SRI SATHYA SAI INSTITUTE OF HIGHER LEARNING

(DEEMED TO BE UNIVERSITY)

SCHEME OF INSTRUCTION & EVALUATION

B.S. (Honours)

&

B.S. (Honours with Research) in

Actuarial Data Science

(Interdisciplinary program)

(EFFECTIVE FROM JUNE 2024 BATCH ONWARDS)

Center of Excellence for Actuarial Data Science

Authorised Signatory

CADS-COORDINATOR

DEAN OF ACADEMIC AFFAIRS
Sri Sathya Sai Institute of Higher Learning
(Deemed to be University)
Vidyagiri, Prasanthi Nilayam
Sri Sathya Sai District, A.P. - 515 134
India

Background:

In response to the growing demand for actuarial expertise in India's financial landscape and the global emphasis on data-driven risk management, SSSIHL introduces a BS program in Actuarial Data Science. This strategic initiative is in harmony with the nation's economic priorities and underscores the institute's commitment to providing integral and value-based education. In the midst of a dynamic financial environment, the program aims to bridge the gap between academia and industry, cultivating a transdisciplinary workforce equipped with the specialized skills required in the actuarial field. Recognizing the scarcity of skilled actuarial professionals, the initiative addresses the need for industry-ready talent to position India as a key player in actuarial and financial domains. SSSIHL's dedication to visionary education, coupled with a transdisciplinary approach, situates the program at the forefront of actuarial innovation.

Rationale:

The BS in Actuarial Data Science responds to the intricate intersection of mathematics, finance, and risk management, meeting the increasing demand for professionals with expertise in these domains. Aligned with the objectives of financial development and a heightened focus on risk analysis and management, the program prepares graduates to contribute to actuarial practices, insurance, and financial planning. Emphasizing integral and value-based education, it instills ethical responsibility alongside the technical skills necessary for the actuarial profession. With a global perspective, the program positions our institution at the forefront of educational innovation, preparing students for careers that merge the analytical power of Actuarial Data Science with the complexities of financial landscapes. This visionary approach anticipates the future, positioning graduates to lead in the evolving landscape of financial risk management.

Course design exercise:

The 4-year BS in Actuarial Data Science curriculum is designed to bridge the gap between theoretical knowledge and practical skills necessary for success in academia and the actuarial industry. Developed collaboratively by faculties from the Department of Mathematics and the Department of Humanities and Social Sciences, this program aims to facilitate a seamless transition from graduation to contemporary transdisciplinary research and development in the field of Actuarial Data Science.

Approach:

The 4-year BS program courses were initially adapted from existing curricula in Mathematics, Statistics, and related fields offered by various departments. A comparative analysis with renowned national and international universities refined the structure. Leveraging departmental expertise ensured a comprehensive curriculum aligned with core strengths in Actuarial Data Science. Courses were enriched with real-world applications and project engagement to motivate and deepen understanding. Industry

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alignment involved consultation with experts and organizations providing actuarial training. Feedback from diverse experts emphasized a balance between academic excellence and industry relevance, shaping a curriculum to meet both needs.

Recognizing the importance of industry expertise, it was decided that industry-related modules would be initially taught by professionals with experience in Actuarial Data Science. Concurrently, Faculty Development Programs (FDPs) would be conducted by these experts to cover these modules and address potential futuristic needs. This approach facilitates the seamless assimilation of skills by the faculty, ensuring effective course execution and research projects. The revised curriculum, thoroughly vetted and finalized by the Core Committee, incorporated valuable inputs from the Board of Studies (BOS) members. The result is a meticulously designed course, inspired by industry insights, enhancing industry readiness and preparing graduates for academic pursuits and industry placements with a versatile skill set in Actuarial Data Science.

Why Choose BS in Actuarial Data Science at SSSIHL?

Hands-On Actuarial Expertise: Engage in cutting-edge research utilizing financial data and risk analysis. Develop proficiency in actuarial calculations and analysis using diverse tools, gaining practical insights from experienced professionals in the field.

Mathematics and Statistical Excellence: Acquire practical skills in advanced mathematics, statistics, and quantitative techniques for risk assessment, financial modeling, and Actuarial Data Science. Collaborate with faculties engaged in impactful projects, ensuring a dynamic learning environment with real-world applications.

Real-World Problem Solving: Today's and tomorrow's careers demand advanced degrees and practical experience in tackling real-world, real-time challenges. Our program prepares you for the evolving landscape of Actuarial Data Science, equipping you with both knowledge and hands-on expertise.

Live Ongoing Projects: Participate in live ongoing projects through collaborative programs with industry professionals. From risk assessment to financial modeling and actuarial calculations, students engage in every aspect of the actuarial process, gaining invaluable experience.

Industry Exposure and Internships: Enhance your learning through hands-on industry exposure. Our program includes a series of internships, providing practical insights and preparing you for seamless integration into the professional landscape.

Choose SSSIHL for a transformative educational experience that goes beyond theory, offering a dynamic blend of research, real-world applications, and

industry exposure. Thrive in Actuarial Data Science with us, where knowledge meets hands-on expertise.

Program Objectives:

The Multi-Disciplinary Program, equips students for academia and the actuarial industry. With a focus on advanced statistical tools, data science and Actuarial Data Science, the program aims to:

1. Interdisciplinary Mastery: Develop expertise in core mathematics, statistics, and actuarial science.
2. Financial Risk Analysis Impact and Innovation: Apply actuarial techniques for transformative solutions in financial and risk assessment. Drive advancements in insurance and finance through actuarial integration in risk management and financial modeling.
3. Data Science Proficiency: Master data science, utilizing mathematics, statistics, and quantitative techniques for impactful insights across financial industries. Equip graduates for diverse roles, from actuarial pursuits to entrepreneurial ventures, shaping the future of financial risk management.

Program Specific Objectives (PSO):

The PSOs ensure graduates will:

1. Versatile Proficiency: Versatile Proficiency: Cultivate expertise for graduates to excel as versatile professionals, adept in roles such as Actuarial Analysts, Risk Managers, or Financial Consultants. They should demonstrate leadership and provide support in diverse financial teams.
2. Effective Project Leadership to Deliver Solutions to Society: Develop graduates' communication, leadership, and analytical skills for project initiation, risk assessment, and proficient data collection. They should execute predictive analytics, contributing substantial outcomes to financial projects and recognizing evolving research, industrial, and societal needs.
3. Adaptive Computing Prowess: Nurture adaptability to changing financial requirements and evolving developments, enabling graduates to navigate seamlessly through the rapidly evolving financial landscape within actuarial projects.

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Forge Your Career Path: Limitless Opportunities for BS in Actuarial Data Science Graduates!

Embark on a journey of professional success with a BS in Actuarial Data Science, where students receive comprehensive training in advanced mathematics, statistics, and risk management. Graduates from this cutting-edge program are poised for diverse and exciting employment opportunities:

Actuarial Analyst: Apply your actuarial skills to revolutionize financial analysis. Contribute to risk assessment, investment strategies, and innovative financial solutions.

Insurance Pioneer: Dive into the insurance industry, leveraging your expertise in Actuarial Data Science for risk management, policy pricing, and optimizing insurance interventions.

Reinsurance Specialist: Spearhead reinsurance initiatives by applying your actuarial expertise to refine risk management strategies, optimize financial models, and assess potential risks. Contribute to the development of innovative solutions in the dynamic field of reinsurance.

Pricing Specialist: Craft and Implement Pricing Strategies, specialize in developing and implementing actuarial pricing strategies for insurance products. Utilize advanced modelling techniques to assess risk and set competitive pricing structures. Collaborate with cross-functional teams to optimize pricing models.

Reserving Specialist: Expert in Reserving Practices: Lead the charge in actuarial reserving, integrating cutting-edge techniques into strategic decision-making. Drive advancements in financial modelling for reserving, ensuring accurate and robust assessment of liabilities. Contribute to innovative solutions in risk analysis and mitigation related to reserves.

Risk Management Trailblazer: Lead the way in risk management by integrating actuarial techniques into strategic decision-making, financial modeling, and risk assessment. Drive advancements in risk analysis and mitigation.

Actuarial Data Science Specialist: Become a sought-after data science professional, utilizing your proficiency in advanced mathematics, statistics, and quantitative techniques for meaningful insights in various financial industries.

Financial Consultant: Specialize in financial consulting, unraveling the complexities of financial data. Contribute to investment planning, wealth management, and financial decision-making.

Actuarial Researcher and Developer: Fuel advancements in Actuarial Data Science as a researcher or developer. Contribute to cutting-edge projects in risk modeling, financial forecasting, and actuarial applications across industries.

Financial Modeler: Apply your skills to economic analysis, modeling financial systems, and contributing to sustainable economic development using actuarial approaches.

Financial Analysis and Fraud Detection: Enter the realm of Financial Analysis, utilizing actuarial tools and build models for fraud detection.

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Academic Pursuits: Pursue advanced studies and research in academia, contributing to the evolving field of Actuarial Data Science.

Start-up Entrepreneur: Launch your own venture, leveraging your interdisciplinary skills to pioneer innovative solutions in financial risk management or actuarial consulting.

Your BS in Actuarial Data Science is your passport to a future where mathematics and finance converge, opening doors to a myriad of opportunities in today's dynamic job market. Unleash your potential and shape the future!

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(EFFECTIVE FROM 2024-25 BATCH ONWARDS)

SUMMARY TABLE

Semester	I	II	III	IV	V	VI	VII		VIII	
Total Credits	24	24	22	24	24	23	Hons	Research	Hons	Research
							18	18	18	18
Theory	22	22	16	20	20	18	18	10	14	12
Practical	2	2	6	4	4	5	-	8	4	6
Total Hours	27	27	28	22	30	28	18	28	22	30

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Paper Code	Title of the Paper	Course Category	Type of Paper	Credits	Hours L-T-P	Mode of Evaluation	Max. Marks
SEMESTER-I							
	General English*	AEC	T	3	3-0-0	IE	100
	Another Language*	AEC	T	3	3-0-0	IE	100
UADS-101	Probability & Statistics	DSC	T	4	3-1-0	IE	100
UADS-102	Financial Mathematics	DSC	T	4	3-0-2	IE	100
UADS-103	Business Economics - Micro	DSC	T	3	3-0-0	IE	100
UADS-104	Introduction to R	DSC	P	1	0-0-2	I	50
UADS-105	Skill Enhancement Course@	SEC	P	1	0-0-2	I	50
UAWR-100	Awareness$	VBC	T	2	2-0-0	I	50
	Multidisciplinary Course#	MDC	T	3	3-0-0	I	100
Total				**24**	**27**		**750**
SEMESTER-II							
	General English*	AEC	T	3	3-0-0	IE	100
	Another Language*	AEC	T	3	3-0-0	IE	100
UADS-201	Fundamentals of Actuarial Mathematics	DSC	T	4	3-1-0	IE	100
UADS-202	Data Concepts and Visualization	DSC	T/P	4	3-0-2	IE	100
UADS-203	Business Economics - Macro	DSC	T	3	3-0-0	IE	100
UADS-204	Actuarial mathematics using R	DSC	P	1	0-0-2	I	50
UADS-205	Skill Enhancement Course@	SEC	P	1	0-0-2	I	50
UAWR-200	Awareness$	VBC	T	2	2-0-0	I	50
	Multidisciplinary Course#	MDC	T	3	3-0-0	I	100
Total				**24**	**27**		**750**
SEMESTER-III							
	General English*	AEC	T	3	3-0-0	IE	100
UADS-301	Advanced Short-Term Actuarial Mathematics-I	DSC	T	4	4-0-0	IE	100
UADS-302	Advanced Long-Term Actuarial Mathematics-I	DSC	T	4	4-0-0	IE	100
UADS-303	Corporate Finance	DSC	T	3	3-0-0	IE	100
UADS-304	Introduction to Python	DSC	P	1	0-0-2	I	50
UADS-305	Skill Enhancement Course@	SEC	P	2	0-0-4	I	50
UAWR-300	Awareness$	VBC	T	2	2-0-0	I	50
	Multidisciplinary Course#	MDC	P	3	0-0-6	I	100
Total				**22**	**28**		**600**
SEMESTER-IV							
UADS-401	Advanced Short-Term Actuarial Mathematics-II	DSC	T	4	4-0-0	IE	100
UADS-402	Advanced Long-Term Actuarial Mathematics-II	DSC	T	4	3-1-0	IE	100
UADS-403	Accounting for Financial Institutions	DSC	T	3	3-0-0	IE	100
UADS-404	Introduction to Machine Learning	DSC	P	1	0-0-2	I	50
UADS-405	Property and Casualty Insurance Fundamentals	DSC	T	4	3-0-0	IE	100
UADS-406	Skill Enhancement Course@	SEC	P	2	0-0-4	I	50
UAWR-400	Awareness$	VBC	T	2	2-0-0	I	50
Total				**20**	**22**		**550**

