling. The focus of the course will be on using the computer to analyze real data by using the statistical techniques introduced through lectures, interpreting the results and writing about the findings. Students should have a good background in multiple regression analysis, including the use and interpretation of dummy variables and interactions.

FMS214 MACROECONOMICS

Macroeconomics uses the tools of economics to understand how an economy functions and to develop policies that promote economic growth. In this course students will learn about how a national economy works, and how various government policies affect the economy and, by extension, its citizens' lives. This course gives students the concepts and factual knowledge to read and understand the economic news and events that relate to the three main concerns of macroeconomics: inflation, unemployment, and economic growth.

FMS215 FINANCIAL ACCOUNTING

The course introduces the basic framework of accounting to all students majoring in accountancy. It exposes accounting students to underlying accounting concepts and constraints, and helps them in preparation of financial records, financial statements, and analysis of the major financial statements.

FMS216 FINANCIAL MATHEMATICS

This module provides fundamental introductory knowledge, and skills to identify which mathematical formulas to use in a specific financial problem. Students who complete this module will be able to solve problems involving for interest rates, annuities, amortisation, stock pricing and capital budgeting.

FMS217 DIFFERENTIAL EQUATIONS

Differential Equations are the language in which the laws of nature are expressed. Understanding properties of solutions of differential equations is fundamental to much of contemporary science and engineering. Ordinary differential equations (ODE's) deal with functions of one variable, which can often be thought of as time.

FMS218 TIME SERIES ANALYSIS

The course provides a survey of the theory and application of time series methods in econometrics. Topics covered will include univariate stationary and non-stationary models, vector autoregressions, frequency domain methods, models for estimation and inference in persistent time series, and structural breaks. The course will cover different methods of estimation and inferences of modern dynamic stochastic general equilibrium models (DSGE): simulated method of moments, Maximum likelihood and Bayesian approach. The empirical applications in the course will be drawn primarily from macroeconomics.

FMS219 STATISTICAL PROGRAMMING WITH R

This course provides an introduction to mathematical and statistical computing using the R statistical computing environment. The course is very much about programming, but it will be different from those taught in computer science, because of its emphasis on mathematical and statistical applications. R can be used both as a programming language, and a piece of software. It can be used for data manipulation, calculation and graphical display.

FMS220 PRINCIPLES OF MANAGEMENT

The course provides an overview of the history of management thought and of managerial activities and analysis of the process of planning, organizing, leading, controlling, and forces of environments in which businesses operate. Topics include strategic planning, organizational design, human resources management, decision-making, ethics, and social responsibility. Relating topics to the current business environment is emphasized. The case analysis concerned with each of these forces is discussed, with emphasis on problem solving.

FMS321 NUMERICAL METHODS

To explore complex systems, physicists, engineers, financiers and mathematicians require computational methods since mathematical models are only rarely solvable algebraically. Numerical methods, based upon sound computational mathematics, are the basic algorithms underpinning computer predictions in modern systems science. Such methods include techniques for simple optimisation, interpolation from the known to the unknown, linear algebra underlying systems of equations, ordinary differential equations to simulate systems, and stochastic simulation under random influences. Topics covered are: the mathematical and computational foundations of the numerical approximation and solution of scientific problems; simple optimisation; vectorisation; clustering; polynomial and spline interpolation; pattern recognition; integration and differentiation; solution of large-scale systems of linear and nonlinear equations; modelling and solution with sparse equations; explicit schemes to solve ordinary differential equations; random numbers; stochastic system simulation.

FMS322 THEORY OF INTEREST

Financial transactions involving interest: measurement of interest, force of interest, annuities-certain, introduction to financial derivatives. Simple and compound interest, time value of money, annuities, cash flow analysis, amortization schedules, sinking funds, bonds, other securities, and miscellaneous topics.

FMS323 SAMPLING TECHNIQUES

This course will introduce students to a wide range of statistical sampling techniques that are used to make inferences about a population. Students will learn when to use and how to implement sampling designs that are more complex than a simple random sample. They will also understand why the sampling design used to collect data determines how we choose to graph the data, estimate certain parameters, and quantify the uncertainty in these estimates with a margin of error.

FMS324 CATEGORICAL DATA ANALYSIS

The Categorical Data course is an introduction to the methods used to analyze data that are categorical rather than continuous in nature. The topics include description and inference using proportions and odds ratios, contingency tables, Poisson regression, logistic regression, and multi-category logit models.

FMS325 FINANCIAL MANAGEMENT

The course introduces basic principles in finance such as cash flow, the time value of money, valuation of the firm and financial assets, and capital budgeting.

FMS326 MATHEMATICAL MODELLING

This course is an introduction to mathematical modeling based on the use of elementary functions to describe and explore real-world phenomena and data. Linear, exponential, logarithmic, and polynomial function models are examined closely and are applied to real-world data in course assignments and projects. Other function models may also be

considered. Throughout the course, computational tools (graphing calculators, spreadsheets, etc.) are used to implement, examine, and validate these models. Students are expected to actively engage in the modeling process by questioning phenomena, collecting or creating data, and using computational tools to develop their models and evaluate their efficacy.

FMS327 OPERATIONS RESEARCH

Operations research helps in solving problems in different environments that needs decisions. The module cover topics that include: linear programming, Transportation, Assignment, and CPM/ MSPT techniques. Analytic techniques and computer packages will be used to solve problems facing business managers in decision environments.

FMS328 DESIGN AND ANALYSIS OF EXPERIMENTS

This is a basic course in designing experiments and analyzing the resulting data. The course objective is to learn how to plan, design and conduct experiments efficiently and effectively, and analyze the resulting data to obtain objective conclusions. Both design and statistical analysis issues are discussed. Opportunities to use the principles taught in the course arise in all aspects of today's industrial and business environment. Applications from various fields will be illustrated throughout the course. Computer software packages (JMP, Design-Expert, Minitab) will be used to implement the methods presented and will be illustrated extensively.

FMS329 ACTUARIAL MATHEMATICS I

Definition and use of straightforward functions estimation in straightforward function. Main variables, benefit, disability; and long-term care contract, Calculation of net premiums and reserves. Future expenses and bonus influence of inflation. Equation of value for fixed benefits and variable benefits. Techniques of discounted emerging costs, pricing, reserving and assessing of profitability. Decision theory; Fundamental concepts of Bayesian statistics and its use. Probabilities and moments of loss distributions, Construction of risk models. Concepts of credibility theory, rating systems, techniques for analyzing delay (or run off) triangle and projecting the ultimate position.

FMS330 FINANCIAL REPORTING

This course is an introduction to the basic concepts and standards underlying financial accounting systems. Several important concepts will be studied in detail, including: revenue recognition, inventory, long-lived assets, present value, and long-term liabilities. The course emphasizes the construction of the basic financial accounting statements - the income statement, balance sheet, and cash flow statement - as well as their interpretation.

FMS331 SEMINAR - PROFESSIONAL DEVELOPMENT

It is a specialized study of advanced professional skills related to the discipline. At the end of the course, the student will be able to demonstrate a range of advanced skills selected from but not limited to the following: skills in research, writing, editing, public presentation, grant and proposal writing, and colloquium organization. The course may take a variety of forms, from a series of guest speakers to a focused exploration of a current research topic, or a combination of both.

FMS332 INDUSTRIAL TRAINING

This course provides exposure and experience to the students in terms of technology development, effective communication, teamwork practices, policies, procedures and regulations, professional perspective and reporting. This course will build enthusiasm and proactive attitude among students and increase their confidence to be an excellent coach.

FMS433 MULTIVARIATE DATA ANALYSIS

The course provides knowledge within multivariate statistics: theory, calculation technique and applications. The course will also provide some deeper studies of the inference theory in multivariate analysis. The concepts that are more thoroughly treated are: Matrix algebra. Multivariate normal distribution and statistical inference under multivariate normality. Confirmatory factor analysis. Multivariate analysis of variance. Discriminant analysis. Structural equation models. The course is taught at an intermediate statistical level. The emphasis is on both the theory of multivariate statistics and its applications in multivariate analysis. The course assumes familiarity with basic concepts in probability and inference theory.

FMS434 STOCHASTIC PROCESSES

A stochastic process is a set of random variables indexed by time or space. Stochastic modelling is an interesting and challenging area of probability and statistics that is widely used in the applied sciences. In this course the students will gain the theoretical knowledge and practical skills necessary for the analysis of stochastic systems. They will study the basic concepts of the theory of stochastic processes and explore different types of stochastic processes including Markov chains, Poisson processes and birth-and-death processes.

FMS435 STRATEGIC FINANCE

This course is focused on the strategic aspects of the corporate management and methodological issues for development of value-based management systems. A special attention is devoted to measures and approaches of the corporate strategy effectiveness evaluation and strategy monitoring.

FMS436 LOSS MODELS

Introduction to the construction and evaluation of actuarial models, with topics covered by examinations of the Society of Actuaries and the Casualty Actuarial Society. *Loss Models* contains a wealth of examples that highlight the real-world applications of the concepts and puts the emphasis on calculations and spreadsheet implementation. With a focus on the

loss process, the course covers the essential quantitative techniques such as random variables, basic distributional quantities, and the recursive method, and discusses techniques for classifying and creating distributions. Parametric, non-parametric, and Bayesian estimation methods are thoroughly.

FMS437 ACTUARIAL INESTIGATIONS: FINANCIAL

The course will focus on the following topics: Introduction to actuarial modelling, the application of compound interest techniques to financial transactions, generalised cash-models to describe financial transactions such as zero-coupon bonds, fixed interest securities, cash on deposit, equities, interest only loans, repayment loans, annuities certain and others and Introduction to life insurance.

FMS438 RESEARCH PROJECT

Learners will be expected to conduct some enquiry into any phenomena related to financial mathematics and applied statistics. The goal is to engage them in the discovery of new information and to help them to answer questions of interest they may have developed throughout the duration of study. This scientific inquiry will also contribute towards the body of knowledge in the discipline of financial mathematics and applied statistics as well as solving some problems that may be identified through the findings of the research projects.

FMS439 STOCHASTIC CALCULUS

The primary goal of this course is to provide the student a background in the mathematics of stochastic processes, risk, and financial economics as it relates to actuarial models. The underlying foundation of this course is the mathematics and economics of the pricing of financial options. The course will cover the theoretical basis of corporate finance and financial models, and it will highlight the application of those models to insurance and other financial risks.

FMS440 ECONOMETRICS

This course covers the statistical tools needed to understand empirical economic research and to plan and execute independent research projects. Topics include statistical inference, regression, generalized least squares, instrumental variables, simultaneous equations models, and evaluation of government policies and programs.

FMS441 STATISTICAL LEARNING

This is an introductory-level course in supervised learning, with a focus on regression and classification methods. The syllabus includes: linear and polynomial regression, logistic regression and linear discriminant analysis; cross-validation and the bootstrap, model selection and regularization methods (ridge and lasso); nonlinear models, splines and generalized additive models; tree-based methods, random forests and boosting; support-vector machines. Some unsupervised learning methods are discussed: principal components and clustering (k-means and hierarchical).

FMS442 ACTUARIAL MATHEMATICS II

This course is a study of actuarial reserves, Markov chains, multiple decrements, pension mathematics and profit calculations.

