King Fahd University of Petroleum and Minerals
Department of Mathematics
STAT 413 Syllabus, Term 252 (2025-26)
Instructor: Dr. M Riaz (riazm@kfupm.edu.sa)

Course Title: Statistical Modelling

Course Credit Hours: 3-0-3

Textbook: A. Agresti. Foundations of Linear and Generalized Linear Models, Wiley (2015).

Reference Books:
- Linear Regression Models - Applications in R by John P. Hoffman, Chapman & Hall/CRC (2021).
- Introduction to Linear Regression Analysis by Montgomery, Peck and Vinning, 6th edition, Wiley (2021).
- An Introduction to Statistical Learning with Applications in R by G. James, D. Witten, T. Hastie and R. Tibshirani, 2nd Edition, Springerlink 2021.

Software Package: R language and R studio.

Course Objective:
- Introduce statistical tools for modeling.
- Develop models that learn from the observed data.
- Implement statistical models based on the statistical analysis.

Description: Simple and Multiple Linear Regression, Polynomial Regression, Splines; Generalized Additive Models; Hierarchical and Mixed Effects Models; Bayesian Modeling; Logistic Regression, Generalized Linear Models, Discriminant Analysis; Model Selection.
Prerequisite: MATH 405

Course Learning Outcomes: Upon successful completion of the course, a student should be able to
- Develop statistical models to describe the observed data using computational tools.
- Describe different statistical tools to analyze data.
- Measure the effectiveness of models.
- Present effectively through oral presentation and written reports outcome of the models.
- Interpret the statistical models.

Grading Policy:

Activity	Weight
Classwork (quizzes, active class participation, attendance, bonuses, etc.)	20%
Project	20%
Midterm Exam	25%
Final Exam (Comprehensive)	35%

Coverage Plan

No	List of Topics	Contact hours
1	**Statistical Learning** • What is Statistical Learning • Descriptive Analysis • Probability and Sampling Distributions • Inferential Analysis • Introduction to R language	3
2	**Simple Linear Regression** • Estimating the Coefficients • Assessing the Accuracy of the Coefficient Estimates • Assessing the Accuracy of the Model	3
3	**Multiple Linear Regression** • Estimating Regression Coefficients • Some Important Questions • Other Considerations in the Regression Model • Qualitative Predictors • Extensions of the Linear Model • Model fitting using R	6
4	**Polynomial Regression** • Introduction to Polynomial Regression • Step Functions • Basis Functions • Polynomial Regression Fitting using R	3
5	**Linear and Non-Linear Spline Fitting** • Regression Splines • Piecewise Polynomials • Constraints and Splines • Smoothing Splines • Spline Fitting using R	3
6	**LOGIT and PROBIT models** • Models with a Binary Response Variable • Logistic Regression Models • Probit Regression Models • Estimating the Parameters in a Logistic Regression Model • Interpretation of the Parameters in a Logistic Regression Model • Fitting LOGIT and PROBIT Models using R	6
7	**Poisson Regression** • Introduction to Poisson Regression • Application of Poisson Regression using R	3
8	**Generalized Linear Models** • Link Functions and Linear Predictors • Parameter Estimation and Inference in the GLM • Prediction and Estimation with the GLM • Residual Analysis in the GLM • Using R to Perform GLM Analysis	6
9	**Model Building Techniques** • Best Subset Selection • Stepwise Selection • Choosing the Optimal Model • Model Selection Using R	6

10	**Bayesian Modeling**
	   • Testing and Comparing Models
	   • Making the Most Accurate Predictions
	   • Interpreting Results Quickly & Effectively
		3

11	**Non-Linear Regression**
	   • Linear and Nonlinear Regression Models
	   • Origins of Nonlinear Models
	   • Nonlinear Least Squares
	   • Transformation to a Linear Model
	   • Parameter Estimation in a Nonlinear System
	   • Statistical Inference in Nonlinear Regression
	   • Examples of Nonlinear Regression Models Using R
		3

	Total	45

Academic Integrity: All KFUPM policies regarding ethics and academic honesty apply to this course.

Excuse: In case a student misses an exam (Midterm or Final) for a legitimate reason (such as medical emergencies), he/she must bring an official excuse from Students Affairs. Otherwise, he/she will get a score of zero in the missed exam.

Cheating and Plagiarism: Cheating or any attempt at cheating by use of illegal activities, techniques and forms of fraud will result in a grade of DN in the course along with reporting the incident to the higher university administration for further action. Cheating in exams includes (but is not restricted to):
➢ Looking at the papers of other students.
➢ Talking to other students.
➢ Using mobiles, smart watches or any other electronic devices.

Mobiles: The use of mobiles is *strictly banned* during class. Students are required to keep their phones off/silent and placed inside their pockets during the class timings.

Project: Project Guidelines will be uploaded to Blackboard, and guidelines for the report will also be posted there. The instructor will form project groups.

Letter Grades: The letter grades will follow a grading curve, which depends on the average of all students enrolled in the course.

Attendance Notes:
Students are expected to attend all lectures.
➢ If a student misses a class, he/she is responsible for any announcement made in that class.
➢ After being warned twice by the instructor, a DN grade will be awarded to any student who accumulates
    o 6 unexcused absences (20%), or,
    o 10 excused and unexcused absences (33%)

Use of AI Tools (like ChatGPT):
➢ Students are encouraged to use AI responsibly as a learning aid for understanding lecture content, practicing statistical concepts, and preparing for exams.
➢ However, the use of AI during quizzes and exams is *strictly prohibited* and will be treated as an academic integrity violation.