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

Mathematics 342 – Statistical Decision Making

I. Catalog and Departmental Description.

MAT 342 is a second course in statistics and focuses on analyzing data, interpreting results and critically analyzing underlying assumptions. The course is meant to be a continuation of a statistical class that covered probability, descriptive statistics and statistical inference. A software package is required.

II. Purpose.

MAT 342 will introduce statistical techniques for analyzing data and the strengths and limitations of these procedures. MAT 342 will illustrate proper design of experiments, regression analysis, categorical data analysis and significance testing.

III. Credit.

(A) MAT 342 carries 3 semester-hours of University credit.

(B) MAT 342 satisfies the University's Liberal Education Tier 3 requirement

IV. Liberal Education Program.

This course satisfies the LEP requirements for a Tier 3 Capstone Course.

(A) It utilizes the Tier 1 Competencies of Quantitative Reasoning , Technological Fluency and Written Communication at the advanced level. Quantitative Reasoning will be utilized by calculation of probabilities, calculation of statistics and development of mathematical models. Technological Fluency will be utilized by the requirement and extensive use of statistical software such as R or SAS. Written Communication will be utilized by several statistical reports that students will write.

(B) MAT 342 could address several Areas of Knowledge, especially Natural World I, Natural World II, or Social Structure, Conflict and Consensus, since all make extensive use of the course's statistical methods. The theme for this proposed class is pharmaceutical drug development and testing. This will address the Area of Knowledge of Natural World II: Life in the Environment. This theme for MAT 342 will be used to illustrate the power and limitations of statistical procedures such as hypothesis testing, ANOVA and regression. Specifically, clinical trials and dose-response experiments will be explored in depth.

(C) MAT 342 will discuss the values of Ethical Judgment, Human Diversity and Rational Thought. See section VIII for specific details.

V. Prerequisites.

Mathematics 342 has a prerequisite of MAT 107 Elementary Statistics or MAT 221 Intermediate Applied Statistics or MAT 320 Probability and Statistics or ECO 221 Statistics for Economics and Business.

VI. Format.

Mathematics 342 will follow a lecture format with homework assignments. Use of a computer package is required. A computer lab session is recommended.

VII. Technology.

A statistical package is required. R is strongly recommended.

VIII. LEP Tier III

An example of MAT 342 would be using pharmaceutical drug development as a theme. This theme would be used to discuss the values of Ethical Judgment, Human Diversity and Rational Thought. Ethical Judgment will be addressed in the discussions of allocation of subjects during clinical trials, requiring individuals to be vaccinated, and toxicity studies performed on animals. Human Diversity will be addressed in the use of ethnicity and race as a factor in clinical trials and observational studies. Rational Thought will be addressed in statistical methodology and analysis of statistical methods and their effects on inferences and conclusions. Because the statistical methods of this class are wide-ranging, the topic may change at the discretion of the instructor.

IX. Course Objectives.

Students in MAT 342 should achieve several objectives.

A. Calculate and interpret confidence intervals and hypothesis tests for a single population mean and single population proportion
B. Calculate and interpret confidence intervals and hypothesis tests for two population means and two population proportions
C. Design, analyze and interpret experiments for the difference between means, using one-way ANOVA and non-parametric alternatives
D. Calculate and interpret multiple comparison techniques
E. Calculate and interpret tests for independence, including the Chi Squared Test and the Fisher Exact Test
F. Calculate and interpret the relative risk and odds ratio for categorical data
G. Create simple non-linear regression models and use them for prediction
H. Evaluate the utility of linear and non-linear regression models
I. Utilize Logistic Regression to model dichotomous response data and interpret the results
J. Identify and explain the limitations of the statistical procedures they use

X. Laboratory

The Mathematics Department maintains a computer laboratory that should be used to enhance the class.

XI. Outline. (Based on a 15 week semester, plus Final Exam period)

A. Review of Random Variable: (1 week)

1. Random Variables in general, pdf's expected values, variances
2. Binomial Random Variables
3. Normal Random Variables

B. Statistical Inference for One Parameter (1.5 weeks)

1. Confidence Intervals for one mean
2. Confidence Intervals for one proportion
3. Hypothesis Testing for one mean
4. Hypothesis Testing for one proportion
5. Type I and Type II errors

C. Statistical Inference of Two Parameters (3 weeks)

1. Two Populations means
2. Matched Paired Inferences
3. Population Proportions
4. Population Variances
5. Non-parametric Alternatives

D. Design of Experiments (3.5 weeks)

1. Types of Experiments
2. One-Factor Analysis of Variance
3. Multi-comparison techniques
4. Randomized Block Designs
5. Two-Factor Analysis of Variance
6. Non-parametric Alternatives

E. Categorical Data Analysis (3 weeks)

1. Two-Way Contingency Tables (Bivariate data)
2. Chi-Squared tests for independence
3. Fisher Exact Test
4. Relative Risk and Odds Ratios
5. Multiple Contingency Tables

F. Linear Regression Analysis (3 weeks)

1. Method of Least squares and correlation
2. ANOVA Table Analysis and Assumptions
3. Inferences based on Estimators
4. Evaluating the model including Residual Analysis
5. Transformations
6. Non-Linear Regression
7. Logistic Regression
8. Pitfalls of Regression

VIII. Sample Texts.

Statistics, By James T. McClave and Terry Sincich, Prentice Hall, New Jersey, 2012 (11th Edition).

Practicing Statistics: Guided Investigations for the Second Course, By Shonda Kupier and Jeffrey Sklar, Pearson, Boston 2013.

Introductory Statistics: A Problem Solving Approach, By Steven Kokoska, Freeman Press, New York, 2013.

IX. Waiver Policy.

Mathematics 342 cannot be waived by a departmental examination.

X. Bibliography.

Brody, Tom, Clinical Trials: Study Design, Endpoints and Biomarkers, Drug Safety, and FDA and ICH Guidelines, London, Academic Press, 2011.

Devore Jay, Probability and Statistics for Engineers, Thompson, Toronto 2004.

Fleiss Joseph, Statistical Methods for Rates and Proportions, Wiley, New York, 1981.

Friedman Lawrence, Curt D. Furberg, Fundamentals of Clinical Trials, New York, Springer, 2010.

McClave James T. and Terry Sincich, Statistics, Prentice Hall, New Jersey, 2012 (11th Edition).

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

XIII. Approval

By Departmental Curriculum Committee: TBD
By Department: TBD