FMS443 SURVIVAL METHODS

An introduction to stochastic processes with emphasis on life history analysis and actuarial applications. Principles of modelling; model selection, calibration, and testing; Stochastic processes and their classification into different types by time space, state space, and distributional properties; construction of stochastic processes from finite-dimensional distributions, processes with independent increments, Poisson processes and renewal processes and their applications in general insurance and risk theory, Markov processes, Markov chains and their applications in life insurance and general insurance, extensions to more general intensity-driven processes, counting processes, semi-Markov processes, stationary distributions. Determining transition probabilities and other conditional probabilities and expected values; Integral expressions, Kolmogorov differential equations, numerical solutions, simulation techniques. Survival models - the random life length approach and the Markov chain approach; survival function, conditional survival function, mortality intensity, some commonly used mortality laws. Statistical inference for life history data; Maximum likelihood estimation for parametric models, non-parametric methods (Kaplan-Meier and Nelson-Aalen), regression models for intensities including the semi-parametric Cox model and partial likelihood estimation; Various forms of censoring; The technique of occurrence-exposure rates and analytic graduation; Impact of the censoring scheme on the distribution of the estimators; Confidence regions and hypothesis testing.

MULTIPLE VARIABLES

In this course, students explore the mathematical foundations of multivariable calculus. Topics include partial derivatives, gradients, optimization, multiple integrals, and vector calculus. Applications to actuarial science, finance, and risk modeling are emphasized. Students develop analytical skills and learn to apply mathematical techniques to real-world scenarios in insurance, pensions, and investment analysis.

FINANCIAL ECONOMICS

The “Financial Economics” course explores the intersection of economics and finance. Students delve into topics such as asset pricing, portfolio theory, risk management, and market efficiency. Emphasis is placed on understanding financial markets, investment strategies, and economic decision-making. Practical applications in insurance, pensions, and investment analysis are integrated throughout the course, providing students with essential skills for actuarial roles and financial modeling.

SURVIVAL ANALYSIS

The “Survival Analysis” course explores statistical methods for analyzing time-to-event data. Students delve into concepts such as hazard functions, survival curves, and censoring. Applications in actuarial science, insurance, and risk modeling are emphasized. Graduates gain essential skills for assessing longevity risk, modeling life insurance policies, and understanding survival probabilities in financial contexts.

DERIVATIVES

The “Derivatives” course explores financial instruments such as options, futures, and swaps. Students delve into concepts like pricing models, risk management, and hedging strategies. Emphasis is placed on understanding derivative markets, arbitrage opportunities, and their applications in insurance, pensions, and investment analysis. Graduates gain essential skills for assessing financial risk and optimizing investment portfolios.

COURSE OUTLINES

Course Title: Accounting

Course Description:

This course provides an introduction to accounting principles, practices, and financial reporting. Students will learn about financial statements, transactions, and the role of accounting in decision-making. Emphasis will be placed on understanding financial data and interpreting it for various stakeholders.

Learning Objectives:

- Understand the fundamental principles of accounting.
- Analyze financial statements and interpret key metrics.
- Apply accounting concepts to real-world scenarios.
- Explore ethical considerations in accounting practices.

Topics Covered:

1. **Introduction to Accounting:**
    - Overview of accounting principles and concepts.
    - Role of accounting in business and society.
    - Accounting standards and regulatory bodies.
2. **Financial Statements:**
    - Income statement, balance sheet, and cash flow statement.
    - Recording transactions and adjusting entries.
    - Ratio analysis and financial performance evaluation.
3. **Financial Reporting:**
    - Preparation of financial statements.
    - Disclosure requirements and notes to the financial statements.
    - International Financial Reporting Standards (IFRS) vs. Generally Accepted Accounting Principles (GAAP).
4. **Managerial Accounting:**
    - Cost behavior and cost-volume-profit analysis.
    - Budgeting, variance analysis, and performance measurement.

    - Decision-making using relevant costs.
5. **Ethics in Accounting:**
    - Professional ethics and integrity.
    - Ethical dilemmas in financial reporting.
    - Corporate social responsibility.

Assessment:

- **Midterm Exam:** Covers material from the first half of the course.
- **Final Exam:** Comprehensive assessment of all topics.
- **Assignments and Quizzes:** Regular assessments to reinforce learning.
- **Group Projects:** Apply accounting concepts to real-world scenarios.

Recommended Reading:

1. Horngren, C. T., Sundem, G. L., & Elliott, J. A. (2020). *Accounting: The Financial Chapters*. Pearson.
2. Weygandt, J. J., Kimmel, P. D., & Kieso, D. E. (2019). *Financial Accounting: IFRS*

Course Title: Financial Economics

Course Description:

The Financial Economics course explores the intersection of economics and finance. Students delve into topics such as asset pricing, portfolio theory, risk management, and market efficiency. Emphasis is placed on understanding financial markets, investment strategies, and economic decision-making. Practical applications in insurance, pensions, and investment analysis are integrated throughout the course.

Learning Objectives:

By the end of this course, students will be able to:

1. Understand the fundamental principles of financial economics.
2. Apply economic theories to analyze financial markets and asset pricing.
3. Evaluate risk and return trade-offs in investment decisions.
4. Interpret financial data and make informed choices based on economic insights.

Topics Covered:

1. Introduction to Financial Economics
2. Asset Pricing Models (CAPM, APT)
3. Efficient Market Hypothesis
4. Portfolio Theory and Diversification
5. Risk Management and Hedging Strategies
6. Behavioral Finance
7. Financial Derivatives
8. Real-World Applications in Insurance and Investment

Assessment:

- Midterm and Final Examinations
- Individual or Group Projects
- Quizzes and Homework Assignments
- Participation in Class Discussions

Recommended Reading:

1. Bodie, Z., Kane, A., & Marcus, A. J. (2014). *Investments*. McGraw-Hill Education.
2. Malkiel, B. G. (2015). *A Random Walk Down Wall Street*. W. W. Norton & Company.
3. Campbell, J. Y., Lo, A. W., & MacKinlay, A. C. (1997). *The Econometrics of Financial Markets*. Princeton University Press.

Course Title: Survival Analysis

Course Description:

The "Survival Analysis" course explores statistical methods for analyzing time-to-event data. Students delve into concepts such as hazard functions, survival curves, censoring, and lifetime distributions. Emphasis is placed on understanding survival probabilities, modeling lifetimes, and assessing risk in various contexts. Practical applications in actuarial science, insurance, and financial modeling are integrated throughout the course.

Learning Objectives:

By the end of this course, students will be able to:

1. Understand the fundamental principles of survival analysis.
2. Apply survival models to real-world data, including actuarial and financial datasets.
3. Interpret survival curves and hazard rates.
4. Assess risk and make informed decisions based on time-to-event data.

Topics Covered:

1. Introduction to Survival Analysis
2. Kaplan-Meier Estimator
3. Parametric Survival Models (e.g., Exponential, Weibull, Log-Normal)
4. Cox Proportional Hazards Model
5. Censoring and Truncation
6. Time-Dependent Covariates
7. Applications in Actuarial Science and Insurance

Assessment:

- Midterm and Final Examinations
- Individual or Group Projects (Applying survival models to real data)
- Homework Assignments (Interpreting survival curves and hazard rates)

Recommended Reading:

1. Kleinbaum, D. G., & Klein, M. (2012). *Survival Analysis: A Self-Learning Text*. Springer.

2. Therneau, T. M., & Grambsch, P. M. (2000). *Modeling Survival Data: Extending the Cox Model*. Springer.

Course Title: Derivatives

Course Description:

The “Derivatives” course explores financial instruments such as options, futures, and swaps. Students delve into concepts like pricing models, risk management, and hedging strategies. Emphasis is placed on understanding derivative markets, arbitrage opportunities, and their applications in insurance, pensions, and investment analysis.

Learning Objectives:

By the end of this course, students will be able to:

1. Understand the fundamental principles of derivatives and their role in financial markets.
2. Apply pricing models to value options, futures, and other derivative contracts.
3. Evaluate risk exposure and develop hedging strategies using derivatives.
4. Interpret derivative market data and make informed investment decisions.

Topics Covered:

1. Introduction to Derivatives
2. Option Pricing Models (e.g., Black-Scholes Model)
3. Futures Contracts and Forward Pricing
4. Swaps and Interest Rate Derivatives
5. Risk Management with Derivatives
6. Volatility Trading and Implied Volatility
7. Real-World Applications in Insurance and Investment

Assessment:

- Midterm and Final Examinations
- Derivatives Pricing Projects (Applying pricing models to real data)
- Homework Assignments (Solving derivative-related problems)
- Participation in Class Discussions

Recommended Reading:

1. Hull, J. C. (2018). *Options, Futures, and Other Derivatives*. Pearson.
2. McDonald, R. L. (2014). *Derivatives Markets*. Pearson.

Course Title: Multiple Variables

Course Description:

The “Multiple Variables” course provides a rigorous exploration of multivariable calculus. Students delve into concepts such as partial derivatives, gradients, optimization, multiple integrals, and vector calculus. Emphasis is placed on understanding mathematical functions in higher dimensions and their applications in actuarial science, finance, and risk modeling.

Learning Objectives:

By the end of this course, students will be able to:

1. Understand the principles of multivariable calculus, including partial differentiation and gradient vectors.
2. Apply optimization techniques to solve real-world problems related to risk assessment and financial modeling.
3. Interpret multiple integrals and their geometric significance.
4. Manipulate vector-valued functions and understand their role in mathematical modeling.

Topics Covered:

1. Partial Differentiation
2. Gradient Vectors and Directional Derivatives
3. Optimization (Maxima and Minima)
4. Multiple Integrals (Double and Triple Integrals)
5. Line Integrals and Green’s Theorem
6. Vector Fields and Divergence
7. Applications in Actuarial Science and Financial Modeling

Assessment:

- Midterm and Final Examinations
- Problem Sets and Homework Assignments
- Application Projects (Using multivariable calculus to analyze financial data)
- Participation in Class Discussions

Recommended Reading:

1. Stewart, J. (2015). *Calculus: Early Transcendentals*. Cengage Learning.
2. Marsden, J. E., & Tromba, A. J. (2011). *Vector Calculus*. W. H. Freeman.

Course Title: Macroeconomics

Course Description:

This course explores the macroeconomic principles that shape national and global economies. Students will analyze economic aggregates, policies, and their impact on growth, inflation, and employment. Emphasis will be placed on understanding economic indicators and policy tools.

Learning Objectives:

- Understand the key macroeconomic concepts, including GDP, inflation, and unemployment.
- Analyze fiscal and monetary policies and their effects on economic stability.

- Explore international trade and exchange rate dynamics.
- Apply macroeconomic theories to real-world scenarios.

Topics Covered:

1. **Introduction to Macroeconomics:**
    - Overview of macroeconomic goals and measurement.
    - Circular flow of income and expenditure.
    - Aggregate demand and supply.
2. **Economic Growth and Development:**
    - Factors influencing economic growth.
    - Human capital, technological progress, and productivity.
    - Economic development indicators.
3. **Inflation and Unemployment:**
    - Causes and consequences of inflation.
    - Types of unemployment and their impact.
    - Phillips curve and trade-offs.
4. **Monetary Policy and Central Banking:**
    - Role of central banks.
    - Money supply, interest rates, and monetary policy tools.
    - Quantitative easing and unconventional policies.
5. **Fiscal Policy and Government Spending:**
    - Government budget, taxation, and public debt.
    - Multiplier effect and fiscal stimulus.
    - Crowding out and Ricardian equivalence.