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SEMESTER-V							
UADS-501	Statistics for Risk Modelling - I	DSC	T	4	4-0-0	I	100
UADS-502	Introduction to Deep Learning	DSC	P	1	0-0-2	IE	50
UADS-503	Modern Actuarial Statistics - Part 1	DSC	T	4	4-0-0	I	100
UADS-504	Advanced Actuarial Statistics - Part 1	DSC	T	4	4-0-0	IE	100
UADS-505	Specialization Elective-I	DSE	T	4	4-0-0	IE	100
UADS-506	Specialization Elective-II	DSE	P	3	0-0-6	IE	100
UADS-507	Skill Enhancement Course[@]	SEC	T	2	2-0-0	IE	50
UAWR-500	Awareness[$]	VBC	T	2	2-0-0	I	50
Total				**24**	**30**		**650**
SEMESTER-VI							
UADS-601	Statistics for Risk Modelling - 2	DSC	T	4	4-0-0	IE	100
UADS-602	Modern Actuarial Statistics - Part 2	DSC	T	4	4-0-0	IE	100
UADS-603	Advanced Actuarial Statistics - Part 2	DSC	T	4	4-0-0	IE	100
UADS-604	Predictive Modelling using Python	DSC	P	3	0-0-6	IE	100
UADS-605	Specialization Elective - III	DSE	T	4	4-0-0	IE	100
UADS-606	Mini-Project	DSC	PW	2	0-0-4	I	50
UAWR-600	Awareness[$]	VBC	T	2	2-0-0	I	50
Total				**23**	**28**		**600**
SEMESTER-VII							
UADS-701	Basic Ratemaking	DSC	T	4	4-0-0	IE	100
UADS-702	International Regulation P&C	DSC	T	4	4-0-0	IE	100
UAWR-700	Awareness	VBC	T	2	2-0-0	I	50
Hons.							
UADS-703	Specialization Elective IV	DSE	T	4	4-0-0	E	100
UADS-704	Specialization Elective V	DSE	T	4	4-0-0	IE	100
Total				**18**	**18**		**450**
Research							
UADS-703	Project	DSC	PW	8	0-0-16	IE	200
UADS-704	Research Methodology	DSC	T	2	2-0-0	I	50
Total				**18**	**28**		**500**
SEMESTER-VII							
UADS-801	Estimating Claim Liabilities	DSC	T	4	4-0-0	I	100
UAWR-800	Awareness[$]	VBC	T	2	2-0-0	I	50
Hons.							
UADS-802	Specialization Elective VI	DSE	T	4	4-0-0	IE	100
UADS-803	Specialization Elective VII	DSE	T	4	4-0-0	IE	100*
UADS-804	Project	DSC	PW	4	0-0-8	IE	100*
Total				**18**	**22**		**450**
Research							
UADS-803	Project		PW	12	0-0-24	I	300
Total				**18**	**30**		**450**

GRAND-TOTAL	Credits	Hours	Marks
BS (Honours)	**177**	**202**	**4800**
BS (Honours with Research)	**177**	**220**	**4850**

[*] The paper code and the title of the paper is listed in Annexure – 1.

[$] Paper code and title of Awareness courses are listed in Annexure -2.

[#] List of available Multidisciplinary courses is given in Annexure - 3.

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[@] SEC courses and their syllabi are listed at the end of the syllabus doc.

NEP Compliance and Flexibility:

BS Actuarial Data Science is New Education Policy 2020 compliant. Students exiting the program after 3 years will be awarded B.Sc. (Actuarial Data Science) provided they secure 145 credits including internship and satisfy the minimum credit requirements under each specified category of courses.

Indicator	Legend
AEC	Ability Enhancement Compulsory Course
DSC	Discipline Specific Core
DSE	Discipline Specific Elective
SEC	Skill Enhancement Course
MDC	Multidisciplinary Course
OE	Open Elective
VOC	Vocational Course
L/T/P/FW	Lecture/Tutorial/Practical/Field Work
S/In/PW/V	Seminar/Internship/ Project Work/Viva-voce
IE	CIE and ESE
I	Continuous Internal Evaluation (CIE) only (Note: 'I' does not connote 'Internal Examiner')
E	End Semester Examination (ESE) only (Note: 'E' does not connote 'External Examiner')

List of Discipline-Specific Electives Courses

S. N0.	Electives
1	Predictive Analytics using R-I
2	Predictive Analytics using R-II
3	Advanced Topics in Predictive Analytics
4	Actuarial Practice I
5	Actuarial Practice II
6	Financial Economics
7	Financial Reporting

List of Skill Enhancement Courses offered. Scheme of Evaluation and Instructions for Skill Enhancement Courses

Course Code	Title of the Course	Course Category#	Credits	Hours	Mode of Evaluation	Type of Paper	Max. Marks
UADS-105	Excel Basics for Actuarial Practice	SEC	1	2	I	P	50
UADS-205	Excel Advanced for Actuarial Practice	SEC	1	2	I	P	50
UADS-305	Actuarial Communications - I	SEC	2	4	I	P	50
UADS-406	Actuarial Communications - II	SEC	2	4	I	P	50
UADS-507	Course on Ethics and Professionalism	SEC	2	4	I	P	50

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UADS-101 SEMESTER 1	Probability & Statistics	CREDITS: 4
Course Category:	DSC	**Total Periods: 52**

Pre-requisite (If any): 10+2 School Level Mathematics

Course Objectives: The student will understand

- basic probability concepts, combinatorics, and discrete mathematics.
- key concepts concerning discrete and continuous univariate random variables (including binomial, negative binomial, geometric, hypergeometric, Poisson, uniform, exponential, gamma, normal, lognormal, and beta) and their applications.
- key concepts concerning multivariate discrete random variables, the distribution of order statistics, and linear combinations of independent random variables, along with associated applications.

Course Syllabus: At the end of the course, the student will be able to:

Unit	Description	Periods
I	1. Define set functions, Venn diagrams, sample space, and events. Define probability as a set function on a collection of events and state the basic axioms of probability. 2. Calculate probabilities using addition and multiplication rules. 3. Define independence and calculate probabilities of independent events. 4. Calculate probabilities of mutually exclusive events. 5. Define and calculate conditional probabilities.	10
II	6. Calculate probabilities using combinatorics, such as combinations and permutations. 7. State Bayes Theorem and the law of total probability and use them to calculate conditional probabilities. 8. Explain and apply the concepts of random variables, probability, probability density functions, and cumulative distribution functions. 9. Calculate conditional probabilities. 10. Explain and calculate expected value and higher moments, mode, median, and percentile.	10

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III	11. Explain and calculate variance, standard deviation, and coefficient of variation. 12. Apply the concepts of deductibles, coinsurance, benefit limits, and inflation to convert a given loss amount from a policyholder into the corresponding payment amount for an insurance company. 13. Calculate the expected value, variance, and standard deviation of both the loss random variable and the corresponding payment random variable upon the application of policy adjustments. 14. Determine the sum of independent random variables (Poisson and normal). 15. Explain and perform calculations concerning joint probability functions and cumulative distribution functions for discrete random variables only.	10
IV	16. Determine conditional and marginal probability functions for discrete random variables only. 17. Calculate moments for joint, conditional, and marginal discrete random variables. 18. Calculate variance and standard deviation for conditional and marginal probability distributions for discrete random variables only. 19. Calculate joint moments, such as the covariance and the correlation coefficient for discrete random variables only. 20. Determine the distribution of order statistics from a set of independent random variables.	14
V	21. Calculate probabilities for linear combinations of independent normal random variables. 22. Calculate moments for linear combinations of independent random variables. 23. Apply the Central Limit Theorem to calculate probabilities for linear combinations of independent and identically distributed random variables.	8

References:

- A First Course in Probability (Tenth Edition), 2019, by Ross, S.M., Pearson, ISBN: 978-0134753119
- Mathematical Statistics with Applications (Seventh Edition), 2008, by Wackerly, D., Mendenhall III, W., Scheaffer, R., Thomson Brooks/Cole ISBN: 978-0495110811
- Probability for Risk Management, (Third Edition), 2021, by Hassett, M., Stewart, D., Milovanovic, J., ACTEX, ISBN: 978-1-64756-322-6
- Probability and Statistics with Applications: A Problem-Solving Text, (Second Edition) 2015, by Asimow, L. and Maxwell, M., ACTEX, ISBN: 978-1-62542-472-3
- Probability and Statistical Inference (Tenth Edition), 2020, by Hogg, R.V., Tanis, E.A., and Zimmerman, D.L., Prentice Hall, ISBN: 978-0135189399

- Probability (Second Edition), 2018, by Leemis, L.M., Lightning Source, ISBN: 978-0-9829174-7-3.

UADS-102 SEMESTER 1	**Financial Mathematics**	**CREDITS: 4**
Course Category:	DSC	**Total Periods: 52**

Pre-requisite (If any): 10+2 School Level Mathematics

Course Objectives: The student will understand and be able to

- perform calculations relating to present value, current value, and accumulated value.
- calculate present value, current value, and accumulated value for sequences of non-contingent payments.
- key concepts concerning loans and how to perform related calculations.
- key concepts concerning bonds, and how to perform related calculations.
- key concepts concerning yield curves, rates of return, measures of duration and convexity, cash flow matching and immunization, and how to perform related calculations.

Course Syllabus: At the end of the course, the student will be able to:

Unit	Description	Periods
I	1. Define and recognize the definitions of the following terms: interest rate (rate of interest), simple interest, compound interest, accumulation function, future value, current value, present value, net present value, discount factor, discount rate (rate of discount), convertible m-thly, nominal rate, effective rate, inflation and real rate of interest, force of interest, equation of value. 2. Given any three of interest rate, period of time, present value, and future value, calculate the remaining item using simple or	10

	compound interest. Solve time value of money equations involving variable force of interest. 3. Given any one of the effective interest rate, the nominal interest rate convertible m-thly, the effective discount rate, the nominal discount rate convertible m-thly, or the force of interest, calculate any of the other items.	
II	4. Write the equation of value given a set of cash flows and an interest rate 5. Define and recognize the definitions of the following terms: annuity-immediate, annuity due, perpetuity, payable m-thly or payable continuously, level payment annuity, arithmetic increasing/decreasing annuity, geometric increasing/decreasing annuity, term of annuity. 6. For each of the following types of annuity/cash flows, given sufficient information of immediate or due, present value, future value, current value, interest rate, payment amount, and term of annuity, calculate any remaining item. a. Level annuity, finite term. b. Level perpetuity. c. Non-level annuities/cash flows. i. Arithmetic progression, finite term and perpetuity. ii. Geometric progression, finite term and perpetuity. iii. Other non-level annuities/cash flows.	12
III	7. Define and recognize the definitions of the following terms: principal, interest, term of loan, outstanding balance, final payment (drop payment, balloon payment), amortization. 8. Calculate: a. The missing item, given any four of: term of loan, interest rate, payment amount, payment period, principal. b. The outstanding balance at any point in time. c. The amount of interest and principal repayment in a given payment. d. Similar calculations to the above when refinancing is involved. 9. Define and recognize the definitions of the following terms: price, book value, market value, amortization of premium, accumulation of discount, redemption value, par value/face value, yield rate, coupon, coupon rate, term of bond, callable/non-callable, call price, call premium, accumulated value with reinvestment of coupons.	12

IV	10. Given sufficient partial information about the items listed below, calculate any of the remaining items a. Price, book value, market value, accumulated value with reinvestment of coupons, amortization of premium, accumulation of discount. (Note that valuation of bonds between coupon payment dates will not be covered). b. Redemption value, face value. c. Yield rate. d. Coupon, coupon rate. e. Term of bond, point in time that a bond has a given book value, amortization of premium, or accumulation of discount. 11. Calculate the price of a callable bond to achieve a specified minimum yield 12. Define and recognize the definitions of the following terms: yield rate/rate of return, current value, duration and convexity (Macaulay and modified), portfolio, spot rate, forward rate, yield curve, cash flow and duration matching, and immunization (including full immunization and Redington immunization).	14
V	13. Calculate: a. The duration and convexity of a set of cash flows. b. Either Macaulay or modified duration given the other. c. The approximate change in present value due to a change in interest rate, o Using 1st-order linear approximation based on modified duration. o Using 1st-order approximation based on Macaulay duration. d. The present value of a set of cash flows, using a yield curve developed from forward and spot rates. 14. Construct an investment portfolio to: a. Protect the value of an asset-liability portfolio using either Redington or full immunization b. Exactly match a set of liability cash flows.	4

References:

- Broverman, S.A., Mathematics of Investment and Credit (Seventh Edition), 2017, ACTEX Publications, ISBN 978-1-63588-221-6
- Vaaler, L.J.F., Harper, S.K., and Daniel, J.W. Mathematical Interest Theory (Third Edition), 2019, The Mathematical Association of America, ISBN: 978-1-4704-4393-1
- Brown, R and Kopp, S, Financial Mathematics: Theory and Practice, 2012, Reprint: ACTEX Learning, Published by McGraw-Hill Ryerson: ISBN: 978-1-63588-694-8
- Francis, J. and Ruckman, C., Interest Theory – Financial Mathematics and Deterministic Valuation; (Third Edition), 2022, Actuarial Brew, ISBN 978-09981604-4-3

- Chan, Wai-Sum, and Tse, Yiu-Kuen, Financial Mathematics for Actuaries, Third Edition 2022, World Scientific Publishing ISBN: 978-9811243271 (hard cover) or 978-9811245671 (paperback).

