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

Course Specification

(Postgraduate Programs)

Course Title:	**Predictive Modeling in Finance and Insurance (1)**
Course Code:	**AFM 6213**
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 introduces students to advanced statistical and machine learning techniques used to forecast financial outcomes and assess risks in the insurance industry. Emphasizing practical applications, the course covers linear models, generalized linear models, regression analysis, frequency-severity models, and spatial and unsupervised learning approaches. Students will explore real-world datasets to design and evaluate predictive models that address complex actuarial and financial challenges.					
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: • Provide a comprehensive understanding of predictive modeling techniques, including linear and generalized linear models, and their applications in finance and insurance. • Explore regression methods for different dependent variable types, such as categorical, count, and continuous, in various business contexts. • Teach students to apply frequency-severity modeling for financial and insurance claims analysis. • Introduce advanced topics like longitudinal data modeling, spatial modeling, and fat-tailed regression techniques. • Develop proficiency in unsupervised learning techniques such as factor analysis and clustering for extracting meaningful insights from complex datasets. • Foster the ability to critically evaluate and compare predictive models, ensuring their validity and applicability in real-world scenarios. • Promote teamwork, ethical conduct, and professional communication in the development and presentation of predictive modeling projects.					

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	0	0%

No	Mode of Instruction	Contact Hours	Percentage
	• E-learning		
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	**Demonstrate understanding of predictive modeling techniques, including generalized linear models and their applications in actuarial science.**	**K1, K2**	**Lectures, case study discussions, and guided readings.**	**Direct: Written exams, quizzes, and assignments analyzing real data.**
1.2	**Explain the theoretical foundation of linear regression, logistic regression, and frequency-severity models in financial and insurance contexts.**	**K1, K2**	**Interactive lectures, problem-solving sessions, and case studies.**	**Direct: Midterm exams, final exams, and report-based assessments.**
2.0	**Skills**			
2.1	**Apply regression techniques (e.g., linear, logistic, and Poisson) to real-world financial and insurance datasets for predictive analysis.**	**S1,S3**	**Practical labs with software like R/Python, case-based learning.**	**Direct: Project work, lab reports, and practical exams.**
2.2	**Distinguish the appropriate modeling techniques for various types of dependent variables, such as**	**S1,S2**	**Hands-on modeling workshops, guided assignments, and group activities.**	**Direct: Assignments involving data analysis and case study reports.**

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	categorical and count data.			
2.3	**Analyze data using unsupervised learning methods such as factor analysis and clustering to extract meaningful insights.**	**S3**	**Data visualization workshops, tutorials, and interactive problem-solving.**	**Direct: Data analysis project, presentations, and software-based evaluations.**
2.4	**Design and evaluate predictive models for frequency-severity and spatial data applications in finance and insurance.**	**S1,S2**	**Advanced workshops, project-based learning, and simulations.**	**Direct: Project-based evaluation, oral presentations, and peer reviews.**
3.0	**Values, autonomy, and responsibility**			
3.1	**Perform effectively in teams to implement predictive modeling solutions and present findings.**	**V1**	**Group projects, peer learning activities, and team discussions.**	**Direct: Peer assessments, group project evaluations, and presentations.**
3.2	**Show ethical considerations and professional conduct in the interpretation and communication of predictive modeling results.**	**V2**	**Case study analysis focusing on ethical dilemmas and discussions on professional standards.**	**Direct: Ethics-focused essays, reflective journals, and oral defenses.**

C. Course Content

No	List of Topics	Contact Hours (Lectures, Tutorials, Labs)
1.	**Introduction** Predictive Modeling and Insurance Company Operations, A Short History of Predictive Modeling in Actuarial Science	2
2.	**Overview of Linear Models** Linear Model Theory (Linear Regression) with Examples, Case Study (MEPS Diabetes Data)	4
3.	**Regression with Categorical Dependent Variables** Coding Categorical Variables, Modeling a Binary Response, Logistic Regression Model, Probit and Other Binary Regression Models, Models for Categorical Dependent Variables (Ordinal and Nominal)	6
4.	**Regression with Count-Dependent Variables** Poisson Distribution, Poisson Regression, Heterogeneity in the Distribution, Zero-Inflated Distribution	4
5.	**Generalized Linear Models** Introduction to Generalized Linear Models, Exponential Family of Distributions, Link Functions, Applications and Comparing models	6
6.	**Frequency and Severity Models**	6

	Sampling and the Generalized Linear Model, Frequency-Severity Models, Application: Massachusetts Automobile Claims	
7.	**Longitudinal and Panel Data Models** Intrduction, Linear and Nonlinear models	4
8.	**Linear Mixed Models** Mixed Models in Actuarial Science, Linear Mixed Models (with examples)	4
9.	**Credibility and Regression Modeling** Credibility and the LMM Framework, Numerical Examples, Theory versus Practice	4
10.	**Fat-Tailed Regression Models** Transformation, GLM, Regression with Generalized Distributions, Median Regression	6
11.	**Spatial Modeling** Exploratory Analysis of Spatial Data, Spatial Autoregression, Average Claim Size Modeling, Hierarchical Model for Total Loss	6
12.	**Unsupervised Learning** Factor and Principal Components Analysis, Cluster Analysis, Applications with Datasets (Indices, SimClus)	8
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 I: Predictive Modeling Techniques***, EDWARD W. FREES, RICHARD A. DERRIG, GLENN MEYERS, 2014, 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/index.htm)**

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)**