Assessment:

- **Midterm Exam:** Covers material from the first half of the course.
- **Final Exam:** Comprehensive assessment of all topics.
- **Assignments and Quizzes:** Regular assessments to reinforce learning.
- **Group Projects:** Apply macroeconomic theories to real-world scenarios.

Recommended Reading:

1. Blanchard, O. (2017). *Macroeconomics*. Pearson.
2. Mankiw, N. G. (2018). *Principles of Macroeconomics*. Cengage Learning.

Course Title: Discrete Mathematics

Course Description:

Discrete mathematics provides the foundation for solving problems related to countable structures, algorithms, and decision-making. This course explores topics such as graph theory, combinatorics, logic, and discrete probability. Students will develop critical thinking skills and learn to apply mathematical concepts to real-world scenarios.

Learning Objectives:

- Understand fundamental concepts in graph theory, including paths, cycles, and connectivity.

- Apply combinatorial techniques to solve problems related to permutations, combinations, and discrete probability.
- Analyze algorithms and their efficiency using mathematical reasoning.
- Explore formal logic and its applications.

Topics Covered:

1. **Graph Theory:**
   - Graphs, trees, and networks.
   - Eulerian and Hamiltonian paths.
   - Planar graphs and coloring.
2. **Combinatorics:**
   - Permutations and combinations.
   - Binomial coefficients and Pascal's triangle.
   - Generating functions.
3. **Discrete Probability:**
   - Probability spaces and events.
   - Conditional probability and independence.
   - Random variables and expected values.
4. **Formal Logic:**
   - Propositional logic and truth tables.
   - Predicate logic and quantifiers.
   - Proof techniques (direct proof, contrapositive, induction).

Assessment:

- **Midterm Exam:** Covers material from the first half of the course.
- **Final Exam:** Comprehensive assessment of all topics.
- **Problem Sets and Quizzes:** Regular assessments to reinforce learning.
- **Project or Presentation:** Apply discrete mathematics concepts to practical scenarios.

Recommended Reading:

1. Rosen, K. H. (2019). *Discrete Mathematics and Its Applications*. McGraw-Hill.
2. Epp, S. S. (2019). *Discrete Mathematics with Applications*. Cengage Learning.

Course Title: Probability and Distributions

Course Description:

This course introduces fundamental concepts in probability theory and statistical distributions. Students will explore the mathematical foundations of uncertainty, random variables, and their distributions. Emphasis will be placed on practical applications in actuarial science, risk management, and data analysis.

Learning Objectives:

- Understand the principles of probability, including sample spaces, events, and conditional probability.
- Analyze discrete and continuous random variables.
- Explore common probability distributions (e.g., binomial, normal, exponential).
- Apply probability concepts to real-world scenarios.

Topics Covered:

1. **Probability Basics:**
    - Sample spaces, events, and probability axioms.
    - Conditional probability and independence.
    - Law of total probability and Bayes' theorem.
2. **Random Variables:**
    - Discrete vs. continuous random variables.
    - Probability mass functions (PMFs) and probability density functions (PDFs).
    - Expected value and variance.
3. **Common Distributions:**
    - Binomial distribution.
    - Poisson distribution.
    - Normal distribution.
    - Exponential distribution.
4. **Joint Distributions:**
    - Bivariate distributions.
    - Covariance and correlation.
    - Multivariate normal distribution.

Assessment:

- **Midterm Exam:** Covers material from the first half of the course.
- **Final Exam:** Comprehensive assessment of all topics.
- **Problem Sets and Quizzes:** Regular assessments to reinforce learning.
- **Practical Applications:** Apply probability concepts to actuarial problems.

Recommended Reading:

1. Ross, S. M. (2019). *A First Course in Probability*. Pearson.
2. Devore, J. L. (2015). *Probability and Statistics for Engineering and the Sciences*. Cengage Learning.

Course Title: Economics for Actuaries

Course Description:

This course provides a comprehensive understanding of economics from an actuarial perspective. Students will explore economic principles, financial markets, and their impact on risk management and decision-making. Emphasis will be placed on applying economic theories to actuarial scenarios.

Learning Objectives:

- Understand fundamental economic concepts, including supply and demand, utility theory, and market structures.
- Analyze financial markets, interest rates, and investment strategies.
- Explore behavioral economics and its relevance to actuarial practice.
- Apply economic models to assess risk and uncertainty.

Topics Covered:

1. **Microeconomics:**
    - Consumer behavior and utility maximization.
    - Production, costs, and market structures (perfect competition, monopoly, oligopoly).
    - Game theory and strategic decision-making.
2. **Macroeconomics:**
    - National income accounting and economic indicators.
    - Monetary policy, fiscal policy, and central banking.
    - Economic growth, inflation, and unemployment.
3. **Financial Markets:**
    - Bond markets, stock markets, and derivatives.
    - Risk and return trade-offs.
    - Efficient market hypothesis.
4. **Behavioral Economics:**
    - Prospect theory and decision biases.
    - Herd behavior and market anomalies.
    - Implications for actuarial modeling.

Assessment:

- **Midterm Exam:** Covers material from the first half of the course.
- **Final Exam:** Comprehensive assessment of all topics.
- **Case Studies and Projects:** Apply economic principles to actuarial problems.

Recommended Reading:

1. Blanchard, O. (2017). *Macroeconomics*. Pearson.
2. Mankiw, N. G. (2018). *Principles of Microeconomics*. Cengage Learning.

Course Title: Mathematical Statistics

Course Description:

Mathematical statistics provides the tools and techniques necessary for analyzing data, making predictions, and assessing uncertainty. Students will delve into probability theory, statistical distributions, and hypothesis testing. Emphasis will be placed on practical applications relevant to actuarial science and data analysis.

Learning Objectives:

- Understand the foundations of probability theory.
- Explore discrete and continuous probability distributions.
- Apply statistical methods to real-world data.
- Develop critical thinking skills for hypothesis testing.

Topics Covered:

1. **Probability Theory:**
    - Sample spaces, events, and probability axioms.
    - Conditional probability and Bayes' theorem.

- Random variables and probability distributions.

2. **Statistical Distributions:**
   - Discrete distributions (e.g., binomial, Poisson).
   - Continuous distributions (e.g., normal, exponential).
   - Moments, skewness, and kurtosis.
3. **Hypothesis Testing:**
   - Null and alternative hypotheses.
   - Type I and Type II errors.
   - Confidence intervals and p-values.
4. **Regression and Correlation:**
   - Simple linear regression.
   - Multiple regression.
   - Correlation coefficients.

Assessment:

- **Midterm Exam:** Covers material from the first half of the course.
- **Final Exam:** Comprehensive assessment of all topics.
- **Data Analysis Projects:** Apply statistical techniques to actuarial scenarios.

Recommended Reading:

1. Ross, S. M. (2019). *A First Course in Probability*. Pearson.
2. Devore, J. L. (2015). *Probability and Statistics for Engineering and the Sciences*. Cengage Learning.

Course Title: Investment and Financial Markets

Course Description:

This course explores the principles of investment, financial markets, and risk management. Students will analyze asset classes, portfolio theory, and valuation techniques. Emphasis will be placed on understanding market dynamics and making informed investment decisions.

Learning Objectives:

- Understand the role of financial markets in the economy.
- Analyze investment vehicles (stocks, bonds, derivatives).
- Apply portfolio theory to optimize risk and return.
- Evaluate investment strategies and asset allocation.

Topics Covered:

1. **Introduction to Financial Markets:**
   - Overview of stock exchanges, bond markets, and commodities.
   - Efficient market hypothesis and behavioral finance.
   - Role of central banks and monetary policy.
2. **Investment Vehicles:**
   - Stocks, bonds, mutual funds, and ETFs.
   - Derivatives (options, futures, swaps).
   - Real estate and alternative investments.
3. **Portfolio Theory:**

- Risk and return trade-offs.
- Capital Asset Pricing Model (CAPM).
- Diversification and efficient frontier.

4. **Valuation Techniques:**
   - Discounted cash flow (DCF) analysis.
   - Price-to-earnings ratio (P/E ratio).
   - Bond pricing and yield calculations.

Assessment:

- **Midterm Exam:** Covers material from the first half of the course.
- **Final Exam:** Comprehensive assessment of all topics.
- **Investment Simulation:** Apply theoretical concepts to real-world scenarios.

Recommended Reading:

1. Bodie, Z., Kane, A., & Marcus, A. J. (2018). *Investments*. McGraw-Hill.
2. Malkiel, B. G. (2015). *A Random Walk Down Wall Street*. W. W. Norton & Company.

Course Title: Microeconomics

Course Description:

Microeconomics provides a foundational understanding of individual economic behavior, market dynamics, and resource allocation. Students will explore topics such as supply and demand, utility theory, and cost analysis. Emphasis will be placed on applying microeconomic principles to real-world scenarios relevant to actuarial science.

Learning Objectives:

- Understand the basics of microeconomic theory.
- Analyze consumer behavior, production, and costs.
- Explore market structures and their implications.
- Apply economic concepts to insurance and risk assessment.

Topics Covered:

1. **Demand and Supply Analysis:**
   - Law of demand and elasticity.
   - Factors affecting supply and demand.
   - Price controls and their effects.
2. **Utility Theory and Consumer Behavior:**
   - Marginal utility and consumer choice.
   - Budget constraints and indifference curves.
   - Rational decision-making.
3. **Cost Analysis and Production Factors:**
   - Short-run vs. long-run costs.
   - Production functions and input factors.
   - Profit maximization.
4. **Market Structures:**
   - Perfect competition, monopoly, and oligopoly.

- Game theory and strategic interactions.
- Market failures and externalities.

Assessment:

- **Midterm Exam:** Covers material from the first half of the course.
- **Final Exam:** Comprehensive assessment of all topics.
- **Assignments and Quizzes:** Regular assessments to reinforce learning.
- **Application to Actuarial Problems:** Apply microeconomic concepts to insurance and risk scenarios.

Recommended Reading:

1. Varian, H. R. (2014). *Intermediate Microeconomics: A Modern Approach*. W. W. Norton & Company.
2. Pindyck, R. S., & Rubinfeld, D. L. (2018). *Microeconomics*. Pearson.

Course Title: Statistics for Risk Modeling

Course Description:

Statistics for Risk Modeling provides students with the essential tools for quantitatively assessing risk in actuarial practice. Students will explore statistical inference, regression models, and probability distributions relevant to insurance and financial risks. Emphasis will be placed on practical applications and modeling techniques.

Learning Objectives:

- Understand the concepts of statistical inference, including estimation and hypothesis testing.
- Analyze time series data using regression models.
- Explore frequency, severity, and aggregate claims models.
- Apply statistical techniques to assess risk in insurance and financial contexts.

Topics Covered:

1. **Statistical Inference:**
   - Estimation of parameters (mean, variance, etc.).
   - Hypothesis testing (null vs. alternative hypotheses).
   - Confidence intervals.
2. **Regression Models:**
   - Linear regression and multiple regression.
   - Time series analysis and forecasting.
   - Generalized linear models (GLMs).
3. **Frequency and Severity Models:**
   - Contingent payment models.
   - Modeling claim frequencies.
   - Aggregate claims models.
4. **Risk Assessment and Applications:**
   - Principal component analysis.
   - Cluster analysis.
   - Economic reasoning in risk modeling.

Assessment:

- **Midterm Exam:** Covers material from the first half of the course.
- **Final Exam:** Comprehensive assessment of all topics.
- **Practical Projects:** Apply statistical models to real-world risk scenarios.

