Southern Connecticut State University
School of Arts and Science
Department of Mathematics

Mathematics 326 – Regression Analysis

I. Description.

Catalog Description: Model building and analysis focusing on regression. Topics include Method of Least Squares, ANOVA, Model Assumptions, Inferences about parameters, Residual Analysis, Model adequacy, Dummy Variables, Non-linear terms, Pitfalls and Limitations

Departmental Description: The course is meant to be a continuation of a statistical class, which covered statistical inference. Some theory will be presented, but the class should focus on applying statistical model building techniques and analysis of the models. A software package is required..

II. Credit.

Mathematics 326 carries 3 semester-hours of University credit.

III. Prerequisites.

Mathematics 326 has a prerequisite of MAT 320 (Probability and Statistics I) or MAT 221 (Intermediate Applied Statistics).

IV. Purpose.

To introduce statistical model building methods and the tools to critically analyze the models. Students should be exposed to the wide-spread use of statistical modeling, in fields of physical and social sciences and the strengths and limitations of these models.

V. Format.

Mathematics 326 will follow a lecture format with homework assignments. Use of a computer package is required. A computer lab session is recommended.

VI. Outline. (assuming 42 hours less 6 hours for exams/review in addition to the Final exam for a total of 36 hours)

A. Review of Basic Probability and Statistics: (2 Hours 6%)

1. Treatment of Data Frequency Distributions, Histograms
2. Descriptive Measures: Central Tendency, Variation, Percentiles.
3. Conditional Probability
4. Confidence Intervals for one sample
5. Hypothesis Testing for one sample

B. Statistical Inference of Two Samples (4 Hours 11%)

1. Populations means
2. Matched Paired Inferences
3. Population Proportions
4. Population Variances

C. Linear Regression Analysis (4 hours 11%)

1. Method of Least squares
2. ANOVA Table Analysis
3. Inferences based on Estimators
4. Residual Analysis

D. Multiple Regression: (18 hours 50%)

1. Matrices and Regression
2. Model Assumptions
2. Inferences about the parameters
3. Checking the utility and adequacy of the model
4. Using the model for estimation and prediction
5. Interactive and quadratic models
6. Sequential procedures for model building
7. Non-Linear Regression
8. Pitfalls of Regression

E. Analysis of Variance: (4 hours = 11%)

1. Designed Experiments
2. Completely Randomized Design
3. Multiple Comparisons
4. Block Designs
5. Factorial Designs
6. Analysis of Covariance

F. Categorical Data Analysis: (4 hours = 11%)

1. Introduction
2. Chi-Square Tests
3. Logistic Regression

VII. Objectives.

Students in MAT 326 should achieve several objectives. These objectives, provided by the Mathematics Department and National Council of Accreditation of Teacher Education (NCATE), are listed below. Also listed are the topics from Section VI which satisfy the objectives.

Mathematics Department Objectives.

1. Demonstrate that they can model and solve problems that represent a wide variety of realistic applications. (Applied Math Goal 1, Topics B, C, D and E)
2. Appreciate the beauty, joy, and challenge in mathematics and experience mathematics as an engaging field with contemporary open questions. (Department Goal 8, Topics C, D and E)
3. Think analytically and critically and be able to formulate problems, solve them, and interpret their solutions. (Department Goal 9, Topics B, C, D and E)

NCATE Objectives

1. Problem solving: provide opportunities for your candidates to mature in their problem solving abilities. (NCATE 1.1, Topics A though E).
2. Connections: provide opportunities for your candidates to demonstrate an understanding of mathematical relationships across disciplines across connections within mathematics. (NCATE 1.4, Topics C, D and E)
3. Apply numerical computation and estimation techniques and extend them to algebraic expressions. (NCATE 1.5.2, Topics B, C, D and E)
4. Use both descriptive and inferential statistics to analyze data, make predictions and draw conclusions. (NCATE 1.5.6, Topics B, C, D and E)
5. Understand the concept of a random variable, distribution function, and the difference between theoretical and simulated probability and to apply the concepts to real world situations. (NCATE 1.5.7, Topics B)
6. Use mathematical modeling to solve problems from fields such as natural sciences, social sciences, business, and engineering. (NCATE 1.5.12, Topics B, C, D and E)

Students successfully completing MAT 326 will be able:

To create, utilize, analyze and interpret simple linear models using the method of least squares (Regression).
To create, utilize, analyze and interpret complex regression models, involving quadratic ordered terms or higher, dummy variables and interaction terms.
To calculate, and interpret hypothesis tests for population parameters such as the model coefficients.
To design, analyze and interpret experiments for the difference between means, using ANOVA, including Randomized Block Designs and ANCOVA.
To calculate and interpret categorical data analysis, such as Independence and Goodness of Fit tests and Logistic Regression.
To identify and explain the limitations of the statistical procedures they use.

VIII. Sample Texts.

Neter John, Wasserman William, and Kutner Michael. Applied Linear Statistical Methods, second edition. Richard Irwin, Homewood, IL, 1985.

Kleinbaum David, Kupper Lawrence, Muller Keith and Nizam Azhar. Applied Regression Analysis and other Multivariate Methods. Duxbury Press, Albany, NY 1998.

IX. Waiver Policy.

Mathematics 326 can be waived by a departmental examination.

X. Bibliography.

Draper Norman and Smith Harry. Applied Regression Analysis. Wiley, New York, NY 1998.

Mendenhall William and Sincich Terry. A Second Course in Regression Analysis. Pearson Prentice Hall, Upper Saddle River, NJ 2003.

Ott R. Lyman and Longnecker Michael. An Introduction to Statistical Methods and Data Analysis. Duxbury Press, Albany, NY 2001.

XI. Prepared.

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XII. Preparer.

Raymond Mugno