UADS-103 SEMESTER 1	**Business Economics - Micro**	**CREDITS: 3**
Course Category:	DSC	**Total Periods: 39**

Pre-requisite (If any): 10+2 School Level Mathematics

Course Objectives: The student will understand and be able to

- key concepts of micro economics including supply-demand curve, market competition and profitability.

Course Syllabus: At the end of the course, the student will be able to:

Unit	Description	Periods
I	1. Explain the concept of utility and how rational utility maximizing agencies make consumption choices.	10
II	2. Explain the elasticity of supply and demand and the effects on a market of the different levels of elasticity. 3. Explain the interaction between supply and demand and the way in which equilibrium market prices are achieved.	12
III	4. Explain various pricing strategies that can be used by firms. 5. Explain the core economic concepts involved in choices made by businesses with respect to short-run and long-run investment and production choices.	12
IV	6. Explain competitive markets and how they operate. 7. Explain profitability in markets with imperfect competition.	5

References:

- Economics. 11th ed. Sloman, J. Pearson, 2022. eISBN: 978-1292187853
- Economics for business. 8th ed. Sloman, J.; Hinde, K; Garratt, D. Pearson, 2019. ISBN: 9781292239279.

UADS-104 SEMESTER 1	**Introduction to R**	**CREDITS: 1**
Course Category:	DSC (P)	**Total Periods: 26**

Pre-requisite (If any): 10+2 School Level Mathematics

Course Objectives: The student will understand and be able to do the below activities in R

- Production of simple visualisations and statistics from a data set.
- The basic properties and uses of commonly-used probability distributions and the statistical properties of data generated by randomly sampling from a known distribution.
- Use of statistics to make inferences about the process underlying a data set
- Use of statistics to examine and make inferences about the relationships between two or more data sets
- Use of Bayesian statistics to update prior beliefs about a data-generating process.

Course Syllabus: At the end of the course, the student will be able to the following in R:

1. Describe the purpose and function of data analysis
2. Complete exploratory data analysis
3. Understand the characteristics of basic univariate distributions and how to generate samples from them.
4. Determine the characteristics of jointly distributed random variables
5. Evaluate expectations and conditional expectations
6. Evaluate and apply generating functions
7. State and apply the central limit theorem
8. Describe random sampling and the sampling distributions of statistics commonly used in statistical inference

9. Construct estimators and discuss their properties
10. Calculate confidence intervals and prediction intervals
11. Apply the concepts of hypothesis testing and goodness of fit
12. Understand and use linear regression models
13. Understand and use generalised linear models
14. Explain fundamental concepts of Bayesian statistics and use these concepts to calculate Bayesian estimators

References:

- Report writing for data science in R. Peng, R. Victoria (Canada): Lean Publishing, 2015. ISBN 978-132973364
- Regression modelling with actuarial and financial implications. Frees, E.W. Cambridge University Press, 2010. ISBN: 978-0521760119

UADS-201 SEMESTER 2	**Fundamentals of Actuarial Mathematics**	**CREDITS: 4**
Course Category:	DSC	**Total Periods: 52**
Pre-requisite (If any): 10+2 School Level Mathematics		

Course Objectives: The student will understand and be able to

- key features of insurance and reinsurance coverages
- characteristics of and uses for commonly used severity, frequency, and aggregate models
- understand and be able to estimate parameters for parametric models
- concepts of credibility and be able to apply certain types of credibility in some practical settings
- use basic methods to calculate premiums and reserves for short-term insurance coverages
- value simple options and derivatives using risk neutral expected present values, under the binomial and Black-Scholes models.
- key features of insurance coverages and retirement financial security programs
- key concepts concerning parametric and non-parametric mortality models for individual lives
- estimate parameters for parametric and non-parametric survival models
- perform calculations on the present value random variables associated with benefits and expenses for long term insurance coverages.
- use and explain the premium and policy value calculation processes for long-term insurance coverages.

Course Syllabus: At the end of the course, the student will be able to:

Unit	Description	Periods
I	1. Course Syllabus: At the end of the course, the student will be able to: 2. Describe and apply techniques for estimating outstanding claims, using the following methods: a. Expected Loss Ratio b. Chain-Ladder c. Bornhuetter-Ferguson 3. Understand the objectives of ratemaking and the data used for ratemaking. 4. Calculate the adjustments to ratemaking data, including development, trend and adjusting premium to current rate levels. 5. Understand how expenses and the profit and contingencies loading are used in ratemaking. 6. Calculate overall average rates and rate changes using the loss cost and loss ratio methods.	10

II	7. Identify the cash flows and characteristics of puts and calls. 8. Apply the binomial option pricing model to calculate the price of a simple European-style derivative on a single non-dividend paying asset. 9. Apply the Black-Scholes formula to calculate the price and delta hedge of a simple Europeanstyle derivative on a single non-dividend paying asset. 10. Apply put-call parity. 11. Define and apply the concept of insurable interest. 12. Identify the long-term insurance coverages (life, health), annuities, and defined benefit and defined contribution pension plans.	12
III	13. Understand parametric survival models, life tables, and the relationships between them. 14. Given a parametric survival model, calculate survival and mortality probabilities, the force of mortality function, and moments of the curtate and complete future lifetime random variable. 15. Identify and apply standard actuarial notation for future lifetime distributions and moments, including select and ultimate functions. 16. Given a life table, calculate survival and mortality probabilities, the force of mortality function, and moments of the curtate and complete future lifetime random variable, using appropriate fractional age assumptions where necessary. 17. Understand and apply select life tables. 18. Identify common features of population mortality curves.	12
IV	19. Use Maximum Likelihood Estimation to estimate log-likelihood functions for various laws of mortality 20. Apply Kaplan Meier and Nelson Aalen methods to estimate empirical survival functions using censored and truncated lifetime data. 21. Calculate approximate standard errors of the parameter/probability estimates. 22. Construct linear and non-linear confidence intervals (as appropriate) for parameters/estimates. 23. Identify the present value random variables associated with life insurance, endowment, and annuity payments for single lives, based on annual, 1/m-thly and continuous payment frequency. 24. Calculate probabilities, means, variances and covariances for the random variables in Topic 22, using fractional age or claims acceleration approximations where appropriate. 25. Understand the relationships between the insurance, endowment, and annuity present value random variables in Topic 10(a), and between their expected values. 26. Calculate the effect of changes in underlying assumptions (e.g., mortality and interest).	14

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V	27. Identify and apply standard actuarial notation for the expected values of the random variables in Topic 22. 28. Identify the future loss random variables associated with whole life, term life, and endowment insurance, and with term and whole life annuities, on single lives. 29. Calculate premiums based on the equivalence principle, the portfolio percentile principle, and for a given expected present value of profit, for the policies in Topic 27. 30. Calculate and interpret gross premium, net premium and modified net premium policy values for the policies in Topic 27. 31. Calculate the effect of changes in underlying assumptions (e.g., mortality and interest). 32. Apply the following methods for modelling extra risk: age rating; constant addition to the force of mortality, constant multiple of the rate of mortality.	4

References:

- Loss Models: From Data to Decisions, (Fifth Edition), 2019, by Klugman, S.A., Panjer, H.H. and Willmot, G.E., Wiley, ISBN: 978-1-119-52378-9
- Introduction to Ratemaking and Loss Reserving for Property and Casualty Insurance (Fifth Edition), 2022 by Brown and Lennox, ACTEX, ISBN: 978-1-64756-787-3
- Actuarial Mathematics for Life Contingent Risks, Third Edition Dickson, C.M.D., Hardy, M.R., Waters, H.R. (2020), Cambridge University Press ISBN: 978-1-108-47808-3.

UADS-202 SEMESTER 2	**Data Concepts and Visualization**	**CREDITS: 4**
Course Category:	DSC	**Total Periods: 52**

Pre-requisite (If any): 10+2 School Level Mathematics

Course Objectives: The student will understand and be able to

- key concepts of Data quality, Data sources and Data visualization.

Course Syllabus: At the end of the course, the student will be able to:

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Unit	Description	Periods
I	1. Summarize concepts of data quality. Understand and describe impact of data quality on Actuarial work and projects. 2. Understand the categories of data quality principles. Given a principle of data quality, provide an example that illustrates the principle. Understand what is involved in a review of data.	10
II	3. Describe these aspects of data documentation: a. Data and metadata terminology b. Relationship between data documentation and data governance c. Types and uses of metadata for data scientists 4. Explain the regulator and business needs for statistical data 5. Understand what typical attributes are made available in each of the following data sources: a. Policy and Premium Data b. Claims Information c. Claim Notes d. Billing Information e. Producer Information	12
III	6. Understand how corrections for each of these attributes are recorded. 7. Understand how to access and the uses of external sources. 8. Understand who collects the information, for what purposes, how frequently it is updated and how it is distributed. For each of these sources understand what typical attributes are made available.	12
IV	9. Understand various derived attributes. Understand if there is a clear way to merge the data into databases used for analysis. 10. Describe the use of univariate descriptive statistics and displays, and some basic techniques for meaningful data characterization. a. Basic Descriptive Statistics b. Graphs, Tables, and Charts c. Displaying and Assessing Time Series Data d. Bucketing for Categorical Variables 11. Describe the use of multivariate summaries and displays to analyze data, detect outliers, and/or formulate preliminary hypotheses. a. Pivot Tables b. Contingency Tables c. Linear and Nonlinear Correlations d. Scatterplots and Correlations e. Heat Maps	14

V	12. Describe these aspects of data visualization: Data preparation for visualization; Basic concepts and methods of data visualization a. Data Preparation for Visualization b. Basic Concepts and Methods of Data Visualization 13. Explain how to visualize data using various types of displays. a. Tables b. Dashboards c. Charts and Graphs d. Maps	4

References:

- Cleveland, W., Visualizing Data, Hobart Press, 1993
- Healy, K., Data Visualization, Princeton University Press, 2019
- Few, Stephen, "Designing Effective Tables and Graphs," perceptualedge.com

UADS-203 SEMESTER 2	**Business Economics - Macro**	**CREDITS: 3**
Course Category:	DSC	**Total Periods: 39**

Pre-requisite (If any): 10+2 School Level Mathematics

Course Objectives: The student will understand and be able to

- key concepts of macroeconomics including macro-economic measures, interest rates and exchange rates.

Course Syllabus: At the end of the course, the student will be able to:

Unit	Description	Periods

I	1. Explain basic macroeconomic measures (e.g., GDP) used to compare the economies of countries. 2. Describe the structure of public finances for an industrialized country. 3. Explain the effect of fiscal and monetary policy on the economy, including the effect on financial markets.	10
II	4. Explain the role of international trade, exchange rates and the balance of payments in the economy. 5. Explain the effect of savings and consumption rates on the economy. 6. Explain the major factors affecting the level of interest rates, the rate of inflation, the exchange rate, the level of employment and the rate of growth for an industrialized country.	12
III	7. Describe the function of money in the economy. 8. Explain the relationship between money and interest rates.	12
IV	9. Explain how macroeconomic policies affect businesses.	5

References:

- Economics. 11th ed. Sloman, J. Pearson, 2022. eISBN: 978-1292187853
- Economics for business. 8th ed. Sloman, J.; Hinde, K; Garratt, D. Pearson, 2019. ISBN: 9781292239279.

UADS-204 SEMESTER 2	**Actuarial Mathematics using R**	**CREDITS: 1**
Course Category:	DSC (P)	**Total Periods: 26**

Pre-requisite (If any): 10+2 School Level Mathematics

Course Objectives: The student will understand and be able to

- Statistical distributions suitable for modelling the variables and risks that arise within insurance contracts.