Recommended Reading:

1. Actuarial textbooks covering statistical methods and risk modeling.
2. Additional resources recommended by the course instructor.

Course Title: Calculus I

Course Description:

Calculus I introduces fundamental concepts in differential and integral calculus. Students will explore limits, derivatives, and integrals, laying the groundwork for mathematical modeling and quantitative analysis. Emphasis will be placed on understanding the applications of calculus in actuarial science and data analysis.

Learning Objectives:

- Understand the concept of limits and continuity.
- Analyze functions and their derivatives.
- Apply differentiation techniques to solve real-world problems.
- Explore the fundamental theorem of calculus.

Topics Covered:

1. **Limits and Continuity:**
    - Definition of limits.
    - One-sided limits and continuity.
    - Intermediate value theorem.
2. **Differentiation:**
    - Derivative as a rate of change.
    - Rules for differentiation (product rule, chain rule).
    - Applications (related rates, optimization).
3. **Integration:**
    - Antiderivatives and indefinite integrals.
    - Definite integrals and the fundamental theorem of calculus.
    - Area under curves.
4. **Applications of Calculus:**
    - Modeling growth and decay.
    - Optimization problems.
    - Introduction to differential equations.

Assessment:

- **Midterm Exam:** Covers material from the first half of the course.
- **Final Exam:** Comprehensive assessment of all topics.
- **Problem Sets and Quizzes:** Regular assessments to reinforce learning.

Recommended Reading:

1. Stewart, J. (2019). *Calculus: Early Transcendentals*. Cengage Learning.
2. Larson, R., & Edwards, B. (2018). *Calculus*. Cengage Learning.

Course Title: Corporate Finance

Course Description:

Corporate Finance explores financial decision-making within organizations. Students will analyze capital budgeting, risk management, and valuation techniques. Emphasis will be placed on understanding financial markets, investment strategies, and their impact on business operations.

Learning Objectives:

- Understand the principles of financial management.
- Analyze investment projects and evaluate their profitability.
- Explore capital structure decisions and cost of capital.
- Apply financial models to real-world scenarios.

Topics Covered:

1. **Time Value of Money:**
    - Discounted cash flow (DCF) analysis.
    - Net present value (NPV) and internal rate of return (IRR).
    - Capital budgeting decisions.
2. **Risk and Return:**
    - Portfolio theory and diversification.
    - Risk assessment and risk-adjusted returns.
    - Capital asset pricing model (CAPM).
3. **Capital Structure and Financing:**
    - Debt vs. equity financing.
    - Weighted average cost of capital (WACC).
    - Leverage and financial risk.
4. **Valuation Techniques:**
    - Valuation of stocks and bonds.
    - Dividend discount model (DDM).
    - Mergers and acquisitions (M&A) valuation.

Assessment:

- **Midterm Exam:** Covers material from the first half of the course.
- **Final Exam:** Comprehensive assessment of all topics.
- **Case Studies and Projects:** Apply corporate finance concepts to practical scenarios.

Recommended Reading:

1. Ross, S. A., Westerfield, R. W., & Jordan, B. D. (2019). *Fundamentals of Corporate Finance*. McGraw-Hill.
2. Brealey, R. A., Myers, S. C., & Allen, F. (2017). *Principles of Corporate Finance*. McGraw-Hill.

Course Title: Calculus II

Course Description:

Calculus II builds upon the foundational concepts introduced in Calculus I. Students will delve deeper into differential and integral calculus, exploring advanced techniques and applications. Emphasis will be placed on mathematical modeling relevant to actuarial science and data analysis.

Learning Objectives:

- Extend understanding of limits, derivatives, and integrals.
- Analyze transcendental functions (exponential, logarithmic, trigonometric).
- Apply integration techniques to solve real-world problems.
- Explore sequences, series, and convergence.

Topics Covered:

1. **Techniques of Integration:**
    - Integration by parts.
    - Trigonometric integrals.
    - Improper integrals.
2. **Applications of Integration:**
    - Area between curves.
    - Volume of solids of revolution.
    - Arc length and surface area.
3. **Sequences and Series:**
    - Convergence and divergence.
    - Taylor and Maclaurin series.
    - Power series representation.
4. **Advanced Differential Calculus:**
    - Higher-order derivatives.
    - L'Hôpital's rule.
    - Parametric and polar curves.

Assessment:

- **Midterm Exam:** Covers material from the first half of the course.
- **Final Exam:** Comprehensive assessment of all topics.
- **Problem Sets and Quizzes:** Regular assessments to reinforce learning.

Recommended Reading:

1. Stewart, J. (2019). *Calculus: Early Transcendentals*. Cengage Learning.
2. Larson, R., & Edwards, B. (2018). *Calculus*. Cengage Learning.

Course Title: Linear Algebra

Course Description:

Linear Algebra provides essential mathematical tools for understanding vector spaces, linear transformations, and systems of linear equations. Students will explore fundamental concepts and applications relevant to actuarial science, data analysis, and other quantitative fields.

Learning Objectives:

- Understand vector spaces, subspaces, and linear independence.
- Analyze matrices, determinants, and eigenvalues.
- Apply linear algebra techniques to solve real-world problems.
- Explore applications in data science, optimization, and risk modeling.

Topics Covered:

1. **Vector Spaces and Subspaces:**
    - Definition of vector spaces.
    - Basis and dimension.
    - Linear transformations.
2. **Matrices and Systems of Equations:**
    - Matrix operations (addition, multiplication).
    - Gaussian elimination and row echelon form.
    - Solving linear systems.
3. **Determinants and Eigenvalues:**
    - Determinant properties and computation.
    - Eigenvalues and eigenvectors.
    - Diagonalization.
4. **Applications in Data Science and Actuarial Science:**
    - Principal component analysis (PCA).
    - Markov chains and transition matrices.
    - Regression models.

Assessment:

- **Midterm Exam:** Covers material from the first half of the course.
- **Final Exam:** Comprehensive assessment of all topics.
- **Problem Sets and Projects:** Apply linear algebra concepts to practical scenarios.

Recommended Reading:

1. Lay, D. C., Lay, S. R., & McDonald, J. J. (2015). *Linear Algebra and Its Applications*. Pearson.
2. Strang, G. (2016). *Introduction to Linear Algebra*. Wellesley-Cambridge Press.

Course Title: Regression Analysis

Course Description:

Regression Analysis focuses on understanding and applying regression models to real-world data. Students will explore various regression techniques, interpret results, and communicate

findings effectively. Emphasis will be placed on practical applications relevant to actuarial science and data analysis.

Learning Objectives:

- Understand the principles of regression modeling.
- Analyze linear regression, logistic regression, and other regression models.
- Apply regression techniques to solve business problems.
- Interpret and communicate regression results.

Topics Covered:

1. **Simple Linear Regression:**
    - Model assumptions and interpretation.
    - Least squares estimation.
    - Residual analysis.
2. **Multiple Linear Regression:**
    - Multiple predictors and interactions.
    - Model selection and diagnostics.
    - Collinearity and variable transformation.
3. **Logistic Regression:**
    - Binary outcomes and odds ratios.
    - Maximum likelihood estimation.
    - Model validation.
4. **Advanced Regression Topics:**
    - Nonlinear regression.
    - Generalized linear models (GLMs).
    - Time series regression.

Assessment:

- **Midterm Exam:** Covers material from the first half of the course.
- **Final Project:** Apply regression techniques to a real-world dataset.
- **Homework Assignments:** Regular assessments to reinforce learning.

Recommended Reading:

1. Montgomery, D. C., Peck, E. A., & Vining, G. G. (2015). *Introduction to Linear Regression Analysis*. Wiley.
2. Agresti, A. (2015). *Foundations of Linear and Generalized Linear Models*. Wiley.

Course Title: Data Science Fundamentals

Course Description:

Data Science Fundamentals introduces students to the essential concepts and techniques in data science. The course focuses on practical applications, real-world examples, and critical thinking. Students will gain the skills necessary to analyze data, make informed decisions, and solve complex problems.

Learning Objectives:

- Understand the fundamental principles of data science.
- Analyze and preprocess data.
- Apply statistical methods and machine learning techniques.
- Communicate findings effectively.

Topics Covered:

1. **Introduction to Data Science:**
    - Role of data science in various domains.
    - Data lifecycle and ethical considerations.
    - Data visualization and exploratory data analysis.
2. **Data Preprocessing:**
    - Data cleaning and handling missing values.
    - Feature engineering and transformation.
    - Data normalization and scaling.
3. **Statistical Methods:**
    - Descriptive statistics (mean, median, variance).
    - Hypothesis testing and confidence intervals.
    - Regression analysis.
4. **Machine Learning Basics:**
    - Supervised vs. unsupervised learning.
    - Decision trees, k-nearest neighbors, and Naive Bayes.
    - Model evaluation and validation.

Assessment:

- **Assignments and Quizzes:** Regular assessments to reinforce learning.
- **Data Analysis Projects:** Apply data science techniques to real-world datasets.
- **Final Exam:** Comprehensive assessment of all topics.

Recommended Reading:

1. James, G., Witten, D., Hastie, T., & Tibshirani, R. (2013). *An Introduction to Statistical Learning*. Springer.
2. VanderPlas, J. (2016). *Python Data Science Handbook*. O'Reilly.

Course Title: Financial Accounting

Course Description:

Financial Accounting provides students with a solid foundation in accounting principles, financial reporting, and analysis. The course focuses on understanding financial statements, transactions, and their impact on decision-making. Emphasis will be placed on practical applications relevant to actuarial science and data analysis.

Learning Objectives:

- Understand the fundamental principles of financial accounting.
- Analyze financial statements (balance sheet, income statement, cash flow statement).
- Apply accounting concepts to real-world scenarios.
- Interpret financial data for various stakeholders.

Topics Covered:

1. **Introduction to Financial Accounting:**
    - Role of accounting in business.
    - Accounting standards (GAAP, IFRS).
    - Ethical considerations.
2. **Financial Statements:**
    - Balance sheet (assets, liabilities, equity).
    - Income statement (revenue, expenses, profit).
    - Cash flow statement (operating, investing, financing activities).
3. **Recording Transactions:**
    - Double-entry bookkeeping.
    - Journal entries and ledger accounts.
    - Trial balance and adjusting entries.
4. **Financial Analysis:**
    - Ratio analysis (liquidity, solvency, profitability).
    - Interpretation of financial data.
    - Trend analysis.

Assessment:

- **Midterm Exam:** Covers material from the first half of the course.
- **Final Exam:** Comprehensive assessment of all topics.
- **Case Studies and Projects:** Apply accounting principles to practical scenarios.

Recommended Reading:

1. Horngren, C. T., Sundem, G. L., & Elliott, J. A. (2020). *Accounting: The Financial Chapters*. Pearson.
2. Weygandt, J. J., Kimmel, P. D., & Kieso, D. E. (2019). *Financial Accounting: IFRS Edition*. Wiley.

Course Title: Theory of Interest

Course Description:

The Theory of Interest course provides students with a comprehensive understanding of interest rates, time value of money, and financial mathematics. Students will explore the mathematical principles underlying various financial transactions and investment decisions. Emphasis will be placed on practical applications relevant to actuarial science and data analysis.

Learning Objectives:

- Understand the concept of interest rates and their impact on financial transactions.
- Analyze annuities, loans, and other financial instruments.
- Apply time value of money concepts to real-world scenarios.
- Interpret and solve problems related to interest calculations.

