

King Fahd University of Petroleum and Minerals

Department of Mathematics

Dhahran, Saudi Arabia

STAT-310: Linear Regression (Term 221)

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Course Objectives: The main objectives of this course are

- To present the simple and multiple linear regression models.
- To explain the method of least square estimation and associated hypothesis tests.
- To discuss the assumptions of regression model and related corrections.
- To demonstrate the model building techniques.

Textbook: *Introduction to Linear Regression Analysis* by Montgomery, Peck and Vinning, 6th edition, Wiley (2021).

Learning Outcomes: At the end of the term a student should be able to

- Define the linear regression models
- Describe the use of indicator variable(s) in regression models
- Develop the hypothesis test and confidence intervals for unknown parameters
- Analyze the adequacy of models and suggest transformation or weighting corrections
- Build a regression model using different variable selection techniques
- Interpret the fitted regression model

Assessment*

Activity	Weight
Class Participation (project, homework, quizzes, attendance, etc.)	15%
First Major Exam	25%
Second Major Exam	25%
Final Exam (<i>Comprehensive</i>)	35%

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

Cheating and Plagiarism: This course is composed of individual assignments. It is important that your individual assignment be completed with your own efforts instead of copying it from your fellow student. KFUPM instructors follow “zero tolerance” approach with regard to cheating and plagiarism. During examinations (quizzes and major exams) cheating or any attempt of cheating by use of illegal activities, techniques and forms of fraud will result in a grade of F in the course along with reporting the incident to the higher university administration.

Important Notes:

- ✓ Only University issued excuses will be accepted.
- ✓ **Attendance** on time is very important. A DN grade will be awarded to any student who accumulates more than 20% unexcused absences or more than 33% excused and unexcused absences of lectures and labs.
- ✓ Use of **mobile** is banned during the class.
- ✓ **Homework** problems will be assigned later.

Weekly Schedule

Date	Section	Topics (Tentative)
Week 1	Chapter 1 <i>Sections 1-4</i>	Chapter 1: INTRODUCTION Regression and model building, data collection, uses of regression, role of the computer
Week 2	Chapter 2 <i>Sections 1-5</i>	Chapter 2: SIMPLE LINEAR REGRESSION Simple linear regression model, least - squares estimation of the parameters, hypothesis testing on the slope and intercept, interval estimation in simple linear regression, prediction of new observations
Week 3	Chapter 2 <i>Sections 6-12</i>	Coefficient of determination, a service industry application of regression, some considerations in the use of regression, regression through the origin, estimation by maximum likelihood, case where the regressor X is random
Week 4	Chapter 3 <i>Sections 1-4</i>	Chapter 3: MULTIPLE LINEAR REGRESSION Multiple regression models, estimation of the model parameters, hypothesis testing in multiple linear regression, confidence intervals in multiple regression
Week 5	Chapter 3 <i>Sections 5-8</i>	Prediction of new observations, a multiple regression model for the patient satisfaction data, hidden extrapolation in multiple regression
Week 6	Chapter 3 <i>Sections 9-11</i>	Standardized regression coefficients, multicollinearity, why do regression coefficients have the wrong sign?
Week 7	Chapter 4 <i>Sections 1-3</i>	Chapter 4: MODEL ADEQUACY CHECKING Introduction, residual analysis, press statistic
Week 8	Chapter 4 <i>Sections 4-5</i>	Detection and treatment of outliers, lack of fit of the regression model

Week 9	Chapter 5 <i>Sections 1-5</i>	Chapter 5: TRANSFORMATIONS AND WEIGHTING TO CORRECT MODEL INADEQUACIES Introduction, variance - stabilizing transformations, transformations to linearize the model, analytical methods for selecting a transformation, generalized and weighted least squares
Week 10	Chapter 6 <i>Sections 1-7</i>	Chapter 6: DIAGNOSTICS FOR LEVERAGE AND INFLUENCE Importance of detecting influential observations, leverage, measures of influence: cook's D, measures of influence: DFFITS and DFBETAS, a measure of model performance, detecting groups of influential observations, treatment of influential observations
Week 11	Chapter 7 <i>Sections 1, 2 and 4</i>	Chapter 7: POLYNOMIAL REGRESSION MODELS Introduction, polynomial models in one variable, models in two or more variables
Week 12	Chapter 8 <i>Sections 1-2</i>	Chapter 8: INDICATOR VARIABLES General concept of indicator variables, comments on the use of indicator variables
Week 13	Chapter 9 <i>Sections 1-5</i>	Chapter 9: MULTICOLLINEARITY Introduction, sources of multicollinearity, effects of multicollinearity, multicollinearity diagnostics, methods for dealing with multicollinearity
Week 14	Chapter 10 <i>Sections 1-4</i>	Chapter 10: VARIABLE SELECTION AND MODEL BUILDING Introduction, computational techniques for variable selection strategy for variable selection and model building, case study: Gorman and Toman asphalt data
Week 15		Catchup and Project Presentations