WINONA STATE UNIVERSITY

COLLEGE OF SCIENCE AND ENGINEERING

DEPARTMENT OF MATHEMATICS AND STATISTICS

**Course Outline – STAT 305**

**Title:** Biometry

**Number of Credits:** 3

**Catalog Description:** An introductory course of statistical applications to the biological sciences. Data reduction, sampling, techniques of estimation, hypothesis testing, and model verification procedures are included. Diversity indices, techniques of species sampling, and other specific biometric methods will be covered. Prerequisite: MATH 112 – Applied Precalculus or higher. **Note:** Cannot be used as a MATH or STAT elective for mathematics, mathematics education, or statistics majors.

**Possible Textbooks:**

* *An Introduction to Biostatistics* by Glover & Mitchell (2002), Waveland Press
* *Biostatistics: A Foundation for Analysis in Health Sciences* by Daniel (2005), Wiley
* *Biostatistical Analysis 3rd Edition* by Zar (1996), Prentice Hall

**Topics Covered:**

1. The Design of Formal Studies
   1. The research question/hypothesis and the predictor, response, and population of interest
   2. The role of random samples; population vs. sample
   3. Types of studies
      1. Experiments and the role of randomization/blocking
      2. Observational studies and effects of confounding
2. Data Displays and Summary Statistics
   1. For categorical variables
      1. Bar charts
      2. Mosaic plots
      3. Frequency distributions
      4. Relative frequencies
   2. For numeric variables
      1. Histograms and boxplots
      2. Measures of central tendency: mean/average, median
      3. Measures of variation: variance, standard deviation, interquartile range, coefficient of variation
      4. Measures of location: percentiles/quantiles, quartiles, z-scores
      5. Robustness
   3. Contingency tables
      1. Conditional probabilities
      2. Bayes’ Rule: medical screening tests
      3. Relative risk, difference between proportions, and odds ratios
      4. Relationships in r x c tables
   4. Scatterplots
      1. Measures of correlation
      2. Simple linear regression
      3. Two-variable regression
   5. Density and cumulative distribution function plots
3. Introduction to Sampling Distributions
   1. Statistics vs. parameters
   2. Sampling errors
   3. The importance of random samples
   4. Central Limit Theorem
4. Confidence Interval Estimation
   1. One-sample confidence intervals
      1. Inference about a single proportion
      2. Inference about a single mean
   2. Two-sample confidence intervals
      1. Inference about a difference between two proportions
      2. Inference about relative risks and odds ratios
      3. Inference about a difference between means
   3. Paired-sample confidence interval, involving inference about a mean difference
5. Hypothesis Testing
   1. The logic of hypothesis tests
      1. Translating a research question into null and alternative hypotheses
      2. p-values; Type I and Type II errors
   2. Interpretation of statistical results
      1. Association vs. casual connection
      2. Description of a sample vs. inference about a population
      3. Statistical significance vs. practical significance
   3. Common one-sample tests
      1. For a single proportion
      2. For a single mean
      3. Nonparametric procedures
   4. Common two-sample tests
      1. For a difference between proportions
      2. For a difference between means
      3. Mann-Whitney-Wilcoxon Test
   5. Paired-sample tests
      1. McNemar’s Test
      2. Paired-sample t-test
      3. Wilcoxon signed-rank test
   6. Tests for contingency tables
      1. Fisher’s Exact Test for 2x2 tables
      2. Chi-square test
   7. Comparing several population means
      1. One-way ANOVA
      2. Multiple Comparison tests
      3. Kruskal-Wallis
      4. Two-way ANOVA
   8. Regression analysis
      1. Simple linear regression
      2. Multiple linear regression
      3. Logistic regression
   9. Critical reading of published papers in the biological sciences

**Listing of Sections to be Covered:** Not applicable to this course, since there is no standard textbook. Chosen sections of any text should correspond to the topics outlined above.

**Remarks:** None.

**Approximate Pace of Coverage:** Not Applicable.

**Method of Instruction:** Methods may include lecture, case studies, discussion, group work, problem solving sessions, computer sessions, and discussion of computer output.

**Evaluation Procedure:** Assessments will vary in style and may include written exams, quizzes, homework assignments, and group work.

**Minnesota Transfer Curriculum:** None

**MnSCU Learning Outcomes:**

* This course will promote a student’s ability to use mathematical models to describe real-world phenomena and to solve real-world problems, as well as understand the limitations of models in making predictions and drawing conclusions. All of the problems we will encounter are real-world, biological examples. A successful student will be able to analyze, write conclusions, and discuss limitations of these real-world examples.
* This course will promote a student’s ability to organize data, communicate essential features of the data, and interpret the data in a meaningful way. A successful student will be able to organize data, communicate essential features of data both numerically and graphically, and provide interpretations/conclusions of statistical problems.
* This course will promote a student’s ability to perform critical analysis of scientific and other research. This course will improve your understanding of experimental designs and a successful student will be able to carry out statistical hypothesis tests. A successful student will also acquire the skills to go beyond a simple analysis and provide implications, interpretations, and conclusions for a given problem.
* This course will promote a student’s ability use appropriate technology to describe and solve quantitative problems. A successful student will be able to use the statistical software package JMP for data analysis.

**Possible Computer Software:**

* JMP

**Last Revised:** Spring 2012 by the Statistics Subgroup.