Topics Covered:

1. **Interest Rates and Compound Interest:**
    - Nominal vs. effective interest rates.
    - Compound interest formulas.

- Continuous compounding.

2. **Annuities and Loans:**
   - Ordinary annuities vs. annuities due.
   - Amortization schedules.
   - Loan repayment calculations.
3. **Equations of Value:**
   - Present value and future value.
   - Discounted cash flow terminology.
   - Investment appraisal methods.
4. **Applications in Actuarial Science:**
   - Determination of exposed amounts.
   - Decremental rates and other indices.
   - Actuarial mathematics related to interest theory.

Assessment:

- **Midterm Exam:** Covers material from the first half of the course.
- **Final Exam:** Comprehensive assessment of all topics.
- **Problem Sets and Quizzes:** Regular assessments to reinforce learning.

Recommended Reading:

1. Bowers, N. L., Gerber, H. U., Hickman, J. C., Jones, D. A., & Nesbitt, C. J. (2013). *Actuarial Mathematics*. Society of Actuaries.
2. Trowbridge, C. M., & Trowbridge, E. J. (2015). *Theory of Interest*. Cengage Learning.

Course Title: Differential Equations

Course Description:

Differential Equations are fundamental to understanding dynamic processes in various fields, including physics, finance, and engineering. This course introduces techniques for studying classes of linear and nonlinear differential equations, emphasizing their applications in real-world scenarios. Students will learn how to model and analyze continuous systems that change over time.

Learning Objectives:

- Understand the importance of differential equations in modeling dynamic phenomena.
- Analyze linear and nonlinear differential equations.
- Apply techniques for solving ordinary differential equations.
- Interpret solutions and predict behavior of systems.

Topics Covered:

1. **Introduction to Differential Equations:**
   - Definition of differential equations.
   - Types of differential equations (ordinary vs. partial).
   - Initial value problems and boundary value problems.
2. **First-Order Differential Equations:**
   - Separable equations.
   - Linear equations.

    - Exact equations and integrating factors.
3. **Higher-Order Differential Equations:**
    - Second-order linear differential equations.
    - Homogeneous vs. nonhomogeneous equations.
    - Systems of differential equations.
4. **Applications in Actuarial Science and Data Science:**
    - Modeling population growth and decay.
    - Interest rate modeling using differential equations.
    - Epidemiological models (e.g., SIR model).

Assessment:

- **Midterm Exam:** Covers material from the first half of the course.
- **Final Exam:** Comprehensive assessment of all topics.
- **Problem Sets and Projects:** Apply differential equation techniques to practical scenarios.

Recommended Reading:

1. Boyce, W. E., & DiPrima, R. C. (2017). *Elementary Differential Equations and Boundary Value Problems*. Wiley.
2. Tenenbaum, M., & Pollard, H. (2012). *Ordinary Differential Equations*. Dover Publications.

Course Title: Statistical Programming with Excel

Course Description:

Statistical Programming with Excel introduces students to data analysis, statistical modeling, and programming using Microsoft Excel. The course focuses on practical applications of Excel for solving real-world problems related to actuarial science, finance, and risk management.

Learning Objectives:

- Understand the role of statistical programming in data analysis.
- Develop proficiency in using Excel for statistical calculations.
- Apply Excel functions and features to analyze data.
- Interpret and communicate statistical results effectively.

Topics Covered:

1. **Excel Basics for Data Analysis:**
    - Spreadsheet organization and data entry.
    - Formulas and functions (SUM, AVERAGE, COUNT, etc.).
    - Data validation and error handling.
2. **Statistical Functions in Excel:**
    - Descriptive statistics (mean, median, variance, etc.).
    - Regression analysis using Excel's built-in tools.
    - Hypothesis testing (t-tests, ANOVA).
3. **Data Visualization and Charting:**
    - Creating charts (bar charts, scatter plots, histograms).
    - Customizing chart elements.

    - Using PivotTables for data summarization.
4. **Advanced Excel Techniques:**
    - Macros and VBA programming.
    - Solver for optimization problems.
    - Importing and exporting data.

Assessment:

- **Assignments and Quizzes:** Regular assessments to reinforce learning.
- **Data Analysis Projects:** Apply Excel techniques to real-world datasets.
- **Final Exam:** Comprehensive assessment of all topics.

Recommended Reading:

1. Walkenbach, J. (2019). *Excel 2019 Bible*. Wiley.
2. Winston, W. L. (2019). *Microsoft Excel Data Analysis and Business Modeling*. Microsoft Press.

Course Title: Principles of Management

Course Description:

The Principles of Management course provides students with foundational knowledge and skills related to effective management practices. Students will explore key concepts, theories, and techniques applicable to various organizational contexts. Emphasis will be placed on understanding management principles relevant to actuarial science and data-driven decision-making.

Learning Objectives:

- Understand the fundamental principles of management.
- Analyze organizational structures, functions, and processes.
- Apply management techniques to solve real-world problems.
- Develop critical thinking and leadership skills.

Topics Covered:

1. **Introduction to Management:**
    - Evolution of management theories.
    - Functions of management (planning, organizing, leading, controlling).
    - Managerial roles and responsibilities.
2. **Organizational Behavior:**
    - Individual and group behavior in organizations.
    - Motivation theories and employee engagement.
    - Communication and conflict resolution.
3. **Strategic Management:**
    - SWOT analysis and strategic planning.
    - Competitive advantage and value creation.
    - Business ethics and social responsibility.
4. **Leadership and Decision-Making:**
    - Leadership styles and traits.
    - Decision-making models (rational, bounded rationality, intuitive).

- Change management and innovation.

Assessment:

- **Class Participation:** Active engagement in discussions and case studies.
- **Group Projects:** Apply management principles to practical scenarios.
- **Midterm and Final Exams:** Assess understanding of course material.

Recommended Reading:

1. Robbins, S. P., Coulter, M., & DeCenzo, D. A. (2017). *Fundamentals of Management*. Pearson.
2. Drucker, P. F. (2008). *The Practice of Management*. Harper Business.

Course Title: Numerical Methods

Course Description:

Numerical Methods introduces students to computational techniques for solving mathematical problems that cannot be solved analytically. Students will explore algorithms, approximation methods, and numerical simulations. Emphasis will be placed on practical applications relevant to actuarial science, data analysis, and scientific computing.

Learning Objectives:

- Understand the importance of numerical methods in solving complex mathematical problems.
- Analyze and implement numerical algorithms.
- Apply approximation techniques to real-world scenarios.
- Interpret and evaluate numerical results.

Topics Covered:

1. **Introduction to Numerical Methods:**
   - Role of numerical methods in scientific computing.
   - Sources of error (round-off, truncation).
   - Convergence and stability.
2. **Root-Finding Algorithms:**
   - Bisection method.
   - Newton-Raphson method.
   - Secant method.
3. **Interpolation and Approximation:**
   - Lagrange interpolation.
   - Polynomial approximation.
   - Splines.
4. **Numerical Integration:**
   - Trapezoidal rule.
   - Simpson's rule.
   - Adaptive quadrature methods.
5. **Differential Equations:**
   - Euler's method.
   - Runge-Kutta methods.

- Finite difference schemes.

Assessment:

- **Assignments and Quizzes:** Regular assessments to reinforce learning.
- **Programming Projects:** Implement numerical algorithms in a programming language (e.g., Python, MATLAB).
- **Midterm and Final Exams:** Assess understanding of course material.

Recommended Reading:

1. Burden, R. L., & Faires, J. D. (2015). *Numerical Analysis*. Cengage Learning.
2. Chapra, S. C., & Canale, R. P. (2014). *Numerical Methods for Engineers*. McGraw-Hill.

Course Title: Financial Mathematics

Course Description:

Financial Mathematics provides students with a solid foundation in mathematical techniques for analyzing financial markets, investment decisions, and risk management. The course focuses on understanding interest rates, time value of money, and pricing of financial instruments. Emphasis will be placed on practical applications relevant to actuarial science and data-driven decision-making.

Learning Objectives:

- Understand the concept of interest rates and their impact on financial transactions.
- Analyze annuities, loans, and other financial instruments.
- Apply time value of money concepts to real-world scenarios.
- Interpret and communicate financial results.

Topics Covered:

1. **Interest Rates and Compound Interest:**
   - Nominal vs. effective interest rates.
   - Compound interest formulas.
   - Continuous compounding.
2. **Annuities and Loans:**
   - Ordinary annuities vs. annuities due.
   - Amortization schedules.
   - Loan repayment calculations.
3. **Equations of Value:**
   - Present value and future value.
   - Discounted cash flow terminology.
   - Investment appraisal methods.
4. **Risk Assessment and Financial Modeling:**
   - Pricing of bonds and derivatives.
   - Portfolio optimization.
   - Risk-adjusted return measures.

Assessment:

- **Assignments and Quizzes:** Regular assessments to reinforce learning.
- **Financial Modeling Projects:** Apply financial mathematics techniques to real-world datasets.
- **Midterm and Final Exams:** Assess understanding of course material.

Recommended Reading:

1. Bodie, Z., Kane, A., & Marcus, A. J. (2018). *Investments*. McGraw-Hill.
2. Ross, S. A., Westerfield, R. W., & Jordan, B. D. (2019). *Fundamentals of Corporate Finance*. McGraw-Hill.

Course Title: Time Series Analysis

Course Description:

Time Series Analysis focuses on understanding and modeling sequential data points collected over time. Students will explore statistical techniques, forecasting methods, and applications relevant to actuarial science, finance, and risk management. Emphasis will be placed on analyzing and interpreting time-dependent data.

Learning Objectives:

- Understand the characteristics of time series data.
- Analyze trends, seasonality, and cyclic patterns.
- Apply time series models for prediction and forecasting.
- Interpret and communicate results effectively.

Topics Covered:

1. **Introduction to Time Series:**
    - Definition of time series data.
    - Components of time series (trend, seasonality, noise).
    - Data visualization and exploratory analysis.
2. **Time Series Models:**
    - Moving average (MA) models.
    - Autoregressive (AR) models.
    - Autoregressive integrated moving average (ARIMA) models.
3. **Seasonal Decomposition and Smoothing Techniques:**
    - Seasonal decomposition of time series.
    - Exponential smoothing methods.
    - Holt-Winters method.
4. **Forecasting and Applications:**
    - Point forecasts and prediction intervals.
    - Box-Jenkins methodology.
    - Applications in finance, economics, and risk assessment.

Assessment:

- **Assignments and Quizzes:** Regular assessments to reinforce learning.
- **Time Series Projects:** Apply models to real-world time series data.
- **Midterm and Final Exams:** Assess understanding of course material.

Recommended Reading:

1. Brockwell, P. J., & Davis, R. A. (2016). *Introduction to Time Series and Forecasting*. Springer.
2. Hyndman, R. J., & Athanasopoulos, G. (2018). *Forecasting: Principles and Practice*. OTexts.

Course Title: Sampling Techniques

Course Description:

The Sampling Techniques course provides students with essential knowledge and skills related to sampling methods used in data collection and statistical analysis. Students will explore various sampling designs, estimation techniques, and practical applications. Emphasis will be placed on understanding the principles of sampling theory and their relevance to actuarial science and data-driven decision-making.

Learning Objectives:

- Understand the importance of sampling in statistical inference.
- Analyze different sampling methods (simple random sampling, stratified sampling, cluster sampling).
- Apply estimation techniques to infer population characteristics.
- Interpret and communicate sampling results effectively.