- Statistical concepts for modelling, fitting and forecasting data that is indexed by time.
- Application of Markov models to model time-indexed risk and claim data arising primarily in insurance and other appropriate business-related scenarios.
- Description, estimation and use of statistical models for the time until an event occurs.

Course Syllabus: At the end of the course, the student will be able to work on the following in R:

1. Loss distributions, with and without risk sharing
2. Compound distributions and their applications in risk modelling
3. Introduction to copulas
4. Introduction to extreme value theory
5. Understand the core concepts underlying time series models
6. Applications of time series models
7. Stochastic processes
8. Understand and apply a Markov chain
9. Define and apply a Markov process
10. Concepts of survival models
11. Understand the estimation procedures for lifetime distributions
12. Derive maximum likelihood estimators for transition intensities
13. Transition intensities dependent on age (exact or census)
14. Graduation and graduation tests
15. Mortality projection

References:

- Competing risks and multistate models with R. - Beyersmann, J., Schumacher, M. and Allignol, A. - Springer, 2012. ISBN: 978-1461420347
- An actuarial survey of statistical models for decrement and transition data. Macdonald, A.S. British Actuarial Journal (1996) 2: 129-155; 429-448; 703-726.
- Modelling mortality with actuarial applications. Macdonald, A.S., Richards, S.J. and Currie, I.D. - Cambridge University Press, 2018. ISBN: 978-1107045415

UADS-301 SEMESTER 3	Advanced Short-Term Actuarial Mathematics-I	CREDITS: 4

Course Category:	DSC	**Total Periods: 52**

Pre-requisite (If any): 10+2 School Level Mathematics

Course Objectives: The student will understand and be able to

- perform calculations with commonly used severity distributions, including extreme value distributions
- perform calculations with aggregate models.
- calculate premiums for short-term insurance coverages.
- construct and estimate parameters for parametric models.

Course Syllabus: At the end of the course, the student will be able to:

Unit	Description	Periods
I	1. Describe how changes in the parameters affect the distributions. 2. Create new distributions by multiplication by a constant, raising to a power, exponentiation, mixing and splicing. 3. Understand and interpret the characteristics of severity distributions.	10
II	4. Compare two distributions based on various characteristics of their tails, including moments, ratios of moments, limiting tail behavior, hazard rate functions, and mean excess functions. 5. Understand the derivation and characteristics of the Generalized Extreme Value and the Generalized Pareto distributions. 6. Apply the Generalized Extreme Value and the Generalized Pareto distributions to the estimation of tail measures and probabilities. 7. Use convolution and recursive formulas to derive probability and distribution functions for aggregate claims distributions with (a,b,0) or (a,b,1) frequency, and with discrete severity distributions.	12

III	8. Derive the discretized version of a continuous distribution using the method of rounding and local moment matching. 9. Perform calculations for sums of compound Poisson models. 10. Evaluate the effects of the following coverage modifications: deductibles, policy limits, maximum covered loss, coinsurance, and stop loss reinsurance. 11. Calculate and interpret loss elimination ratios, increased limits factors, and deductible factors.	12
IV	12. Evaluate and interpret the effects of inflation on losses. 13. Estimate the parameters for frequency and severity distributions by maximum likelihood. 14. Estimate the variance of the estimators and construct normal and non-normal confidence intervals. 15. Use the delta method to estimate the variance of the maximum likelihood estimator of a function of the parameter(s).	14
V	16. Estimate the parameters for severity, frequency, and aggregate distributions using Bayesian Estimation. 17. Perform model selection using: a. Graphical procedures. b. Hypothesis tests, including Kolmogorov-Smirnov, Chi-square goodness-of-fit, and Likelihood ratio (LRT) tests. c. Score-based approaches, including Schwarz Bayesian Criterion (SBC), Bayesian Information Criterion (BIC), and Akaike Information Criterion (AIC)	4

References:

- Loss Models: From Data to Decisions, (Fifth Edition), 2019, by Klugman, S.A., Panjer, H.H. and Willmot, G.E., Wiley, ISBN: 978-1-119-52378-9
- Introduction to Ratemaking and Loss Reserving for Property and Casualty Insurance (Fifth Edition), 2022, by Brown and Lennox, ACTEX, ISBN: 978-1-64756-787-3

UADS-302 SEMESTER 3	**Advanced Long-Term Actuarial Mathematics-I**	**CREDITS: 4**
Course Category:	DSC	**Total Periods: 52**

Pre-requisite (If any): 10+2 School Level Mathematics

Course Objectives: The student will understand and be able to

- key concepts concerning multiple state mortality/morbidity and joint life mortality models for insurance and annuity contracts.
- perform calculations on the present value random variables associated with benefits and expenses for single life, joint life, CCRCs, or other state-dependent insurance and annuity contracts
- key concepts concerning estimation and construction of multiple state and joint life models for insurance and annuity contracts.

Course Syllabus: At the end of the course, the student will be able to:

Unit	Description	Periods
I	1. Apply Markov multiple state models to state-contingent life and long-term health insurance benefits, and Continuing Care Retirement Communities (CCRCs). 2. Understand and critique the assumptions underlying Markov multiple state models for longterm insurance. 3. Derive and apply Kolmogorov's forward equations for continuous time Markov multiple state models.	10
II	4. Calculate state-dependent probabilities for continuous time Markov models. 5. Apply the Chapman-Kolmogorov equations to calculate discrete time transition probabilities in the Markov model. 6. Construct and deconstruct multiple decrement tables using the associated single decrement models and appropriate fractional age assumptions. 7. Calculate maximum likelihood estimates of transition intensities and probabilities for multiple state and multiple decrement models, assuming piecewise constant transition intensities.	12
III	8. Calculate approximate confidence intervals for the estimators in Topic 7, using asymptotic properties of the maximum likelihood estimators. 9. Define and interpret state-dependent insurance and annuity present value random variables and identify and calculate their expected values. 10. Derive and apply two-term and three-term Woolhouse approximations for calculating expected present values of state-dependent cash flows.	12

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	11. Calculate premiums for state-dependent life insurance, long-term health insurance, and CCRCs using the equivalence principle.	
IV	12. Calculate policy values for state-dependent life insurance, long-term health insurance, and CCRCs. 13. Identify and apply Thiele's differential equation in a single life or multiple state setting. 14. Understand how joint-life mortality can be modelled using a. a time-to-status-failure random variable b. a multiple state model. 15. Understand the implications of independence or dependence of future lifetimes in both versions of the joint life model from point 14. Identify sources of dependence and understand how they are accommodated in the models.	14
V	16. Calculate premiums for insurance and annuities on joint lives using the equivalence principle. 17. Calculate policy values for insurance and annuities on joint lives.	4

References:

- Actuarial Mathematics for Life Contingent Risks, Third Edition Dickson, C.M.D., Hardy, M.R., Waters, H.R. (2020), Cambridge University Press ISBN: 978-1-108-47808-3

UADS-303 SEMESTER 3	**Corporate Finance**	**CREDITS: 3**
Course Category:	DSC	**Total Periods: 39**

Pre-requisite (If any): 10+2 School Level Mathematics

Course Objectives: The student will understand and be able to

- key concepts of corporate finance including capital structure, different financial instruments and their characteristics.

Course Syllabus: At the end of the course, the student will be able to explain:

Unit	Description	Periods
I	1. Definitions of key finance terms: stock company; capital structure 2. Key finance concepts: financing companies; characteristics and uses of financial instruments; sources of capital; cost of capital; dividend policy; personal and corporate taxation 3. Factors to be considered by a company when deciding on its capital structure and dividend policy	10
II	4. Impact of financial leverage and long/short term financing policies on capital structure 5. Characteristics of the principal forms of financial instruments issued or used by companies, and the ways in which they may be issued 6. How a company's cost of capital relates to the investment projects the company wishes to undertake	12
III	7. Definitions of key finance terms: financial instruments – bond, stock, basic options (calls, puts); dividends; price to earnings ratio 8. Structure of a stock company and the different methods by which it may be financed 9. Calculate value of stocks 10. Measures of financial performance: balance sheet; income statement; statement of cash flows; financial ratios (e.g. leverage, liquidity, profitability, market value ratios); net present value: the payback, discounted payback models; internal rate of return and profitability index models	12
IV	11. Assessment of financial performance using various measures: balance sheet; income statement; statement of cash flows, financial ratios (e.g. leverage, liquidity, profitability, market value ratios); net present value; the payback, discounted payback models; internal rate of return and profitability index models	5

References:

- Ross, Stephen, Westerfield, Randolph, Jaffe, Jaffrey (February 2002), Corporate Finance,6th Ed., McGraw-Hill Companies.
- Berk, Jonathan, and DeMarzo, Peter (2007), Corporate Finance, Pearson International.

- Brealey, R.A., Myers, S.C. and Allen, F. (2003), Principles of Corporate Finance, 7th Ed,McGrawHill.
- Copeland, T., Weston, F., and Shastri, K. (2004), Financial Theory and Corporate Policy,4th Ed., New York: Addison-Wesley.

UADS-304 SEMESTER 3	**Introduction to Python**	**CREDITS: 1**
Course Category:	DSC (P)	**Total Periods: 26**

Pre-requisite (If any): 10+2 School Level Mathematics

Course Objectives: The student will understand and learn the basics of python and the usage of major packages.

Course Syllabus: At the end of the course, the student will be able to do the following in Python:

1. Setup python environment
2. Basic variable types and how to use them
3. Python Syntax
4. Introduction and usage of Numpy
5. Introduction and usage of Pandas
6. Data Visualization with seaborn and matplotlib
7. Types of data
8. Handling missing data
9. Data encoding and Feature Scaling
10. Handling data imbalance
11. Simple linear regression
12. Multiple linear regression
13. Polynomial regression

References:

- Grus, J. (2019). Data Science from Scratch: First Principles with Python. O'Reilly Media.
- Géron, A. (2019). Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow. O'Reilly Media.
- Raschka, S., & Mirjalili, V. (2017). Python Machine Learning. Packt Publishing.

UADS-401 SEMESTER 4	**Advanced Short-Term Actuarial Mathematics-II**	**CREDITS: 4**
Course Category:	DSC	**Total Periods: 52**

Pre-requisite (If any): 10+2 School Level Mathematics

Course Objectives: The student will understand and be able to

- estimate losses using credibility procedures.
- calculate reserves for short-term insurance coverages
- calculate premiums for short-term insurance coverages.

Course Syllabus: At the end of the course, the student will be able to:

Unit	Description	Periods
I	1. Explain and apply Bayesian (greatest accuracy) credibility.	10
II	2. Apply Bühlmann and Bühlmann-Straub models and understand their relationship to Bayesian models. 3. Explain and apply empirical Bayesian estimation in the nonparametric and semiparametric cases	12

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III	4. Understand, interpret, and apply techniques for estimating outstanding claims, using the following methods: a. Expected Loss Ratio b. Chain-Ladder c. Bornhuetter-Ferguson d. Bayesian e. Frequency and Severity	12
IV	5. Understand, interpret, and apply the following statistical models and assumptions used for outstanding claims reserves: a. Mack's model b. Poisson model c. Overdispersed Poisson mode 6. Calculate projected losses using trend analysis. 7. Calculate overall average rates and rate changes using the loss cost and loss ratio methods.	14
V	8. Calculate risk classification differential changes, including balancing back.	4

References:

- Loss Models: From Data to Decisions, (Fifth Edition), 2019, by Klugman, S.A., Panjer, H.H. and Willmot, G.E., Wiley, ISBN: 978-1-119-52378-9
- Introduction to Ratemaking and Loss Reserving for Property and Casualty Insurance (Fifth Edition), 2022, by Brown and Lennox, ACTEX, ISBN: 978-1-64756-787-3

UADS-402 SEMESTER 4	**Advanced Long-Term Actuarial Mathematics-II**	**CREDITS: 4**
Course Category:	DSC	**Total Periods: 52**
Pre-requisite (If any): 10+2 School Level Mathematics		
Course Objectives: The student will understand and be able to ● analyze emerging surplus, and to set premiums and reserves, using profit testing		

- understand how retirement benefits are accrued, valued, and funded.
- understand the policy design and benefits payable under Type A and Type B Universal Life contracts and be able to assess and quantify account values, premiums, and reserves.
- various types of equity-linked life insurance guarantees, options that are embedded in life insurance and annuity contracts and be able to price, reserve, and hedge the risk inherent in these options.

