

ROWAN UNIVERSITY
Department of Mathematics

Master Syllabus

STAT 02350 Regression Analysis (3sh)

CATALOG DESCRIPTION:

This course will provide a comprehensive introduction to simple and multiple linear regression. Students will learn the principles of least squares estimation, model diagnostics and remedies, through simple linear regression. Students will extend what they learned to the techniques of multiple regression, including models for numerical predictors, and numerical and categorical predictors; analyses, model diagnostics, multicollinearity, and transformations of variables; and model selection techniques. Students will be exposed to the matrix foundations of regression and introduced to nonlinear regression, such as logistic and Poisson regression. Concepts taught in this course will be enhanced through the use of appropriate statistical software.

OBJECTIVES:

As a result of learning in this course, students will be able to

- Fit simple and multiple linear regression models to data sets.
- Evaluate the adequacy of regression models via residual analysis.
- Compute by hand the parameters of (simple) regression models and/or interpret the output of statistical software to find regression parameters.
- Phrase and test meaningful hypotheses on regression model parameters.
- Evaluate regression models with regards to necessity of transformation of either predictor(s) or response and apply such transformations.
- Identify leverage and influence points in simple and multiple regression applications.
- Fit polynomial regression models in one or two variables and find set of predictor values that optimizes the response.
- Fit regression models to data sets that include one or more categorical predictors. Create indicator variables to code for the categorical predictors. Interpret software output for different methods of contrast coding in multiple regression. Phrase hypotheses for a specific application and create contrasts with which these hypotheses can be tested.
- Understand the relationship between regression and ANOVA models.
- Conduct variable selection by exhaustive search of the space of all predictor subset models. Compare appropriate criteria to evaluate the subset models.
- Apply variable selection algorithms using software and interpret the results.
- Apply the methods learned in the course to the analysis of a data set and present the results of the analysis both in an oral presentation and in the form of a summary paper.

PREREQUISITES:

(Undergraduate level MATH 01210 Minimum Grade of C- and Undergraduate level STAT 02260 Minimum Grade of C-) or Undergraduate level STAT 02320 Minimum Grade of C- or Undergraduate level STAT 02284 Minimum Grade of C- or Undergraduate level STAT 02280 Minimum Grade of C-

CONTENT:

(1) Linear Regression with One Predictor Variable

- ☐ Numerically describes the relationship between two variables using **simple linear regression**
- ☐ Inferences in Regression Analysis
- ☐ Analysis of Variance Approach to Regression Analysis
- ☐ Diagnostics and Remedial Measures
- ☐ Diagnostics for residuals and Transformations
- ☐ Matrix approach to simple linear regression analysis

(2) Multiple regression models I

- ☐ Introduction model building
- ☐ General linear regression in matrix terms
- ☐ Estimation of regression coefficients
- ☐ Inferences about regression parameters
- ☐ Estimation of mean response and prediction of new observation
- ☐ Diagnostics and remedial measures

(3) Multiple Regression II

- ☐ Extra sums of squares
- ☐ Uses of extra sums of squares in tests for regression coefficients
- ☐ Summary of tests concerning regression coefficients
- ☐ Coefficients of partial determination
- ☐ Multicollinearity and its effects
- ☐ Qualitative predictors

(4) Regression models for quantitative and qualitative predictors

- ☐ Polynomial regression models
- ☐ Interaction regression models
- ☐ Modeling interactions between quantitative and qualitative variables

- ☐ More complex models
- ☐ Building the regression model
- ☐ model selection and validation
- ☐ Different criteria for model selection
- ☐ Forward selection, Backward elimination & Stepwise

(5) Model Building/ Diagnostics

- ☐ Partial regression plots/ adjusted variable plots.
- ☐ Studentized residuals
- ☐ Identifying outlying or extreme observation.
- ☐ Leverage and Influence points
- ☐ Multicollinearity

(6) More regression

- ☐ Weighted least squares.
- ☐ Ridge regression
- ☐ Smoothing
- ☐ Logistic regression
- ☐ Nonlinear and other types of regression (if time permits)

SUGGESTED TEXTS:

- *Kutner, M. et al. Applied Linear Statistical Models 5th Edition*
- A Modern Approach to Regression with R, by Sheather.
- Applied Regression Analysis, by Dielman
- An Introduction to Statistical Learning, by James, Witten, Hastie, and Tibshirani.

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