Topics Covered:

1. **Introduction to Sampling:**
    - Population vs. sample.
    - Sampling frame and sampling units.
    - Sampling error and bias.
2. **Simple Random Sampling:**
    - Random number generators.
    - Sampling with and without replacement.
    - Estimation of population parameters.
3. **Stratified Sampling:**
    - Stratification criteria.
    - Proportional allocation.
    - Efficiency gains.
4. **Cluster Sampling:**
    - Cluster definition.
    - One-stage vs. two-stage sampling.
    - Intra-cluster correlation.
5. **Applications and Case Studies:**
    - Surveys and opinion polls.
    - Quality control sampling.
    - Actuarial risk assessment.

Assessment:

- **Assignments and Quizzes:** Regular assessments to reinforce learning.
- **Sampling Projects:** Apply sampling techniques to real-world datasets.

- **Midterm and Final Exams:** Assess understanding of course material.

Recommended Reading:

1. Cochran, W. G. (1977). *Sampling Techniques*. Wiley.
2. Kish, L. (1965). *Survey Sampling*. Wiley.

Course Title: Categorical Data Analysis

Course Description:

Categorical Data Analysis focuses on statistical methods for analyzing data with categorical variables. Students will explore techniques for modeling and interpreting discrete outcomes, such as binary responses, count data, and multinomial data. Emphasis will be placed on practical applications relevant to actuarial science, data analysis, and decision-making.

Learning Objectives:

- Understand the characteristics of categorical data.
- Analyze relationships between categorical variables.
- Apply statistical models for categorical outcomes.
- Interpret and communicate results effectively.

Topics Covered:

1. **Introduction to Categorical Data:**
    - Types of categorical variables (nominal, ordinal).
    - Contingency tables and cross-tabulations.
    - Chi-squared tests.
2. **Logistic Regression:**
    - Binary outcomes and odds ratios.
    - Model estimation and interpretation.
    - Goodness-of-fit tests.
3. **Poisson Regression:**
    - Count data models.
    - Overdispersion and zero-inflation.
    - Applications in insurance and risk assessment.
4. **Multinomial Regression:**
    - Modeling categorical outcomes with more than two levels.
    - Nominal and ordinal responses.
    - Model selection and diagnostics.

Assessment:

- **Assignments and Quizzes:** Regular assessments to reinforce learning.
- **Categorical Data Projects:** Apply models to real-world datasets.
- **Midterm and Final Exams:** Assess understanding of course material.

Recommended Reading:

1. Agresti, A. (2018). *Categorical Data Analysis*. Wiley.

2. Long, J. S. (1997). *Regression Models for Categorical and Limited Dependent Variables*. Sage Publications.

Course Title: Financial Management

Course Description:

Financial Management provides students with essential knowledge and skills related to financial decision-making, risk assessment, and investment strategies. The course focuses on understanding financial markets, capital budgeting, and financial analysis. Emphasis will be placed on practical applications relevant to actuarial science and data-driven decision-making.

Learning Objectives:

- Understand the principles of financial management.
- Analyze investment projects and evaluate their profitability.
- Apply financial models to real-world scenarios.
- Interpret and communicate financial results effectively.

Topics Covered:

1. **Introduction to Financial Management:**
    - Role of financial management in organizations.
    - Financial statements and performance metrics.
    - Time value of money concepts.
2. **Capital Budgeting and Investment Decisions:**
    - Net present value (NPV) analysis.
    - Internal rate of return (IRR).
    - Risk assessment and sensitivity analysis.
3. **Financial Markets and Asset Pricing:**
    - Stock markets, bond markets, and derivatives.
    - Efficient market hypothesis.
    - Portfolio theory and diversification.
4. **Risk Management and Financial Analysis:**
    - Risk-adjusted return measures (Sharpe ratio, Treynor ratio).
    - Financial ratios and trend analysis.
    - Working capital management.

Assessment:

- **Assignments and Quizzes:** Regular assessments to reinforce learning.
- **Financial Modeling Projects:** Apply financial management techniques to real-world datasets.
- **Midterm and Final Exams:** Assess understanding of course material.

Recommended Reading:

1. Brigham, E. F., & Houston, J. F. (2018). *Fundamentals of Financial Management*. Cengage Learning.
2. Ross, S. A., Westerfield, R. W., & Jordan, B. D. (2019). *Fundamentals of Corporate Finance*. McGraw-Hill.

Course Title: Mathematical Modeling

Course Description:

Mathematical Modeling introduces students to the process of formulating, analyzing, and solving real-world problems using mathematical techniques. Students will explore various modeling approaches, including differential equations, optimization, and statistical models. Emphasis will be placed on practical applications relevant to actuarial science, data analysis, and decision-making.

Learning Objectives:

- Understand the importance of mathematical modeling in various fields.
- Analyze different modeling techniques and their limitations.
- Apply mathematical models to real-world scenarios.
- Interpret and communicate modeling results effectively.

Topics Covered:

1. **Introduction to Mathematical Modeling:**
    - Role of mathematical models in problem-solving.
    - Model formulation and validation.
    - Ethical considerations in modeling.
2. **Differential Equation Models:**
    - Ordinary differential equations (ODEs).
    - Partial differential equations (PDEs).
    - Applications in physics, biology, and finance.
3. **Optimization Models:**
    - Linear programming.
    - Nonlinear optimization.
    - Sensitivity analysis.
4. **Statistical Models:**
    - Regression analysis.
    - Time series models.
    - Bayesian modeling.

Assessment:

- **Assignments and Projects:** Apply modeling techniques to real-world datasets.
- **Model Validation and Sensitivity Analysis:** Evaluate model performance.
- **Midterm and Final Exams:** Assess understanding of course material.

Recommended Reading:

1. Bender, E. A., & Orszag, S. A. (1999). *Advanced Mathematical Methods for Scientists and Engineers*. Springer.
2. Montgomery, D. C., Peck, E. A., & Vining, G. G. (2015). *Introduction to Linear Regression Analysis*. Wiley.

Course Title: Operations Research

Course Description:

Operations Research (OR) is a field that applies mathematical and analytical techniques to solve complex decision-making problems. In this course, students will explore optimization, modeling, and simulation methods. Emphasis will be placed on practical applications relevant to actuarial science, data analysis, and risk management.

Learning Objectives:

- Understand the role of OR in solving real-world problems.
- Analyze optimization models and decision variables.
- Apply modeling techniques to improve efficiency and effectiveness.
- Interpret and communicate results from OR analyses.

Topics Covered:

1. **Introduction to Operations Research:**
    - Historical context and applications.
    - Problem formulation and modeling.
    - Decision-making under uncertainty.
2. **Linear Programming (LP):**
    - LP formulation and graphical solution.
    - Simplex method.
    - Sensitivity analysis.
3. **Integer Programming (IP) and Network Models:**
    - IP models and branch-and-bound method.
    - Transportation and assignment problems.
    - Network flow models (max flow, shortest path).
4. **Simulation and Stochastic Models:**
    - Monte Carlo simulation.
    - Queuing theory.
    - Markov chains.

Assessment:

- **Assignments and Quizzes:** Regular assessments to reinforce learning.
- **Modeling Projects:** Apply OR techniques to real-world scenarios.
- **Midterm and Final Exams:** Assess understanding of course material.

Recommended Reading:

1. Hillier, F. S., & Lieberman, G. J. (2014). *Introduction to Operations Research*. McGraw-Hill.
2. Winston, W. L. (2014). *Operations Research: Applications and Algorithms*. Cengage Learning.

Course Title: Design and Analysis of Experiments

Course Description:

The Design and Analysis of Experiments course introduces students to statistical techniques for planning, conducting, and analyzing experiments. Students will explore the principles of experimental design, hypothesis testing, and statistical inference. Emphasis will be placed on practical applications relevant to actuarial science, data analysis, and decision-making.

Learning Objectives:

- Understand the importance of experimental design in scientific research.
- Analyze different experimental designs (completely randomized, randomized block, factorial, etc.).
- Apply statistical methods to evaluate treatment effects.
- Interpret and communicate results from experiments.

Topics Covered:

1. **Introduction to Experimental Design:**
    - Role of experiments in hypothesis testing.
    - Randomization and control groups.
    - Ethical considerations.
2. **Completely Randomized Designs:**
    - One-factor experiments.
    - Analysis of variance (ANOVA).
    - Post-hoc tests.
3. **Randomized Block Designs:**
    - Blocking factors.
    - Latin square designs.
    - Repeated measures designs.
4. **Factorial Designs:**
    - Two-factor experiments.
    - Interaction effects.
    - Fractional factorial designs.

Assessment:

- **Assignments and Quizzes:** Regular assessments to reinforce learning.
- **Experimental Projects:** Plan and analyze experiments using real-world data.
- **Midterm and Final Exams:** Assess understanding of course material.

Recommended Reading:

1. Montgomery, D. C. (2017). *Design and Analysis of Experiments*. Wiley.
2. Box, G. E. P., Hunter, W. G., & Hunter, J. S. (2005). *Statistics for Experimenters: Design, Innovation, and Discovery*. Wiley.

Course Title: Actuarial Mathematics

Course Description:

Actuarial Mathematics provides students with the mathematical foundation necessary for actuarial science. The course focuses on risk assessment, financial modeling, and statistical techniques. Emphasis will be placed on practical applications relevant to insurance, finance, and risk management.

Learning Objectives:

- Understand the principles of actuarial mathematics.
- Analyze financial risks and uncertainties.
- Apply mathematical models to assess insurance and investment decisions.
- Interpret and communicate actuarial results effectively.

Topics Covered:

1. **Probability and Statistics for Actuarial Science:**
    - Probability distributions (binomial, Poisson, normal).
    - Statistical inference and hypothesis testing.
    - Survival models and life tables.
2. **Interest Theory and Time Value of Money:**
    - Compound interest and annuities.
    - Present value and future value.
    - Yield curves and discounting.
3. **Risk Models and Insurance Mathematics:**
    - Loss distributions and aggregate claims.
    - Premium calculations and risk loading.
    - Reserving methods.
4. **Stochastic Processes and Financial Modeling:**
    - Markov chains and transition probabilities.
    - Option pricing models (Black-Scholes).
    - Monte Carlo simulation.

Assessment:

- **Assignments and Quizzes:** Regular assessments to reinforce learning.
- **Actuarial Projects:** Apply mathematical models to insurance and financial scenarios.
- **Midterm and Final Exams:** Assess understanding of course material.

Recommended Reading:

1. Bowers, N. L., Gerber, H. U., Hickman, J. C., Jones, D. A., & Nesbitt, C. J. (2013). *Actuarial Mathematics*. Society of Actuaries.
2. Ross, S. A., Westerfield, R. W., & Jordan, B. D. (2019). *Fundamentals of Corporate Finance*. McGraw-Hill.

Course Title: Financial Reporting

Course Description:

Financial Reporting provides an in-depth understanding of financial statements, their preparation, and analysis. Students learn about accounting principles, standards, and regulations governing financial reporting. The course emphasizes practical application and critical thinking.

Learning Objectives:

1. Understand the conceptual framework of financial reporting.
2. Analyze financial statements (balance sheet, income statement, and cash flow statement).
3. Apply relevant accounting standards (e.g., IFRS, GAAP) to prepare financial statements.
4. Interpret financial ratios and assess a company's financial health.
5. Evaluate the impact of accounting choices on reported financial results.