Course Syllabus: At the end of the course, the student will be able to:

Unit	Description	Periods
I	1. Calculate and interpret common profit measures such as expected profit, actual profit, gain, gain by source and period, profit signature, profit vector, net present value, internal rate of return, profit margin, and discounted payback period for long-term life and health insurance, and annuity contracts. 2. Calculate premiums for long-term life and health insurance and annuity contracts based on a specified profit objective. 3. Calculate reserves for long-term life and health insurance and annuity contracts using profit testing.	10
II	4. Calculate replacement ratios for Defined Contribution (DC), and Defined Benefit (DB) plans, including final average salary (FAS), career average earnings (CAE), and career average revalued earnings (CARE) plans. 5. Calculate the required contribution rate to meet a target replacement ratio for a DC plan participant, using a deterministic approach. 6. Identify, interpret, and apply service table and salary scale functions for pension plan valuation.	12
III	7. For a DB plan, calculate and interpret replacement ratios, accrued benefits, including benefits on early exit from the plan. 8. For a DB plan, calculate and interpret the actuarial accrued liability and the normal cost for benefits payable on age retirement or early exit using the projected unit credit (PUC) and traditional unit credit (TUC) valuation methods. 9. Identify and interpret the assumptions and funding methods used for retiree health care valuation.	12
IV	10. Calculate and interpret the expected present value of future benefits, accumulated postretirement benefit obligation (APBO), and the normal cost or service cost for retiree health care plans.	14

	11. Understand the cashflows and calculate account values and benefits under Type A and Type B Universal Life policies. b) Calculate reserves for no-lapse guarantees. c) Use deterministic profit testing to calculate premiums and to assess emerging surplus for Universal Life insurance. 12. Define and calculate payoffs under each of the following options embedded in insurance and annuity contracts: a. Guaranteed minimum death benefit b. Guaranteed minimum maturity benefit c. Guaranteed minimum income benefit d. Guaranteed minimum withdrawal benefit	
V	13. Value the following options embedded in insurance and annuity contracts, using the BlackScholes model: a. Guaranteed minimum death benefit b. Guaranteed minimum accumulation/maturity benefit 14. Construct a replicating portfolio for the options in 13 using delta-hedging 15. Understand and evaluate the costs associated with discrete-time rebalancing.	4

References:

- Actuarial Mathematics for Life Contingent Risks, Third Edition Dickson, C.M.D., Hardy, M.R., Waters, H.R. (2020), Cambridge University Press ISBN: 978-1-108-47808-3

UADS-403 SEMESTER 4	**Accounting for Financial Institutions**	**CREDITS: 3**
Course Category:	DSC	**Total Periods: 39**
Pre-requisite (If any): 10+2 School Level Mathematics		
Course Objectives: The student will understand and be able to explain • key concepts of corporate accounting and finance including taxation and capital budgeting.		

Course Syllabus: At the end of the course, the student will be able to:

Unit	Description	Periods
I	1. Describe the basic principles of corporate taxation and the taxation of investments held by institutions. 2. Explain why companies are required to produce annual reports. 3. Explain fundamental accounting concepts and terms, and describe the main sources of accounting regulation.	10
II	4. Explain the structure and purpose of the income statement, balance sheet, and statement of cash flows. and the interactions between them. 5. Construct simple statements of financial position and profit or loss. 6. Calculate and interpret financial ratios.	12
III	7. Explain the characteristics of various forms of equity capital from the point of view of the issuer and the investor. 8. Explain the characteristics of various forms of long-term debt capital from the point of view of the issuer and the investor. 9. Explain the characteristics of various forms of short- and medium-term financing from the point of view of the issuer and the investor.	12
IV	10. Calculate weighted-average cost of capital. 11. Explain the main methods of capital budgeting. 12. Calculate a project's investment return.	5

References:

- Atrill, P., & McLaney, E. (2015). Management Accounting for Decision Makers (9th ed.). Prentice Hall. ISBN: 9781292062716.
- Berry, A., & Jarvis, R. (2011). Corporate Finance: Principles & Practice (5th ed.). Cengage. ISBN: 9781408030479.
- Leiwy, D., & Perks, R. (2015). Accounting: Understanding and Practice (4th ed.). McGraw-Hill. ISBN: 9780077139131.

UADS-404 SEMESTER 4	Introduction to Machine Learning	CREDITS: 1
Course Category:	DSC (P)	**Total Periods: 26**

Pre-requisite (If any): 10+2 School Level Mathematics

Course Objectives: The student will understand and be able to

- key concepts and applications of machine learning such as Statistical learning, Classification method, Resampling method, Model selection, Linear, shrinkage and regularization methods, Semiparametric models, Tree based methods and Unsupervised learning.

Course Syllabus: At the end of the course, the student will be able to:

1. Understanding the tradeoff between prediction accuracy and model interpretability and bias/variance tradeoff.
2. Assessing model accuracy (i.e., MSE, error rate, training error)
3. Applying multiple logistic regression in prediction.
4. Applying LDR, QDA and KNN in prediction.
5. Comparing logistic regression, LDA, QDA and KNN prediction results
6. Understanding bootstrapping, leave-one-out cross validation, kfold cross validation and test sample.
7. Use LRT to select the best smoothing parameters and predictor variables.
8. Use complexity parameters and cross-validation to select optimal sub-models.
9. Selecting the tuning parameters for both lasso and ridge regression.
10. Applying lasso and ridge regression to make predictions.
11. Applying GAM, Additive models, nonlinear models to model real continuous response variable with both categorical and real continuous variables.
12. Understanding tree-based regression models.
13. Understanding bagging, boosting and random forests.
14. Candidates need to be able to use the Tree libraries and functions such as tree, rpart, and party, but do not need to be able to do trees from first principals.

15. Applying principal components Analysis to model clusters.
16. Applying k-means to model clusters.

References:

- Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani. (2021). An Introduction to Statistical Learning: With Applications in R. Second Edition New York: Springer)
- Venables, W. N., Ripley, B. D., & Venables, W. N. (2002). Modern Applied Statistics with S.

UADS-405 SEMESTER 4	**Property and Casualty Insurance Fundamentals**	**CREDITS: 4**
Course Category:	DSC	**Total Periods: 52**

Pre-requisite (If any): 10+2 School Level Mathematics

Course Objectives: The student will understand and be able to explain

- key concepts of Understanding Risk, Risk Management, Risk Control and Risk Financing.

Course Syllabus: At the end of the course, the student will be able to:

Unit	Description	Periods
I	1. Describe each of the following in the context of risk: a. Uncertainty b. Possibility c. Possibility compared with probability 2. Explain how the following classifications of risk apply and how they help in risk management: a. Pure and speculative risk b. Subjective and objective risk	10

	c. Diversifiable and non-diversifiable risk d. Quadrants of risk (hazard, operational, financial, and strategic)	
II	3. Describe the three financial consequences of risk. 4. Describe the basic purpose and scope of risk management in terms of the following: a. How risk management is practiced by individuals and organizations b. The basic distinction between traditional risk management and enterprise-wide risk management	12
III	5. Describe the following elements of property, liability, personnel, and net income loss exposures: a. Assets exposed to loss b. Causes of loss, including associated hazards c. Financial consequences of loss 6. Describe the benefits of risk management and how it reduces the financial consequences of risk for individuals, organizations, and society. 7. Summarize pre-loss and post-loss risk management program goals and the conflicts that can arise as they are implemented.	12
IV	8. Describe each of the steps in the risk management process. 9. Describe the six categories of risk control techniques in terms of the following: a. Whether each reduces loss frequency, reduces loss severity, or makes losses more predictable b. How each can be used to address a particular loss exposure c. How they differ from another 10. Explain how an organization can use risk control techniques and measures to achieve the following risk control goals: a. Implement effective and efficient risk control measures b. Comply with legal requirements c. Promote life safety d. Ensure business continuity	14
V	11. Explain how risk control techniques can be applied to property, liability, personnel, and net income loss exposures. 12. Describe business continuity management in terms of its scope, the process used to implement it, and the contents of a typical business continuity plan.	4

References:

- Parodi, P. 2nd edition. Chapman & Hall/CRC Press, 2023. ISBN: 9781000860832

UADS-501 SEMESTER 5	Statistics for Risk Modeling - I	CREDITS: 4
Course Category:	DSC	**Total Periods: 52**

Pre-requisite (If any): 10+2 School Level Mathematics

Course Objectives: The student will understand and be able to

- key concepts of statistical learning.
- key concepts concerning generalized linear models.

Course Syllabus: At the end of the course, the student will be able to:

Unit	Description	Periods
I	1. Define terms used to classify the types of modeling problems and methods, including supervised versus unsupervised learning and regression versus classification. 2. Compare the common methods of assessing model accuracy.	10

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II	3. Understand how the bias-variance tradeoff impacts the selection of statistical learning methods. 4. Understand resampling methods used for model validation, including a. Training set vs. test set approach b. k-fold cross-validation c. Leave-one-out cross-validation	12
III	5. Compare model assumptions for ordinary least squares and generalized linear models. 6. Identify the members of the exponential family of distributions and corresponding link functions.	12
IV	7. Apply the business context of a problem to interpret parameters. 8. Interpret diagnostic tests of model fit and assumption checking, using a. Graphical methods b. Quantitative methods 9. Select an appropriate model, considering a. Distributions and link functions b. Variable transformations and interactions c. t and F tests d. AIC and BIC e. Likelihood ratio test	14
V	10. Calculate and interpret predicted values, and confidence and prediction intervals. 11. Understand how approaches may differ compared to using an ordinary least squares model, including a. Regularized regression (lasso, ridge regression) b. K-nearest neighbors	4

References:

- Regression Modeling with Actuarial and Financial Applications, Edward W. Frees, 2010, New York: Cambridge. ISBN: 978-0521135962.
- An Introduction to Statistical Learning, with Applications in R, James, Witten, Hastie, Tibshirani, 2013, New York: Springer.

UADS-502 **SEMESTER 5**	**Introduction to Deep Learning**	**CREDITS: 1**

Course Category:	DSC (P)	**Total Periods: 26**

Pre-requisite (If any): 10+2 School Level Mathematics

Course Objectives: The student will understand and be introduced to key concepts of Deep learning and will fit a variety of models and select one appropriate to the circumstances and intended use.

Course Syllabus: At the end of the course, the student will be able to:

1. Explain the importance of model accuracy.
2. Explain, fit, evaluate, and make predictions with each of the following models:
    a. Additive models
    b. Linear mixed models
    c. Neural networks.
3. Apply Bayesian techniques to predictive models.
4. Compare model results with those from linear and tree-based methods.
5. Explain the benefits of and demonstrate the combination of multiple models via stacking and blending.
6. Select and justify a modeling approach based on accuracy, explainability, stability, analytical effort, computational efficiency, and table importability, taking into account the business context of the problem.
7. Recognize and mitigate the effect of:
    a. Starting with too many variables
    b. Repeated use of train/test/validate sets
    c. Model bias, including fairness concepts and proxy discrimination.

References:

- Chapman, P., et al., CRISP-DM: Step-by-Step Data Mining Guide, pp. 6-64

UADS-503 SEMESTER 5	**Modern Actuarial Statistics - Part 1**	**CREDITS: 4**

Course Category:	DSC	**Total Periods: 52**

Pre-requisite (If any): 10+2 School Level Mathematics

Course Objectives: The student will understand and be able to solve problems using stochastic processes and determine the probabilities and distributions associated with these processes.

Course Syllabus: At the end of the course, the student will be able to understand and explain:

Unit	Description	Periods
I	1. Model claim frequencies using Poisson processes 2. Calculate expected values, variances, and probabilities for any Poisson process 3. Calculate limited expected value 4. Perform survival model and hazard rate calculations	10
II	4. Perform joint life calculations 5. Calculate simple whole life or annuity problems 6. Estimate the mean and variance given a sample	12
III	7. Estimate a sufficient statistic for a distribution 8. Test statistical hypotheses, including Type I and Type II errors 9. Test means and variances using critical values from a sampling distribution	12
IV	10. Model insurance claim frequency and severity 11. Model insurance claims in aggregate 12. Calculate order statistics of a sample 13. Perform point estimation of statistical parameters using maximum likelihood estimation (MLE) applying criteria to estimates such as consistency, unbiasedness, sufficiency, efficiency, minimum variance, mean square error (e.g., accounting for censoring and truncation in the data)	14

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V	14. Adjust calculations for the effect of missing data values, including censoring and truncation	4

References:

- Daniel, J.W., “Poisson processes (and mixture distributions),” CAS Study Note, June 2008.
- Ross, S. M., Introduction to Probability Models, 11th edition or 12th edition, Academic Press (an imprint of Elsevier, Inc.), 2014/ 2019.
- Struppeck, T., “Life Contingencies,” CAS Study Note, October 2014, revised September 2015.
- Hogg, R.V., McKean, J.W., and Craig, A.T., Introduction to Mathematical Statistics, 8th edition, Prentice Hall, 2018.
- Tse, Y., Nonlife Actuarial Models, Theory Methods and Evaluation, Cambridge University Press, 2009.

