Course Outline for: MATH 2080 Statistical Modeling

A. Course Description:

1. Number of credits: 3
2. Lecture hours per week: 3
3. Prerequisites: MATH 1080 (C- or better); OR
   MATH 1090 (C- or better); OR
   MATH 1095 (C- or better)
4. Corequisites: None
5. MnTC Goals: Goal 4 Mathematical/Logical Reasoning

Statistical model building will be introduced. The topics of simple linear regression, non-linear models, logistic regression, and multiple regression models will be included. The mathematical applications of the content will involve topics that are found in a variety of disciplines such as physical science, biology, economics, finance, and data science.

B. Date last reviewed/updated: April 2024

C. Outline of Major Content Areas:

1. Brief review of sampling distributions, confidence intervals and the logic of hypothesis tests.
2. Scatterplots and correlation coefficient for two quantitative variables.
3. Simple linear regression; confidence intervals and hypothesis testing regarding the slope, intercept, and correlation coefficient for a linear model. D. Prediction and confidence intervals.
4. Exponential, power and logistic regression models.
5. Variable transformations in model creation.
6. Multiple linear regression and variable transformations.
7. Assumptions of non-collinearity, normality of residuals, and homoscedasticity.
8. An introduction to artificial neural net models (optional).

D. Course Learning Outcomes:

Upon successful completion of the course, the student will be able to:

1. Construct confidence intervals, prediction intervals, and hypothesis tests for a variety of situations including simple linear regression. (Goals 2a, b; 4b, d)
2. Interpret confidence intervals, prediction intervals, and hypothesis tests for a variety of situations. (Goals 2a, b, c, d; 4a, b, d)
3. Select various non-linear models appropriate to a given problem, and to choose appropriate transformation of variables. (Goals 2a, b, c, d; 4a, b, d)
4. Interpret correlation coefficients and coefficients of determination for various models. (Goals 2a; 4b, d)
5. Describe the assumptions of non-collinearity, normality of residuals, and homoscedasticity. (Goals 4a, b, d)

6. Create simple linear regression models, non-linear models, and multiple regression models by using appropriate software. (Goals 2a, b, c; 4a, b, d)
7. Interpret the results of a linear, non-linear or multiple regression model for its appropriateness and usefulness in a given context. (Goals 2a, b, c; 4a, b, d)
8. Explain the appropriateness of different modeling methods for particular situations. (Goals 2a, c, d; 4a, b, d)

E. Methods for Assessing Student Learning:

Methods for assessment may include, but are not limited to, the following:

1. In-class testing
2. Take-home testing
3. Assignments
4. Quizzes
5. Attendance
6. Group or individual projects
7. Research

F. Special Information:

Instructors are encouraged to use large data sets in the assessments and in-class examples, including data sets that require manipulation before model creation can be performed. Instructors are encouraged to use software packages such as R. Additional work could be done in Python, Microsoft Excel or web-based software.