هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission
اعتماد
NCAAA
2024
TPG-153

Course Specification

(Postgraduate Programs)

Course Title:	**Predictive Modeling in Finance and Insurance (2)**
Course Code:	**AFM 6215**
Program:	**Executive Master of Science in Actuaries and Financial Mathematics**
Department:	**Mathematics and Statistics**
College:	**Science**
Institution:	**Imam Mohammad Ibn Saud Islamic University**
Version:	**2025 – V1**
Last Revision Date:	**None**

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A. General information about the course:

1. Course Identification

1. Credit hours:					
3 (2 Lectures, 2 Lab, 0 Tutorial)					
2. Course type					
A.	☐University	☐ College	☐ Department	☐Track	☒ Others
B.	☒ Required		☐ Elective		
3. Level/year at which this course is offered: Level 3 / Year 2					
4. Course general Description:					
This course provides advanced insights into applying predictive modeling techniques in financial and insurance contexts. Building on foundational concepts, this course delves into generalized linear models (GLMs), unsupervised learning methods, and predictive frameworks for risk assessment and claim management. It emphasizes hands-on learning with real-world datasets to model pure premiums, detect fraud, analyze loss reserves, and design usage-based insurance plans. By integrating statistical modeling, machine learning, and actuarial applications, the course equips students with the technical expertise and analytical skills required for data-driven decision-making in finance and insurance industries.					
5. Pre-requirements for this course (if any):					
None.					
6. Co-requisites for this course (if any):					
None.					
7. Course Main Objective(s):					
The main objective of this course is to: • Understand and apply advanced GLMs for predictive modeling in insurance and finance. • Explore unsupervised learning techniques for clustering and fraud detection in insurance claims. • Develop frameworks for ratemaking, claim escalation, and risk assessment using predictive models. • Analyze and interpret predictive distributions of loss reserve estimates for capital management. • Implement usage-based insurance models using classification trees and statistical methods. • Foster collaboration and teamwork to solve complex modeling problems in a real-world context.					

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	60	100%
2	E-learning	0	0%
3	Hybrid • Traditional classroom • E-learning	0	0%

No	Mode of Instruction	Contact Hours	Percentage
4	Distance learning	0	0%

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	30
2.	**Laboratory/Studio**	30
3.	**Field**	0
4.	**Tutorial**	0
5.	**Others (specify)**	0
Total		**60**

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	**Perform and understand the application of GLMs in insurance data analysis, including frequency and severity modeling.**	**K1**	**Lectures, case study discussions, and Data-driven problem-solving sessions**	**Direct: Written exams, quizzes, and assignments analyzing real data.**
1.2	**Explain the principles of unsupervised learning and its application in claim fraud detection.**	**K2**	**Conceptual lectures, Case studies, and Group discussions**	**Direct: Quizzes, Midterm exams, final exams**
2.0	**Skills**			
2.1	**Apply GLMs to predict pure premiums and validate models using real-world datasets.**	**S1**	**Hands-on lab sessions, Guided exercises with datasets, and Software tools training**	**Direct: Practical lab evaluations, Project report.**
2.2	**Develop univariate and multivariate ratemaking frameworks using insurance data.**	**S2**	**Workshops, Group discussions, Model comparison exercises**	**Direct: Group project and Mid-term exam.**
2.3	**Analyze the predictive distribution of loss reserve estimates for capital management purposes.**	**S3**	**Data analysis workshops, Real-life problem-solving, and Simulation exercises.**	**Direct: Data analysis assignments, Practical exams.**

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
2.4	**Implement predictive models for usage-based auto insurance using Poisson models and classification trees.**	**S1, S3**	**Case study exercises, Software-based model implementation workshops.**	**Direct: Final project, Peer assessment.**
3.0	**Values, autonomy, and responsibility**			
3.1	**Perform effectively within teams to solve complex modeling problems in general insurance.**	**V1**	**Team-based projects, Role-playing activities, and Peer learning.**	**Direct: Group project evaluation, and Peer feedback.**
3.2	**Show and uphold ethical standards and professional responsibility in predictive modeling and actuarial practices.**	**V2**	**Ethics seminars, Reflective discussions.**	**Direct: Reflection essays, Scenario-based evaluations.**