UADS-504 SEMESTER 5	**Advanced Actuarial Statistics - Part 1**	**CREDITS: 4**
Course Category:	DSC	**Total Periods: 52**

Pre-requisite (If any): 10+2 School Level Mathematics

Course Objectives: The student will understand and be able to

- calculate credibility weighted estimates.
- explain the structure of linear mixed models, including how to accommodate models with correlated observations or models where the variance is either not assumed to be constant or a function of the mean
- describe the basic applications of the Auto Regressive Integrated Moving Average (ARIMA) time series mode

Course Syllabus: At the end of the course, the student will be able to:

Unit	Description	Periods
I	1. Calculate classical (limited fluctuation), Bühlmann, Bühlmann-Straub, and Bayesian credibilityweighted estimates for frequency, severity, and aggregate loss 2. Understand the framework used for the classical (limited fluctuation), Bühlmann, BühlmannStraub, and Bayesian credibility procedures	10
II	3. Understand the assumptions behind the linear mixed model design 4. Understand how to use a hierarchical model	12
III	5. Interpret output from a linear mixed model and make appropriate choices when evaluating modeling options 6. Interpret linear mixed model diagnostics and summary statistics to evaluate the linear mixed model structure and variable selection	12
IV	7. Model relationships of current and past values of a statistic/metric 8. Understand the framework of ARIMA models (e.g., trends and seasonality)	14
V	9. Calculate trends and seasonality using time series with regression (e.g., deterministic vs. stochastic trend) 10. Interpret time series output to make forecasts	4

References:

- Tse, Y., Nonlife Actuarial Models, Theory Methods and Evaluation, Cambridge University Press, 2009.
- West, B. T.; Welsh, K. B.; and Galecki, A. T., Linear Mixed Models: A Practical Guide Using Statistical Software, 3rd Edition, CRC Press, 2022.
- Cowpertwait, P., and Metcalfe, A., Introductory Time Series with R, Springer, 2009.

UADS-601 SEMESTER 6	Statistics for Risk Modeling - 2	CREDITS: 4
Course Category:	DSC	Total Periods: 52

Pre-requisite (If any): 10+2 School Level Mathematics

Course Objectives: The student will understand and be able to

- key concepts concerning regression-based time series models.
- key concepts concerning decision tree models.
- key concepts concerning principal component and cluster analysis.

Course Syllabus: At the end of the course, the student will be able to:

Unit	Description	Periods
I	1. Define the concepts and components of stochastic time series processes, including random walks, stationarity, and autocorrelation. 2. Describe specific time series models, including, exponential smoothing, autoregressive, and autoregressive conditionally heteroskedastic models	10
II	3. Calculate and interpret predicted values and confidence intervals. 4. Describe the construction of decision trees, including a. How they are optimally fit to training data b. How they are pruned to mitigate overfitting	12
III	5. Predict outcomes using: a. Classification trees b. Regression trees 6. Describe bagging, boosting, and random forests and the hyperparameters used to control them.	12
IV	7. Compare decision trees to linear models including uses and relative strengths. 8. Define principal components, including how they are calculated. 9. Interpret the results of a principal components analysis, considering loading factors and proportion of variance explained.	14
V	10. Describe and compare the algorithms for: a. K-means clustering b. Hierarchical clustering 11. Explain methods for deciding the number of clusters.	4

References:

- Regression Modeling with Actuarial and Financial Applications, Edward W. Frees, 2010, New York: Cambridge. ISBN: 978-0521135962.
- An Introduction to Statistical Learning, with Applications in R, James, Witten, Hastie, Tibshirani, 2013, New York: Springer

UADS-602 SEMESTER 6	**Modern Actuarial Statistics - Part 2**	**CREDITS: 4**
Course Category:	DSC	**Total Periods: 52**

Pre-requisite (If any): 10+2 School Level Mathematics

Course Objectives: The student will understand and be able to solve problems using extended linear models and determine when these models are appropriate to use.

Course Syllabus: At the end of the course, the student will be able to:

Unit	Description	Periods
I	1. Select the appropriate model for an extended linear model 2. Select the appropriate model structure for an extended linear model given the behavior of the data set to be modeled (e.g., appropriate link function and distribution for the dependent variable for GLM)	10
II	3. Evaluate models developed using an extended linear model approach 4. Interpret the extended linear model output from statistical software, such as parameter estimate tables and ANOVA tables	12

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III	5. Distinguish among categorical, ordinal, and continuous predictors and their interactions, and how these relate to their usage in an extended linear model 6. Understand and apply control and offset variables in GLMs	12
IV	7. Understand and calculate AIC, BIC, deviance, and R-squared 8. Analyze model diagnostic plots (e.g., residual, marginal model, QQ, and added variable plots) to assess quality of fit	14
V	9. Interpret exploratory data analysis plots for various data types (e.g., box, univariate, histograms)	4

References:

- Dobson, A., and Barnett, A., An Introduction to Generalized Linear Models, 4th edition, Chapman and Hall/CRC Press, 2018.
- Hogg, R.V., McKean, J.W., and Craig, A.T., Introduction to Mathematical Statistics, 8th edition, Prentice Hall, 2018.
- James, G., et al., An Introduction to Statistical Learning, with Application in R, 2nd edition, Springer, 2021.
- Larsen, M., "Generalized Linear Models," CAS Study Note, December 2015, revised June 2016.

UADS-603 SEMESTER 6	**Advanced Actuarial Statistics - Part 2**	**CREDITS: 4**
Course Category:	DSC	**Total Periods: 52**
Pre-requisite (If any): 10+2 School Level Mathematics		
Course Objectives: The student will understand the mechanics of the algorithms identified in the tasks below and recognize their inherent strengths and weaknesses to be able to select the most appropriate procedure for the learning task at hand		

Course Syllabus: At the end of the course, the student will be able to:

Unit	Description	Periods
I	1. Compute K-nearest neighbors (KNN) 2. Prune decision trees	10
II	3. Calculate the summary statistics for a set decision of trees 4. Understand the assumptions underlying different tree ensemble methods and the improvements they can make to decision trees	12
III	5. Compute elements of principal components analysis (PCA) (e.g., loading vectors, variance explained) 6. Interpret principal components analysis (PCA) software outputs	12
IV	7. Perform the computations behind clustering procedures (e.g., K-means, hierarchical) 8. Interpret clustering procedures outputs 9. Interpret neural network results	14
V	10. Calculate measures of model predictive accuracy (e.g., entropy, Gini, confusion matrix, lift) 11. Compare models via predictive performance measures (e.g., double lift chart)	4

References:

- James, G., et al., An Introduction to Statistical Learning, with Application in R, 2nd ed., Springer, 2021.
- Goldburd, M., et al., “Generalized Linear Models for Insurance Rating,” CAS Monograph #5, 2nd edition, 2020.

UADS-604 SEMESTER 6	Predictive Modeling using Python	CREDITS: 3
Course Category:	DSC (P)	**Total Periods: 78**

Pre-requisite (If any): 10+2 School Level Mathematics

- **Course Objectives:** The student will understand and learn the usage of python and its packages to implement Machine learning models.

Course Syllabus: At the end of the course, the student will be able to do the following in Python:

Unit	Description	Periods
I	1. Decision tree regression 2. Random forest regression 3. Evaluation of regression models	15
II	4. K- Nearest Neighbors 5. Decision tree classification 6. Random forest classification	15
III	7. Gradient Boosting classification 8. Evaluation of classification models 9. Clustering 10. K-means clustering	15
IV	11. Hierarchical clustering 12. DBSCAN clustering 13. Principal Component Analysis	15

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V	14. Basic Artificial Neural Networks 15. Basic Convolutional Neural Networks 16. Basic Recurrent Neural Networks	18

References:

- Grus, J. (2019). Data Science from Scratch: First Principles with Python. O'Reilly Media.
- Géron, A. (2019). Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow. O'Reilly Media.
- Raschka, S., & Mirjalili, V. (2017). Python Machine Learning. Packt Publishing.

UADS-701 SEMESTER 7	**Basic Ratemaking**	**CREDITS: 4**
Course Category:	DSC	**Total Periods: 52**

Pre-requisite (If any): 10+2 School Level Mathematics

Course Objectives: The student will have a thorough understanding of basic ratemaking so that they can analyze data, select appropriate techniques, and develop solutions to problems.

Course Syllabus: At the end of the course, the student will be able to:

Unit	Description	Periods
I	1. Define and describe exposure bases as used in the ratemaking process 2. Evaluate and select an exposure base in a given scenario for use in the ratemaking process (e.g., line of business, use cases)	10

	3. Aggregate and/or organize ratemaking data in the following ways: calendar year, policy year, accident year, report year, close year, in-force, net of reinsurance	
II	4. Evaluate ratemaking data and analyses for errors and reasonableness 5. Separate data into groups that balance homogeneity and credibility and summarize the considerations for determining such groups 6. Calculate loss and loss adjustment expenses to be used for ratemaking (e.g., common ratios, adjustments to losses, claims-made vs occurrence coverage)	12
III	7. Calculate various adjustments to the premium used for ratemaking (e.g., on-leveling, premium audit) 8. Calculate and apply trends (e.g., exposure, premium, losses) using different approaches (e.g., exponential, and linear analyses) 9. Calculate the underwriting provisions underlying the overall rate level indication (e.g., fixed and variable expenses, profit and contingency, reinsurance costs) 10. Demonstrate proper handling of extraordinary losses for ratemaking purposes (e.g., large losses, catastrophes)	12
IV	11. Construct an overall rate level indication using the pure premium and loss ratio methods 12. Apply credibility to ratemaking analyses using different methods and justify choice of complement 13. Select and justify a final rate change to implement beyond the calculated overall rate level indication (e.g., Operational/Marketing/Regulatory Constraints, Lifetime Value) 14. Perform calculations related to alternative ratemaking procedures (e.g., classification, territory, deductibles, increased limits, coinsurance, commercial lines rating mechanisms, etc.)	14
V	15. Analyze results of predictive models (e.g., GLM) 16. Apply the four principles of ratemaking to a scenario 17. Understand the considerations for implementing rates to achieve an organization's goals (e.g., non-pricing solutions, minimum premium, rating algorithms)	4

References:

- Werner, G., and Modlin, C., Basic Ratemaking, Casualty Actuarial Society, Fifth Edition, May 2016.
- Statement of Principles Regarding Property and Casualty Insurance Ratemaking, Casualty Actuarial Society, May 1988.

- Actuarial Standards Board of the American Academy of Actuaries, “Actuarial Standard of Practice No. 12, Risk Classification (for All Practice Areas),” revised in 2005, updated for deviation language in 2011.
- Actuarial Standards Board of the American Academy of Actuaries, “Actuarial Standard of Practice No. 13, Trending Procedures in Property/Casualty Insurance,” revised in 2009, updated for deviation language in 2011.
- Actuarial Standards Board of the American Academy of Actuaries, “Actuarial Standard of Practice No. 43, Property/Casualty Unpaid Claim Estimates," adopted in 2007, updated for deviation language in 2011.

UADS-702 SEMESTER 7	**International Regulation P&C**	**CREDITS: 4**
Course Category:	DSC	**Total Periods: 52**

Pre-requisite (If any): 10+2 School Level Mathematics

Course Objectives: The student will understand the role of regulators requiring insurers to demonstrate that they are providing fair and reliable services in accordance with the statutes and regulations of each jurisdiction. The student will also understand to understand the concept and assessment of solvency, including ORSA and various international approaches to assessing solvency

Course Syllabus: At the end of the course, the student will be able to:

Unit	Description	Periods
I	1. Understand marketplace regulation.	10

II	2. Understand marketplace function. 3. Understand marketplace conduct and issues.	12
III	4. Mainstream government and industry programs. 5. Understand solvency components.	12
IV	6. Understand capital adequacy components of solvency regulation. 7. Understand ORSA and ERM in general.	14
V	8. Understand mainstream global solvency assessment.	4

References:

- Blanchard, R.S., “Exam 6-International Study Note – Solvency,” CAS Study Note, May 2021.
- International Actuarial Association, Insurer Solvency Assessment Working Party, “A Global Framework for Insurer Solvency Assessment,” 2004.
- Brown, E. F. and Klein, R. W., Research Handbook on the Law and Economics of Insurance, Edward Elgar Publishing, 2015
- Avraham, R., “Discrimination and Insurance,” The Routledge Handbook To Discrimination Lippert-Rasmussen Ed, University of Texas Law, Law and Econ Research Paper No. E574, 2017.
- Eling, M., "Insurance Regulation in Europe: An Analysis of Effectiveness and Efficiency," Journal of Insurance Regulation Vol. 40, No. 3, National Association of Insurance Commissioners, 2021.
- International Actuarial Association, IAA Risk Book, 2016
- International Actuarial Association, Joint Own Risk Solvency Assessment (ORSA) Subcommittee of the Insurance Regulation Committee and the Enterprise and Financial Risk Committee, “Deriving Value from ORSA – Board Perspective,” 2015.