Topics Covered:

1. Introduction to Financial Reporting
    - Purpose and stakeholders of financial statements
    - Accounting principles and concepts
    - Regulatory environment (IFRS, GAAP)
2. Financial Statements Preparation
    - Balance sheet (assets, liabilities, equity)
    - Income statement (revenue, expenses, profit)
    - Cash flow statement (operating, investing, financing activities)
3. Accounting Standards and Policies
    - International Financial Reporting Standards (IFRS)
    - Generally Accepted Accounting Principles (GAAP)
    - Measurement and recognition criteria
4. Financial Statement Analysis
    - Ratio analysis (liquidity, solvency, profitability)
    - Vertical and horizontal analysis
    - Common-size financial statements

Assessment:

- Midterm exam
- Final project: Prepare financial statements for a fictional company
- Class participation and quizzes
- Homework assignments

Recommended Reading:

1. "Financial Accounting: Tools for Business Decision-Making" by Kimmel, Weygandt, and Kieso
2. "Intermediate Accounting" by Donald E. Kieso, Jerry J. Weygandt, and Terry D. Warfield

Course Title: Industrial Training

Course Description:

The Industrial Training course provides students with practical experience in applying actuarial and data science concepts to real-world scenarios. Through internships, projects, or work placements, students gain insights into the industry, enhance their skills, and prepare for their future careers. The course emphasizes hands-on learning and professional development.

Learning Objectives:

1. **Application of Actuarial Techniques**: Understand how actuarial principles are used in practical settings.
2. **Data Analysis and Interpretation**: Apply statistical methods to analyze data relevant to actuarial work.
3. **Business Communication**: Develop effective communication skills for collaborating with colleagues and stakeholders.
4. **Problem-Solving and Adaptability**: Tackle real-world challenges and adapt to dynamic environments.

Topics Covered:

1. **Industry Exposure**: Students engage with actuaries, data scientists, and industry professionals during their training.
2. **Project Work**: Undertake projects related to insurance, risk assessment, financial modeling, or data analysis.
3. **Software Tools**: Learn to use industry-standard software (e.g., R, Python, Excel) for data manipulation and analysis.
4. **Ethics and Professionalism**: Understand ethical considerations and professional conduct in the workplace.

Assessment:

- **Internship Evaluation**: Based on performance during the industrial training period.
- **Project Reports**: Submit detailed reports on completed projects.
- **Presentation Skills**: Deliver presentations summarizing experiences and learnings.

Recommended Reading:

1. “The Actuary’s Toolkit” by Fred Szabo
2. “Data Science for Business” by Foster Provost and Tom Fawcett

Course Title: Seminar - Professional Development

Course Description:

The Seminar - Professional Development course is designed to enhance your skills as an aspiring actuary and prepare you for a successful career. Through interactive sessions, guest lectures, and practical exercises, you’ll develop both technical expertise and essential

business skills. This course emphasizes professional growth, ethical considerations, and effective communication.

Learning Objectives:

1. **Advanced Actuarial Concepts**: Explore specialized actuarial topics beyond the core principles.
2. **Business Etiquette and Networking**: Learn how to navigate professional environments, build relationships, and collaborate effectively.
3. **Career Path Exploration**: Understand various career paths within actuarial science and data analytics.
4. **Professional Ethics**: Discuss ethical dilemmas and responsibilities faced by actuaries.

Topics Covered:

1. **Industry Insights**: Guest speakers share their experiences and insights from the actuarial field.
2. **Effective Communication**: Enhance your presentation skills, report writing, and interpersonal communication.
3. **Job Search Strategies**: Resume building, interview preparation, and job market trends.
4. **Ethical Decision-Making**: Case studies and discussions on ethical scenarios.

Assessment:

- **Participation**: Active engagement in seminars, workshops, and group activities.
- **Professionalism**: Demonstrating a professional attitude and behavior.
- **Reflections**: Regular self-assessment and goal-setting.

Recommended Reading:

1. “The Actuary’s Handbook” by Albert E. Easton and Mary Hardy
2. “The Art of Professional Connections” by Keith Ferrazzi

Course Title: Multivariate Data Analysis

Course Description:

The Multivariate Data Analysis course equips students with the skills to analyze complex data sets involving multiple variables. Through statistical techniques and software tools, you’ll explore patterns, relationships, and underlying structures within multidimensional data. This course bridges actuarial science and data analytics, emphasizing practical applications.

Learning Objectives:

1. **Dimension Reduction Techniques**: Understand methods like Principal Component Analysis (PCA) and Factor Analysis.
2. **Cluster Analysis**: Learn how to group similar observations based on multivariate data.
3. **Multivariate ANOVA**: Explore analysis of variance for multiple dependent variables.
4. **Interpretation of Results**: Develop skills to communicate findings effectively.

Topics Covered:

1. **Exploratory Data Analysis (EDA)**:
    - Data visualization and summary statistics
    - Scatter plots, correlation matrices, and heatmaps
2. **Dimension Reduction**:
    - Principal Component Analysis (PCA)
    - Factor Analysis (FA)
3. **Cluster Analysis**:
    - Hierarchical clustering
    - K-means clustering
4. **Multivariate ANOVA**:
    - Hypothesis testing for multiple dependent variables

Assessment:

- **Assignments**: Apply techniques to real-world data sets.
- **Project**: Conduct a multivariate analysis project.
- **In-Class Participation**: Engage in discussions and practical exercises.

Recommended Reading:

1. "Applied Multivariate Statistical Analysis" by Richard A. Johnson and Dean W. Wichern
2. "Multivariate Data Analysis" by Hair, Black, Babin, and Anderson

Course Title: Stochastic Processes

Course Description:

The Stochastic Processes course delves into probabilistic models that describe random phenomena evolving over time. You'll explore various stochastic processes, their properties, and applications in actuarial science, finance, and risk assessment. The course emphasizes both theoretical foundations and practical implementation.

Learning Objectives:

1. **Markov Processes**: Understand the concept of memorylessness and Markovian transitions.
2. **Brownian Motion**: Study continuous-time stochastic processes and their applications.
3. **Poisson Processes**: Analyze arrival times of events in various contexts.
4. **Gaussian Processes**: Explore applications in statistical modeling and machine learning.

Topics Covered:

1. **Introduction to Stochastic Processes**:
    - Definitions, basic properties, and classification
    - Transition probabilities and Chapman-Kolmogorov equations
2. **Markov Chains**:
    - Discrete-time Markov chains
    - Absorbing states and steady-state probabilities
3. **Brownian Motion (Wiener Process)**:

    - Definition, properties, and sample paths
    - Applications in finance (e.g., option pricing)
4. **Poisson Processes**:
    - Homogeneous and non-homogeneous Poisson processes
    - Inter-arrival times and intensity functions

Assessment:

- **Homework Assignments**: Solve problems related to stochastic processes.
- **Midterm Exam**: Assess understanding of theoretical concepts.
- **Project or Case Study**: Apply stochastic models to real-world scenarios.

Recommended Reading:

1. “Stochastic Processes” by Sheldon M. Ross
2. “Introduction to Probability Models” by Sheldon M. Ross

Course Title: Strategic Finance

Course Description:

The Strategic Finance course focuses on financial decision-making within organizations. You’ll explore advanced financial concepts, risk management, and investment strategies. The course integrates actuarial principles with data-driven insights to enhance financial decision processes.

Learning Objectives:

1. **Financial Modeling**: Develop skills in building and analyzing financial models.
2. **Risk Assessment**: Understand risk factors and their impact on financial outcomes.
3. **Investment Strategies**: Explore portfolio management, asset allocation, and valuation techniques.
4. **Strategic Decision-Making**: Apply financial insights to business strategy.

Topics Covered:

1. **Capital Budgeting and Investment Appraisal**:
    - Net present value (NPV) analysis
    - Internal rate of return (IRR)
    - Sensitivity analysis
2. **Risk Management and Hedging**:
    - Derivatives (options, futures, swaps)
    - Value at Risk (VaR)
    - Hedging strategies
3. **Financial Markets and Instruments**:
    - Stock markets, bond markets, and commodities
    - Portfolio diversification
    - Efficient market hypothesis
4. **Corporate Finance Strategies**:
    - Capital structure decisions
    - Dividend policy

- Mergers and acquisitions

Assessment:

- **Case Studies**: Analyze real-world financial scenarios.
- **Group Projects**: Apply strategic finance concepts to business cases.
- **Final Exam**: Assess understanding of course material.

Recommended Reading:

1. “Corporate Finance” by Stephen A. Ross, Randolph W. Westerfield, and Jeffrey Jaffe
2. “Options, Futures, and Other Derivatives” by John C. Hull

Course Title: Loss Models

Course Description:

The Loss Models course focuses on modeling and analyzing risks related to financial losses. You’ll explore probabilistic methods, statistical techniques, and actuarial principles to evaluate and manage risk. The course integrates data science concepts, emphasizing practical applications in insurance, finance, and business.

Learning Objectives:

1. **Risk Modeling**: Understand stochastic processes and their relevance to loss modeling.
2. **Extreme Value Theory**: Explore tail risk estimation and extreme events.
3. **Reserving Techniques**: Learn how to estimate future liabilities based on historical data.
4. **Credibility Theory**: Analyze credibility models for small data sets.

Topics Covered:

1. **Frequency and Severity Models**:
   - Poisson distribution for claim frequency
   - Severity distributions (e.g., gamma, lognormal)
2. **Aggregate Loss Models**:
   - Compound Poisson models
   - Collective risk models
3. **Risk Measures and Solvency**:
   - Value at Risk (VaR)
   - Solvency capital requirements
4. **Claims Reserving**:
   - Chain ladder method
   - Bornhuetter-Ferguson method

Assessment:

- **Assignments and Quizzes**: Apply loss modeling techniques to real-world scenarios.
- **Midterm and Final Exams**: Assess understanding of course material.

Recommended Reading:

1. “Loss Models: From Data to Decisions” by Stuart A. Klugman, Harry H. Panjer, and Gordon E. Willmot.

Course Title: Actuarial Investigations: Financial

Course Description:

The Actuarial Investigations: Financial course provides a comprehensive understanding of financial transactions and their actuarial implications. You’ll explore compound interest techniques, cash models, and life insurance concepts. The course integrates practical applications using R programming.

Learning Objectives:

1. **Actuarial Modelling**: Introduction to modeling techniques relevant to financial risk assessment.
2. **Compound Interest**: Application of compound interest principles to various financial instruments.
3. **Cash Models**: Generalized models for zero-coupon bonds, fixed interest securities, annuities, and more.
4. **Life Insurance Basics**: Overview of life insurance products and actuarial considerations.

Topics Covered:

1. **Introduction to Actuarial Modelling**:
    - Understanding risk and uncertainty
    - Probability distributions for financial variables
2. **Compound Interest Techniques**:
    - Future value, present value, and discounting
    - Effective interest rates
3. **Cash Models**:
    - Modeling various financial transactions (e.g., bonds, equities, loans)
    - Cash flow diagrams
4. **Introduction to R Programming for Actuarial Science**:
    - Basics of R language
    - Data manipulation and visualization

Assessment:

- **Exam (90%)**: A written exam assessing theoretical knowledge.
- **Online Assessment (10%)**: Timed online assessment during the January examination period.

Recommended Reading:

1. J. J. McCutcheon & W. J. Scott, “An Introduction to the Mathematics of Finance”
2. Institute and Faculty of Actuaries, “Formulae and Tables for Actuarial Examinations”
3. D. Dickson, M. Hardy & H. Waters, “Actuarial Mathematics for Life Contingent Risks”

Course Title: Financial Statements Analysis

Course Description:

The Financial Statements Analysis course provides a comprehensive understanding of financial statements and their interpretation. You'll learn how to analyze balance sheets, income statements, and cash flow statements. The course integrates quantitative techniques, data analytics, and business insights.

