

**NVCC COLLEGE-WIDE COURSE CONTENT SUMMARY**  
**MTH 244 - PROBABILITY AND STATISTICS II (3 CR)**

**Course Description**

Uses calculus, computer packages and matrix methods to develop the theory of simple and multiple regression using matrices, analysis of variance, non-parametric and Chi-square procedures. Lecture 3 hours per week.

**General Course Purpose**

This course is designed to provide students with the ability to analyze data and make inferences based on that data. The course sequence is primarily intended for students in statistics, computer science, economics, engineering and the sciences.

**Entry Level Competencies**

Prerequisites: MTH 243 - "Probability and Statistics I" and MTH 285 - "Linear Algebra" or equivalent.

**Course Objectives**

As a result of the learning experiences provided in this course, the student should be able to:

- A. give point estimates for the mean, the difference between two means, a proportion, and the difference between two proportions, the variance, and the ratio of two variances,
- B. give confidence intervals for each of the parameters in part A,
- C. test hypotheses for each of the parameters in part A,
- D. perform Chi-square goodness of fit tests and Chi-square test for independence,
- E. fit a linear regression line to data,
- F. determine confidence intervals for the least squares estimators,
- G. given data, set up a multiple regression model in matrix notation,
- H. explain the relationship between regression models and systems of inconsistent equations,
- I. estimate the regression coefficients using matrix notation,
- J. find confidence intervals for the parameters of a multiple regression model,
- K. use a computer package to estimate the parameters and confidence intervals for the parameters of a multiple regression model,
- L. perform a on-way analysis of variance,
- M. perform an analysis of variance using a randomized complete block design,
- N. perform an analysis of variance using a two factor model,
- O. use a computer package to perform the above ANOVAs.

**Major Topics To Be Included**

- A. Estimation Theory
  - 1. Means
  - 2. Difference between two means in paired and independent sampling
  - 3. Proportion
  - 4. Difference between two proportions
  - 5. Variance
  - 6. Ratio of Variances
- B. Tests of Hypotheses
  - 1. Type I and type II errors
  - 2. One and two tailed tests
  - 3. Tests concerning means and variances
  - 4. Sample size considerations

5. Tests concerning proportions
  6. Chi-square goodness-of-fit
  7. Chi-square tests for independence
- C. Simple Linear Regression and Correlation
1. Setting up the model
  2. Solution using calculus (minimizing error sum of squares)
  3. Properties of least squares estimators
  4. Confidence intervals and tests of hypotheses
  5. Correlation
- D. Multiple Linear Regression
1. Review of pertinent linear algebra
    - a. Projection mappings
    - b. Normal equations
  2. Use of normal equations to estimate the parameters
  3. The variance-covariance matrix
  4. Estimation of confidence intervals for the parameters
  5. Estimation of confidence intervals for the mean response
  6. Estimation of confidence intervals for a single response
  7. Coefficient of multiple determinations
  8. Use of computer packages
- E. Analysis of Variance
1. One-way classification
  2. Test for the equality of several means
  3. Comparing sets of treatments in blocks
  4. Two factor models
  5. Two factor models with interaction
  6. Use of computer packages

**Extra Topics (optional)**

- A. More matrix theory
- B. Nonparametric statistics
1. Wilcoxon-rank sum test
  2. Sign test
  3. Runs test
  4. Wilcoxon test for paired observation
  5. Spearman rank correlation
- C. Analysis of Variance
1. Random effects models
  2. Analysis of covariance
- D. Estimation properties of a good statistic
1. Unbiasedness
  2. Minimum variance
  3. Maximum likelihood
  4. Sufficiency, consistency