UADS-801 SEMESTER 8	**Estimating Claim Liabilities**	**CREDITS: 4**
Course Category:	DSC	**Total Periods: 52**
Pre-requisite (If any): 10+2 School Level Mathematics		

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Course Objectives: The student will understand how to estimate unpaid claims for both insurance entities and also for non-insurance entities that retain risk.

Course Syllabus: At the end of the course, the student will be able to:

Unit	Description	Periods
I	1. Organize reserving data in the following ways: calendar year, accident year, policy year, underwriting year, report year, etc. 2. Evaluate reserving data and analyses for errors and reasonableness 3. Describe the role of homogeneity and credibility of data in the process of estimating unpaid claims 4. Describe the fundamentals of different types of insurance (e.g., long tail versus short tail lines, low frequency versus high frequency lines, occurrence versus claims made)	10
II	5. Articulate the importance of accurate estimates of unpaid claims. 6. Build and analyze development triangles (e.g., loss, count, allocated loss adjustment expenses (ALAE)) 7. Apply a tail factor 8. Use development triangles as diagnostic tools to identify changes and trends (e.g., loss and claim count, ratio of losses to premium, severity, ratios of loss and claim counts)	12
III	9. Calculate and evaluate unpaid loss estimation techniques (i.e., development/chain ladder, case outstanding development, expected losses, Bornhuetter-Ferguson, Cape Cod, frequency-severity, Berquist-Sherman, Benktander) 10. Assess the influence of operating changes on the estimation of unpaid losses (e.g., claims coding and/or claim-related expenses, claims processing, underwriting and policy provisions, marketing, reinsurance, treatment of recoveries such as deductibles and salvage and subrogation) 11. Adjust data and/or estimation techniques for changes in the internal and external environment (e.g., claims processes that result in shift in the adequacy of case outstanding or shift in settlement rates, change in mix of business, change in rate level, inflationary or legal environment) 12. Consider the impact of and adjust for the presence of large losses in a reserving analysis	12

IV	13. Calculate and evaluate the estimation techniques for recoveries (e.g., salvage and subrogation, reinsurance) 14. Calculate and evaluate the estimation techniques for allocated loss adjustment expenses 15. Calculate and evaluate the estimation techniques for unallocated loss adjustment expenses 16. Evaluate the results of a reserve analysis for adequacy and reasonableness using loss ratios, severities, pure premiums, frequencies, indicated unpaid losses, etc.	14
V	17. Monitor results for adequacy and reasonability including interim valuations (e.g., actual versus expected, roll forward analysis) 18. Communicate results and drivers of change to various stakeholders (internal management, investors, regulators) 19. Define and apply reinsurance concepts to calculate net, ceded, and gross losses 20. Utilize external information in a reserve analysis	4

References:

- Friedland, J.F., Estimating Unpaid Claims Using Basic Techniques, Casualty Actuarial Society, Third Version, July 2010.
- Actuarial Standards Board of the American Academy of Actuaries, “Actuarial Standard of Practice No. 43, Property/Casualty Unpaid Claim Estimates," adopted in 2007, updated for deviation language in 2011.

ELECTIVES

UADS-505	**Predictive Analytics using R-I**	**CREDITS: 4**
Course Category:	DSE	**Total Periods: 52**
Pre-requisite (If any): 10+2 School Level Mathematics		
Course Objectives: The student will understand and be able to do the following in R ● identify the business problem, how the available data relates to possible analyses, and use the information to propose an appropriate modeling approach.		

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- work with various data types, understand principles of data design, and construct a variety of common visualizations for exploring data.

Course Syllabus: At the end of the course, the student will be able to:

Unit	Description	Periods
I	1. Assess whether descriptive, predictive, and prescriptive analytics applies to a business problem. 2. Describe the characteristics of predictive modeling problems.	10
II	3. Explain the concepts of bias, variance, model complexity, and the bias-variance trade-off. 4. Translate a vague question into one that can be analyzed with statistics and predictive analytics to solve a business problem.	12
III	5. Consider factors such as available data and technology, significance of business impact, and implementation challenges to define the problem. 6. Assess what additional information or next steps would improve the ability to apply predictive analytics to a business problem. 7. Identify structured and unstructured data types.	12
IV	8. Identify the types of variables and terminology used in predictive modeling. 9. Evaluate effective data design with respect to time frame, sampling, and granularity. 10. Apply the key principles of constructing graphs.	14
V	11. Apply univariate data exploration techniques. 12. Apply bivariate data exploration techniques.	4

References:

- Regression Modeling with Actuarial and Financial Applications, Edward W. Frees, 2010, New York: Cambridge. ISBN: 978-0-521-13596-2
- An Introduction to Statistical Learning, with Applications in R, James, Witten, Hastie, Tibshirani, 2013, New York: Springer
- R for Everyone, 2nd ed. Lander, 2017, Boston: Addison-Wesley, ISBN 978-0-13-454692-6.
- Data Visualization: A Practical Introduction, Healy, 2018, Princeton University Press, ISBN 978-0-691- 18162-2

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UADS-506	Predictive Analytics using R-II	CREDITS: 3
Course Category:	DSE (P)	**Total Periods: 78**

Pre-requisite (If any): 10+2 School Level Mathematics

Course Objectives: The student will understand and be able to the following in R:

- transform data, including application of unsupervised learning techniques, to improve predictive modeling outcomes.
- select and validate a generalized linear model (GLM) and apply related modeling concepts as appropriate for a given business problem.
- apply tree-based models as appropriate for a business problem.

Course Syllabus: At the end of the course, the student will be able to:

Unit	Description	Periods
I	1. Create features from existing data that may add value. 2. Apply principal components analysis to transform data.	15
II	3. Apply K-means and hierarchical clustering to transform data. 4. Select and validate a GLM as appropriate for a business problem.	15
III	5. Apply offsets and weights as appropriate. 6. Interpret model coefficients, including interaction terms.	15
IV	7. Select appropriate hyperparameters for regularized regression. 8. Construct, prune, and validate regression and classification trees.	15
V	9. Apply bagging and random forests as appropriate. 10. Apply boosting as appropriate.	18

References:

- Regression Modeling with Actuarial and Financial Applications, Edward W. Frees, 2010, New York: Cambridge. ISBN: 978-0-521-13596-2
- An Introduction to Statistical Learning, with Applications in R, James, Witten, Hastie, Tibshirani, 2013, New York: Springer

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- R for Everyone, 2nd ed. Lander, 2017, Boston: Addison-Wesley, ISBN 978-0-13-454692-6.
- Data Visualization: A Practical Introduction, Healy, 2018, Princeton University Press, ISBN 978-0-691- 18162-2

UADS-605	**Advanced Topics in Predictive Analytics**	**CREDITS: 4**
Course Category:	DSE	**Total Periods: 52**

Pre-requisite (If any): 10+2 School Level Mathematics

Course Objectives: The student will understand and be able to

- work with data and models in an ethical and responsible manner.
- understand basic database calculations and manipulations and prepare data for predictive modeling applications.
- effectively communicate the results of applying predictive analytics, including the relationship between model input and output, to solve a business problem.

Course Syllabus: At the end of the course, the student will be able to:

Unit	Description	Periods
I	1. Apply a general ethical framework for working with data and models. 2. Discuss and comply with relevant standards of practice. 3. Discuss and comply with relevant regulations that apply to working with data and models.	10
II	4. Understand the basic structure of a data pipeline, including being able to perform the following tasks: a. Evaluate the quality of appropriate data sources for a problem b. Explain the difference between a database, data lake, and data warehouse c. Describe how different data structures can be used in different analytical tasks.	12

	5. Explain the basics concepts of database management, in particular, extract, transform, and load (ETL) operations. Demonstrate these skills by performing the following: a. Extract data from various file structures b. Subset, aggregate, summarize, and otherwise modify data for specific exploratory or modeling purposes c. Create data sets as a final product of extracting and transforming data that can be used in a predictive model. 6. Assess the accuracy and quality of data. a. Describe how data collection practices and assumptions affect data quality. b. Validate the data for internal consistency.	
III	7. Explain the terminology and structure of relational databases and be able to use common keys between collections of data to merge information from multiple sources. 8. Clean and organize data by performing each of the following: a. Check for outliers, both univariate and multivariate b. Handle missing data (including understanding the types of missing data) by selecting the appropriate action from deletion of the record, imputation, and adding a missing value flag. 9. Detect possible biases introduced when preparing data for a predictive model.	12
IV	10. Understand aspects of explainability, in particular: a. The connection between ethics and explainability b. Suitability, decomposability, algorithmic transparency, and post-hoc interpretability c. The difference between explainability and interpretability d. When a lack of explainability may be acceptable. 11. Communicate and justify a recommended analytics solution, including use as appropriate of: a. Variable importance plots b. Partial dependence plots c. Individual conditional expectation plots d. Shapley values e. Lift and gain charts. 12. Explain why a model is predicting certain values for certain records.	14
V	13. Perform data and model governance and develop model documentation in an ethical context. 14. Communicate in a clear and straightforward manner using common language that is appropriate for the intended audience. 15. Structure a report in an effective manner while following standards of practice for actuarial communication.	4

References:

- Frees, E. W., Meyers, G., & Miller, T. W. (2014). Predictive Modeling Applications in Actuarial Science: Volume 1, Predictive Modeling Techniques. Cambridge University Press.
- Kuhn, M., & Johnson, K. (2013). Applied Predictive Modeling. Springer.

UADS-703	Actuarial Practice I	CREDITS: 4
Course Category:	DSE	**Total Periods: 52**

Pre-requisite (If any): 10+2 School Level Mathematics

Course Objectives: The student will understand how to apply the underlying actuarial principles, mathematical and statistical techniques as well a business finance and economics concepts to a range of problems and issues in commercial and business environments, focussing on problems and issues in financial services, with application to wider domains and industries. This course is focused on specifying the problem.

Course Syllabus: At the end of the course, the student will be able to:

Unit	Description	Periods
I	1. Understand the clients that actuaries advise and the considerations to ensure that this advice meets the needs of stakeholders 2. Understand the main benefits and financial products that actuaries advise on	10
II	3. Understand the regulatory environment for an organisation 4. Understand the various external forces on an organisation and their impact	12
III	5. Understand the impact of the investment environment 6. Apply the Actuarial Control Cycle for an organisation	12

IV	7. Understand the principles of organisational risk governance 8. Identify risks and understand how risk classification can be used in the design of financial products or for actuarial problem solving 9. Understand and apply the main methods of measuring and monitoring risk that can be used	14
V	10. Understand the main factors to be considered in deciding on the contract design of financial products 11. Recognise the potential risks and issues in working with data and understand how to manage those issues and risks	4

References:

- CP1 – Actuarial Practice Study Guide, the Institute and Faculty of Actuaries (IFoA, UK).

UADS-704	**Actuarial Practice II**	**CREDITS: 4**
Course Category:	DSE	**Total Periods: 52**

Pre-requisite (If any): 10+2 School Level Mathematics

Course Objectives: The student will understand how to apply the underlying actuarial principles, mathematical and statistical techniques as well a business finance and economics concepts to a range of problems and issues in commercial and business environments, focussing on problems and issues in financial services, with application to wider domains and industries.This course is focused on developing a solution to the problem.

Course Syllabus: At the end of the course, the student will be able to:

Unit	Description	Periods

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I	1. Understand how models are used to solve actuarial or financial problems 2. Understand the considerations in setting the assumptions to be used for modelling an actuarial or financial problem	10
II	3. Understand the considerations for determining the cost of a financial product or benefit and the price charged to the consumer 4. Understand relevant investment management principles	12
III	5. Apply relevant approaches and techniques to the valuation of liabilities 6. Understand the relationship between assets and liabilities	12
IV	7. Understand stakeholder responses to risk and how they can be managed 8. Recognise the importance of capital for an organisation 9. Apply appropriate techniques to manage and maintain an organisations profitability	14
V	10. Analyse and understand performance and the considerations for an organisation to distribute surplus 11. Understand how an organisation can monitor its experience and manage risk	4

References:

- CP1 – Actuarial Practice Study Guide, the Institute and Faculty of Actuaries (IFoA, UK).

UADS-802	**Financial Economics**	**CREDITS: 4**
Course Category:	DSE	**Total Periods: 52**

Pre-requisite (If any): 10+2 School Level Mathematics

Course Objectives: The student will develop the knowledge of the theoretical basis of certain actuarial models and the application of those models to insurance and other financial risks.