Learning Objectives:

1. **Financial Statement Interpretation**: Understand the purpose and components of financial statements.
2. **Ratio Analysis**: Apply quantitative methods to evaluate a company's financial health.
3. **Forecasting Techniques**: Predict future financial performance based on historical data.
4. **Industry Comparisons**: Compare financial metrics across companies and sectors.

Topics Covered:

1. **Introduction to Financial Statements**:
    - Balance sheet, income statement, and cash flow statement
    - Accounting principles and conventions
2. **Ratio Analysis**:
    - Liquidity ratios (current ratio, quick ratio)
    - Solvency ratios (debt-to-equity ratio, interest coverage ratio)
    - Profitability ratios (return on equity, gross margin)
3. **Forecasting Methods**:
    - Time series analysis
    - Regression models for financial forecasting
4. **Industry-Specific Considerations**:
    - Sector-specific ratios (e.g., banking, technology)
    - Impact of industry trends on financial statements

Assessment:

- **Case Studies**: Analyze real-world financial statements.
- **Group Projects**: Evaluate company performance and make recommendations.
- **Final Exam**: Assess understanding of financial analysis concepts.

Recommended Reading:

1. "Financial Statement Analysis and Security Valuation" by Stephen H. Penman
2. "Interpretation of Financial Statements" by Benjamin Graham and Spencer B. Meredith

Course Title: Stochastic Calculus

Course Description:

The Stochastic Calculus course introduces mathematical tools for modeling and analyzing random processes. You'll explore stochastic differential equations, Ito's lemma, and applications in finance, insurance, and risk management. The course bridges theoretical foundations with practical implementation.

Learning Objectives:

1. **Stochastic Processes**: Understand the basics of stochastic processes (e.g., Brownian motion, Poisson processes).
2. **Ito Calculus**: Learn Ito's lemma and its applications in finance.
3. **Risk Modeling**: Apply stochastic calculus to assess financial risk.
4. **Numerical Methods**: Explore numerical solutions for stochastic differential equations.

Topics Covered:

1. **Brownian Motion and Martingales**:
    - Definition, properties, and sample paths
    - Martingale representation theorem
2. **Stochastic Differential Equations (SDEs)**:
    - Ito's lemma
    - Geometric Brownian motion (used in option pricing)
3. **Risk Measures and Hedging**:
    - Value at Risk (VaR)
    - Delta hedging strategies
4. **Numerical Methods for SDEs**:
    - Euler-Maruyama method
    - Monte Carlo simulation

Assessment:

- **Homework and Quizzes**: Apply stochastic calculus concepts to real-world scenarios.
- **Midterm and Final Exams**: Assess understanding of theoretical principles.
- **Project or Case Study**: Implement numerical methods for SDEs.

Recommended Reading:

1. "Stochastic Calculus for Finance I: The Binomial Asset Pricing Model" by Steven E. Shreve
2. "Options, Futures, and Other Derivatives" by John C. Hull

Course Title: Econometrics

Course Description:

The Econometrics course introduces statistical methods for analyzing economic data. You'll learn how to model relationships, estimate parameters, and test hypotheses using real-world

data. The course integrates theory with practical applications, emphasizing the use of statistical software.

Learning Objectives:

1. **Statistical Modeling**: Understand regression analysis and time series models.
2. **Parameter Estimation**: Learn techniques for estimating model coefficients.
3. **Hypothesis Testing**: Apply statistical tests to evaluate economic hypotheses.
4. **Data Visualization**: Explore graphical representations of economic data.

Topics Covered:

1. **Introduction to Econometrics**:
   - Types of data (cross-sectional, time series, panel data)
   - Linear regression basics
2. **Multiple Regression Analysis**:
   - Model specification
   - Interpretation of coefficients
3. **Time Series Econometrics**:
   - Autoregressive (AR) and moving average (MA) models
   - Forecasting techniques
4. **Applied Econometric Techniques**:
   - Panel data analysis
   - Instrumental variables
   - Nonparametric methods

Assessment:

- **Assignments and Quizzes**: Apply econometric methods to economic datasets.
- **Midterm and Final Exams**: Assess understanding of theoretical concepts.
- **Project Work**: Conduct an econometric analysis using real-world data.

Recommended Reading:

1. “Introductory Econometrics: A Modern Approach” by Jeffrey M. Wooldridge
2. “Econometric Analysis” by William H. Greene

Course Title: Big Data Analytics

Course Description:

The Big Data Analytics course equips students with the skills to handle and analyze large-scale datasets. You’ll explore data preprocessing, machine learning techniques, and practical applications in finance, insurance, and risk management. The course integrates actuarial principles with cutting-edge data science tools.

Learning Objectives:

1. **Data Preprocessing and Cleaning**: Understand techniques for handling messy, unstructured data.

2. **Machine Learning Algorithms**: Learn about regression, classification, clustering, and recommendation systems.
3. **Big Data Technologies**: Explore tools like Hadoop, Spark, and NoSQL databases.
4. **Applied Projects**: Apply analytics to real-world scenarios (e.g., fraud detection, customer segmentation).

Topics Covered:

1. **Introduction to Big Data**:
    - Characteristics of big data
    - Scalability and distributed computing
2. **Data Preprocessing**:
    - Data cleaning, transformation, and feature engineering
    - Dealing with missing values and outliers
3. **Machine Learning Techniques**:
    - Regression models (linear, logistic)
    - Decision trees, random forests, and neural networks
4. **Big Data Tools and Platforms**:
    - Apache Hadoop and MapReduce
    - Apache Spark for distributed processing

Assessment:

- **Hands-on Projects**: Analyze large datasets using real-world tools.
- **Quizzes and Exams**: Assess understanding of big data concepts.
- **Group Presentations**: Communicate findings from data analysis.

Recommended Reading:

1. “Big Data: A Revolution That Will Transform How We Live, Work, and Think” by Viktor Mayer-Schönberger and Kenneth Cukier
2. “Python Machine Learning” by Sebastian Raschka and Vahid Mirjalili

Course Title: Statistical Learning

Course Description:

The Statistical Learning course introduces methods for analyzing and modeling data using statistical techniques. You’ll learn how to extract meaningful patterns, make predictions, and gain insights from complex datasets. The course integrates theory with practical applications, emphasizing real-world scenarios relevant to actuarial science and data analytics.

Learning Objectives:

1. **Foundations of Statistical Learning**: Understand the principles behind statistical modeling and machine learning.
2. **Regression Analysis**: Learn linear regression, logistic regression, and regularization techniques.
3. **Classification and Clustering**: Explore algorithms for classification (e.g., decision trees, k-nearest neighbors) and clustering (e.g., k-means).

4. **Model Evaluation and Interpretation**: Evaluate model performance, handle overfitting, and interpret results.

Topics Covered:

1. **Introduction to Statistical Learning**:
    - Bias-variance trade-off
    - Model complexity and generalization
2. **Linear Regression**:
    - Simple linear regression
    - Multiple regression
    - Regularization (Lasso, Ridge)
3. **Classification Algorithms**:
    - Logistic regression
    - Decision trees
    - Support vector machines
4. **Clustering Techniques**:
    - K-means clustering
    - Hierarchical clustering

Assessment:

- **Assignments and Projects**: Apply statistical learning techniques to real datasets.
- **Midterm and Final Exams**: Assess understanding of theoretical concepts.
- **Hands-on Labs**: Practice implementing algorithms using Python or R.

Recommended Reading:

1. “Introduction to Statistical Learning” by Gareth James, Daniela Witten, Trevor Hastie, and Robert Tibshirani
2. “Pattern Recognition and Machine Learning” by Christopher Bishop

Course Title: Actuarial Research Project

Course Description:

The Actuarial Research Project provides an opportunity for students to engage in independent research within the field of actuarial science and data analytics. Through this project, you’ll apply your knowledge, analytical skills, and critical thinking to address real-world actuarial problems. The course emphasizes practical application, data analysis, and effective communication.

Learning Objectives:

1. **Research Skills**: Develop the ability to formulate research questions, design studies, and collect relevant data.
2. **Data Analysis Techniques**: Apply statistical and computational methods to analyze actuarial data.
3. **Problem-Solving**: Tackle complex actuarial challenges and propose innovative solutions.
4. **Communication**: Present research findings effectively through written reports and presentations.

Topics Covered:

1. **Research Proposal and Topic Selection**:
    - Identifying research gaps
    - Defining research objectives
2. **Data Collection and Preprocessing**:
    - Gathering relevant data (e.g., insurance claims, financial records)
    - Cleaning and organizing data for analysis
3. **Statistical Analysis and Modeling**:
    - Regression analysis
    - Time series modeling
    - Survival analysis (if relevant)
4. **Interpretation and Recommendations**:
    - Drawing conclusions from research findings
    - Implications for actuarial practice

Assessment:

- **Research Proposal**: Submit a well-defined research proposal.
- **Data Analysis and Modeling**: Apply appropriate techniques to analyze actuarial data.
- **Final Research Report and Presentation**: Communicate research outcomes effectively.

Recommended Reading:

1. “Practical Statistics for Data Scientists” by Peter Bruce and Andrew Bruce
2. “Applied Regression Analysis and Generalized Linear Models” by John Fox

CAPITAL OPERATIONAL BUDGET FOR BACHELOR OF SCIENCE: ACTUARIAL SCIENCE AND FINANCIAL MATHEMATICS

The programme budget is shown in the table below:

Capital Operational Budget for the Bachelor of Science: Actuarial Science & Financial Mathematics **This budget projection calculation is based on forty students per year, covering two semesters, at a cost of R52,000 per student.**					
Description	**2023**	**2024**	**2025**	**2026**	**TOTAL**
Equity Financing	7554354	-	-	-	7554354
BSc – Actuarial Science & Fin Math	2008890	12953250	14407650	19861650	49231440
Other	152712	192708	254520	363600	963 540
TOTAL	**9715956**	**13145958**	**14662170**	**20225250**	**57749334**
Expenditure					
Administrative Costs	690190	1090800	1090800	1090800	3962589
Salaries and Wages	767876	236340	236340	236340	1476896
Equipment Costs	1524073	363600	363600	363600	2614873
Operating Costs	1088626	501768	501768	501768	2593930
Research, Training & Workshops	435451	73811	73811	73811	656883
Construction and Infrastructure	2177248	545400	545400	545400	3813448
Marketing and Studio Recording	217728	36724		36724	291175
Travelling and Accommodation	653175	491587	491587	491587	2127936
Vehicles	-	653171		363600	1016771
Other Expenses	653175	93700	93700	93700	934 274
TOTAL	**8207539**	**4086900**	**3397006**	**3797329**	**19488775**
Repayment					
Equity and Dividend Payments	1888590	1888590	1888590	1888590	7554358
Interest - 18%	339948	339948	339948	339948	1359792
Charges and Accounting	66859	66859	66859	66859	267435
TOTAL	2295396	2295396	2295396	2295396	9181584
Total Income	9715956	13145958	14662170	20225250	57749334
Total Expenditure	10502935	6382296	5692402	6092725	28670358
B/Forward	-786979	6763662	8969768	14132525	29078976
B/ Down	-786979	6763662	8969768	14132525	29078976

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