C. Course Content

No	List of Topics	Contact Hours (Lectures, Tutorials, Labs)
1.	**Pure Premium Modeling using GLMs** Data characteristics, Exploratory data analysis, Frequency modeling, Severity modeling, Pure Premium, and Validation.	8
2.	**Applying Generalized Linear Models to Insurance Data** Comparing model forms, The datasets and model forms, Proof of Equivalence between pure premium model forms, The Gini Index	6
3.	**Generalized Linear Models as Predictive Claim Models** Review of loss reserving, Additional notations, GLM background, Advantages of GLMs, Diagnostics and Examples	6
4.	**Frameworks for General Insurance Ratemaking** Data, Univariate ratemaking framework, Multivariate ratemaking framework, Model comparison	4
5.	**Using Multilevel Modeling for Group Health Insurance Ratemaking: A case study** Data from the Egyptian market, Methods and models, Results	4
6.	**Clustering in General Insurance Pricing** Overview of clustering, Dataset for case study, Clustering methods, Exposure-Adjusted Hybrid (EAH) clustering method, Results	4
7.	**Application of Two Unsupervised Learning Techniques to Questionable Claims** Unsupervised learning basics, Simulated automobile PIP questionable claims data and the fraud issue, The questionable claims dependent variable problem, The PRIDIT method, Processing the questionable claims data from PRIDIT analysis, Computing RIDITS and PRIDITS, PRIDIT results for simulated PIP questionable Claims Data Trees and Random forests, Unsupervised learning with Random	12

	forests, Random forest visualization via Multi-dimensional scaling, Kohonen Neural Network	
8.	**The Predictive Distribution of Loss Reserve Estimates over a Finite Time Horizon** The CASS loss reserve database, Correlated chain ladder model, Predictive distribution of future estimates, Implications for capital management	4
9.	**Finite Mixture Model and Workers' Compensation Large-Loss Regression Analysis** DGLM and FMM, Data with Traditional Distribution analysis, Univariate and correlation analysis, Regression analysis	4
10.	**A Framework for Managing Claim Escalation Using Predictive Modeling** Loss development models, Additioan data for Triage models, Factor selection, Modeling method	4
11.	**Predictive Modeling for Usage-Based Auto Insurance** Usage-based auto insurance, Poisson model for usage-based auto insurance, Classification trees, Implementing UBI models with a traditional rating plan	4
Total		**60**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	**Quizzes, Mini projects, Real-life project**	**During the semester**	**30%**
2.	**Midterm**	**Week 8-9**	**30%**
3.	**Final Exam**	**Week 15**	**40%**

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	1. ***Predictive Modelling Applications in Actuarial Science - Volume II: Case Studies in Insurance***, EDWARD W. FREES, RICHARD A. DERRIG, GLENN MEYERS, 2016, Cambridge University Press.
Supportive References	2. **An Introduction to Statistical Learning with Applications in R -** Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, 2nd edition, Springer
Electronic Materials	3. **LMS – Blackboard**
Other Learning Materials	4. **Online supplements (Dataset and R-code) for Ref.1 (https://instruction.bus.wisc.edu/jfrees/jfreesbooks/PredictiveModelingVol1/glm/v2-chapter-1.html)**

2. Educational and Research Facilities and Equipment Required:

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	▪ Each class room should be equipped with a whiteboard and a projector. ▪ Laboratories should be equipped with computers and an internet connection.
Technology equipment (projector, smart board, software)	The rooms should be equipped with data show and Smart Board.
Other equipment (depending on the nature of the specialty)	None

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	During the semester and at the end of the course each student will complete two evaluation forms.
Effectiveness of Students assessment	Instructor	At the end of each semester the course instructor should complete the course report, including a summary of student questionnaire responses appraising progress and identifying changes that need to be made if necessary.
Quality of learning resources	Students	During the semester and at the end of the course each student will complete two evaluation forms.
The extent to which CLOs have been achieved	Instructor	At the end of each semester the course instructor should complete the course report, including a summary of student questionnaire responses appraising progress and identifying changes that need to be made if necessary.
Other	None	

Assessors (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	MATHEMATICS AND STATISTICS DEPARTMENT COUNCIL
REFERENCE NO.	20/1446
DATE	11/08/1446 (10/02/2025)