Course Syllabus: At the end of the course, the student will be able to:

Unit	Description	Periods
I	1. Explain the mathematics and summary statistics of portfolios. 2. Perform mean-variance analysis 3. Explain the Capital Asset Pricing Model (CAPM). 4. Explain factor models.	10
II	5. Explain the three forms of the efficient market hypothesis (EMH). 6. Explain the main findings of behavioral finance. 7. Discuss the advantages and disadvantages of different measures of investment risk. 8. Conduct risk analysis. 9. Explain different methods to raise capital.	12
III	10. Describe the effect of capital structure on a company. 11. Describe the characteristics and terms of the main derivatives instruments (including forwards and futures). 12. Describe the characteristics and terms relating to both forward contracts and prepaid forward contracts. 13. Describe the characteristics and terms relating to both futures contracts and the associated margin accounts. 14. Explain the cash flow characteristics and terms relating to various options.	12
IV	15. Apply option strategies in a risk management context. 16. Explain the general properties of options that affect option prices. 17. Explain the concept of no arbitrage and the risk-neutral approach to valuing derivatives securities.Use the Binomial Option Pricing Model to calculate the value of European and American call and put options, along with the value of Asian and barrier options. 18. Explain the properties of the lognormal distribution and its applicability to option pricing 19. Explain the Black-Scholes Formula.	14
V	20. Explain the calculation and use of option price partial derivatives. 21. Explain how to control risk by using options in a hedging context. 22. Apply options and other derivatives in the context of actuarial-specific risk management.	4

References:

- Derivatives Markets (Third Edition), 2013, by McDonald, R.L., Pearson Education, ISBN: 978-0-32154-308-0
- Corporate Finance (Fourth Edition), 2017, by Berk, J. and DeMarzo, P., Pearson, ISBN: 978-0- 13408-327-8.

UADS-803	Financial Reporting	CREDITS: 4
Course Category:	DSE	**Total Periods: 52**

Pre-requisite (If any): 10+2 School Level Mathematics

Course Objectives: The student will

- Understand the key principles underlying IFRS 17 including the financial statement presentation.
- Become familiar with reinsurance accounting terminology and practice.
- Understand the professional responsibilities of an actuary as defined by standards of practice, regulators, and insurance laws for financial reporting from an international viewpoint

Course Syllabus: At the end of the course, the student will be able to:

Unit	Description	Periods
I	1. Understand key principles and concepts of IFRS 17	10
II	2. Understand the key components of IFRS 17 reporting	12
III	3. Describe the financial statement elements of IFRS 17 4. Describe Reinsurance and Risk Transfer	12
IV	5. Basics of Reinsurance Accounting 6. Reinsurance Reporting under IFRS 17	14
V	7. Explain the responsibilities of an actuary as defined by actuarial standards of practice, regulators, and insurance laws for financial reporting.	4

References:

- Caramagno, N.; Mamane, D.; and Neilson, L., “An Introduction to IFRS 17 for P&C Actuaries,” CAS Study Note, September 2021.
- EY, “Applying IFRS 17,” 2021

- EY, “Determining eligibility of the premium allocation approach under IFRS 17 for Non-Life insurers,” 2021.
- EY, “Good General Insurance (International) Limited: Illustrative disclosures to meet requirements of IFRS 17 and IFRS 9 for groups of insurance contracts accounted for under the PAA in IFRS 17,” 2020, Introduction, Note 6 (Insurance service expense), and Note 11 (Insurance and reinsurance contracts).
- International Actuarial Association, International Standard of Actuarial Practice
- International Actuarial Association, IAA Risk Book, 2016
- International Actuarial Association, IAA Professionalism Committee

SKILL ENHANCEMENT COURSES

UADS-105	**Excel Basics for Actuarial Practice**	**CREDITS: 1**
Course Category:	SEC	**Total Periods: 26**
Pre-requisite (If any): 10+2 School Level Mathematics		
Course Objectives: The student will understand and apply the critical steps to model data, document the work, create an audit trail, and effectively communicate to colleagues the approach, results and conclusions.		
Course Syllabus: At the end of the course, the student will be able to:		

Unit	**Description**	**Periods**
I	1. Use appropriate tools for checking, cleaning, restructuring and transforming data to make it suitable for analysis 2. Summarise data using appropriate analysis, descriptive statistics and graphical representation 3. Select and carry out appropriate statistical tests of reasonableness	8

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II	4. Make appropriate assumptions about the data provided 5. Repair corrupt or missing data 6. Plan and produce a spreUADSheet model to solve a specified problem 7. Create appropriate charts to support visual interpretation of the results	10
III	8. Perform checks on the intermediate and final results of a model 9. Comment on the reasonableness of the results from a model under different scenarios 10. Create a clear audit trail, which could be followed by a senior actuary and would enable the model to be worked on and corrected by a fellow student and includes: a. key assumptions b. description of data and model checks c. methodology d. reasonableness checks	8

References:

- Excel 2007 formulas. Walkenbach, J. Wiley, 2007. ISBN: 978-0470044025
- How to solve it: a new aspect of mathematical method. Polya, G. Penguin, new ed, 1990. ISBN 978-0691150956
- Mastering financial mathematics in Microsoft Excel: a practical guide for business calculations. 2nd ed. Day, A. Financial Times-Prentice Hall, 2010. ISBN: 978-0273730330
- SpreUADSheet check and control: 47 key practices to detect and prevent errors. O'Beirne, P. Systems Publishing, 2005. ISBN: 978-1905404001
- Successful ICT projects in Excel. 3rd ed. Heathcote, P. M. Payne-Gallway, 2002. ISBN: 978-1903112717

UADS-205	**Excel Advanced for Actuarial Practice**	**CREDITS: 1**
Course Category:	SEC	**Total Periods: 26**
Pre-requisite (If any): 10+2 School Level Mathematics		

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Course Objectives: The student will understand and apply the critical steps to model data, understand the documentation, maintain an audit trail, analyse the methods used and outputs generated and effectively communicate to colleagues the approach, results and conclusions.

Course Syllabus: At the end of the course, the student will be able to:

Unit	Description	Periods
I	1. Perform checks on the intermediate and final results of a model 2. Comment on the reasonableness of the results from a model under different scenarios	8
II	3. Draft a clear summary of the model and the results for a senior actuary to include: a. the data b. assumptions c. approach taken d. results e. conclusions f. suggested next steps to develop the model 4. Provide commentary on the results from a model appropriate for the target audience. This should cover, but not be limited to: a. Analytical comments on each stage of the results, including explaining patterns in the results and any unusual features b. An explanation of the differences between the results under the various strategies modelled	10
III	5. Identify possible next steps for the client having taken into consideration the initial modelling and the results, including: a. Possible enhancements to the model b. Additional modelling to provide additional information to support the project's objectives	8

References:

- Excel 2007 formulas. Walkenbach, J. Wiley, 2007. ISBN: 978-0470044025
- How to solve it: a new aspect of mathematical method. Polya, G. Penguin, new ed, 1990. ISBN 978-0691150956

- Mastering financial mathematics in Microsoft Excel: a practical guide for business calculations. 2nd ed. Day, A. Financial Times-Prentice Hall, 2010. ISBN: 978-0273730330
- SpreUADSheet check and control: 47 key practices to detect and prevent errors. O'Beirne, P. Systems Publishing, 2005. ISBN: 978-1905404001
- Successful ICT projects in Excel. 3rd ed. Heathcote, P. M. Payne-Gallway, 2002. ISBN: 978-1903112717

UADS-305	**Actuarial Communications - I**	**CREDITS: 2**
Course Category:	SEC	**Total Periods: 52**

Pre-requisite (If any): 10+2 School Level Mathematics

Course Objectives: The student will understand the basics of effective communication and be able to provide effective written communications of a technical nature to a non-technical audience. These communications need to convey appropriate information without unnecessary complexity, through the use of appropriate forms of communications, use of appropriate language and identification of the relevant issues to be addressed for the intended audience.

Course Syllabus: At the end of the course, the student will be able to:

Unit	Description	Periods
I	1. Identify key information that must be conveyed in order for a communication to meet the objectives, including: a. setting out any implications that may affect the intended recipients' decisions b. disclosing the extent of any uncertainty involved and any limitations in the information being communicated, if that uncertainty or those limitations may affect the intended recipients' decisions	20

II	2. Assess what information is not necessary and may, if included, detract from communicating effectively 3. Use numbers in a way that is appropriate for the intended recipient(s), given the objectives of the communication: a. Prepare numerical examples, where appropriate, by drawing on some or all of the available data or creating representative numeric examples (if suitable data is not provided) b. Prepare numerical information so that it is presented in an appropriate format (e.g. appropriate use of percentages, ratios, fractions) and level of detail (e.g. well-judged number of significant figures or decimal places)	16
III	4. Be able to justify the choice of information and content 5. Prepare an appropriate structure for a specific communication objective 6. Justify the choice of structure	16

References:

- Oxford Guide to Plain English (2013), Martin Cutts
- Reading from paper versus screens: a critical review of the empirical literature (1992), Andrew Dillon; https://www.ischool.utexas.edu/~adillon/Journals/Reading.htm
- Reading Content on Mobile Devices, Kate Meyer on December 11, 2016; https://www.nngroup.com/articles/mobile-content/
- Readability http://www.see-a-voice.org/marketing-ad/effective-communication/readability/
- Bullet points http://www.better-writing-tips.com/bullet-points.htm
- Plain language www.plainlanguagenetwork.org

UADS-406	**Actuarial Communications - II**	**CREDITS: 2**
Course Category:	SEC	**Total Periods: 52**

Pre-requisite (If any): 10+2 School Level Mathematics

Course Objectives: The student will understand the advanced concepts of effective communication and be able to provide effective written communications of a technical nature to a non-technical audience. These communications need to convey appropriate information without unnecessary complexity, through the use of appropriate forms of communications, use of appropriate language and identification of the relevant issues to be addressed for the intended audience.

Course Syllabus: At the end of the course, the student will be able to:

Unit	Description	Periods
I	1. Assess what terminology will be easily understood by the intended recipient(s) 2. Explain or define necessary technical terms at an appropriate level of detail for the intended recipient(s)	20
II	3. Justify the choice of language and terminology 4. Set out a draft communication for the intended recipient(s), including: a. sufficient explanatory steps b. effective explanation c. appropriate level of detail d. technically correct information that is not misleading	16
III	5. Set out information using simple and effective communication tools: • Visual presentation of numerical information a. Diagrams or pictures b. Bullet points 6. Justify the choice of communication tool(s) for presenting numerical information (e.g. data tables, bar charts, line charts, pie charts, scatter charts etc.)	16

References:

- Oxford Guide to Plain English (2013), Martin Cutts
- Reading from paper versus screens: a critical review of the empirical literature (1992), Andrew Dillon; https://www.ischool.utexas.edu/~adillon/Journals/Reading.htm
- Reading Content on Mobile Devices, Kate Meyer on December 11, 2016; https://www.nngroup.com/articles/mobile-content/

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- Readability http://www.see-a-voice.org/marketing-ad/effective-communication/readability/
- Bullet points http://www.better-writing-tips.com/bullet-points.htm
- Plain language www.plainlanguagenetwork.org

UADS-507	Course on Ethics and Professionalism	CREDITS: 2
Course Category:	SEC	**Total Periods: 26**

Pre-requisite (If any): 10+2 School Level Mathematics

Course Objectives: The student will understand the importance of ethics and professionalism and the requirements expected from an actuary in these lines.

Course Syllabus: At the end of the course, the student will understand:

Unit	Description	Periods
I	1. The Code of Professional Conduct and how to apply it in everyday work. 2. The importance of the applicability of the Code of Professional Conduct to members of the profession at all levels and areas of practice given the self-regulating nature of the actuarial profession. 3. What types of formal professional guidance are applicable to the Casualty Actuary, and which organizations are responsible for promulgating them.	8

II	4. The potential consequences of violations of the Code of Professional Conduct or other formal professional guidance. 5. Basic business communication skills and show familiarity with the skills necessary to communicate actuarial topics to actuarial and non-actuarial audiences. 6. Become familiar with common societal biases and their intersection with professional conduct.	10
III	7. The function of organizations that promulgate formal professional guidance. 8. How an actuary who violates professional standards may be counseled or disciplined. 9. How an actuary should handle an apparent material violation of formal professional guidance by another actuary. 10. The requirements for continuing professional education for the jurisdiction relevant to the Actuary's practice.	8

References:

- Code of Professional Conduct by CAS
- Code of Professional Ethics for Candidates by CAS
- Statement of Principles by CAS