**Biostatistics 611: Intermediate Statistical Analysis I**

**Instructor:**  T. Mark Beasley, Ph.D.  
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**Prerequisites:** Intermediate skills in mathematics (but calculus and linear algebra are not required); permission of instructor

**Target audience:** Students in MSPH in Clinical Research, other physicians, nurses, and health professionals; PhD students in other SOPH Departments

**Introduction:** The course will offer intermediate-level instruction in the principles of biostatistics and the analysis of clinical and epidemiological data.

**Objectives:** Students will gain a thorough understanding of basic analysis methods, elementary concepts, statistical models and applications of probability, commonly used sampling distributions, parametric and nonparametric one and two sample tests, confidence intervals, applications of analysis of two-way contingency table data, simple linear regression, and simple analysis of variance. Students are taught to conduct the relevant analysis using current software such as the Statistical Analysis System (SAS).

**Format:** Faculty will present material in didactic sessions; students will be responsible for exercises and critical readings, and analysis using computer systems.

**Credit hours:** 3

**Evaluation:** Homeworks, Midterm and Final examinations.

**Texts:** W.W. Daniel: Biostatistics – A Foundation for Analysis in the Health Sciences. Wiley

**Disability Student Services**  
Any student with a disability that may need accommodations in order to successfully complete all requirements for this course should visit the Office of Disability Support Services, located in Room 516 of the Hill University Center (205-934-4205). This office is responsible for registering students and ensuring the University’s compliance with Section 504 of the Rehabilitation Act. Once registered, this office will then inform faculty members of all courses in which the student is enrolled, of the student’s status, and the specific nature of any accommodations required. Any student requiring such accommodation should discuss this with the course master and assure that the appropriate correspondence is sent from the Office of Disability Support Services.
Syllabus and Proposed Timeline

Weeks 1 - 2
I. Introduction and background
   A. Course parameters
      1. What is statistics
      2. Dealing with uncertainty
      3. Universe/parameters versus sample/estimates
   B. Types and function of data variables

II. Simple descriptions of data and graphical methods
   A. Data frequencies
      1. For categorical variables
      2. For continuous variables
   B. Numerical descriptions of data
      1. Measures of central tendency
      2. Measures of dispersion
      3. Other measures (skewness and kurtosis)
      4. Measures of Relationship
   C. Simple graphs
      1. histogram,
      2. frequency polygons,
      3. cumulative distribution polygon
      4. box and whisker plot
      5. scatter diagram
      6. line plot

III. Producing simple statistics using computer programs
   A. Overview of computer statistical packages
   B. Introduction to SAS/JMP (SPSS)
      1. Simple data entry
      2. Documenting data files
      3. Producing simple descriptive statistics and graphs

Homework #1

Weeks 3-4
IV. Probability Concepts
   A. Objective vs. Subjective Probability
   B. Calculating Probabilities
   C. Marginal vs. Conditional Probabilities (AND, OR, AT LEAST Rules)
   D. Bayes’ Theorem

V. Introduction to specific distributions
   A. Normal distribution
   B. The standard normal distribution
   C. Binomial distribution
Weeks 5-6
VI. Introduction to Estimation
   A. Review of universe/parameter and sample estimate
   B. Normal distribution
      1. Estimation of the mean (µ)
      2. Sampling distribution
         a. The t-distribution
         b. Standard error
         c. Confidence Intervals
      3. Estimation of the standard deviation (σ)
   C. Binomial distribution
      1. Estimation of p
      2. Sampling distribution
         a. Standard error
         b. Confidence Intervals

Homework #2

Weeks 7-9
VII. Introduction to Hypothesis testing
   A. Types of errors
   B. The one-sample t-test
      1. Performing the test
      2. Relationship to estimation
      3. Statistical power
      4. Sample size calculations
   C. The paired t-test
      1. Introduction and restructuring the problem
      2. Relationship to the one-sample t-test
   D. The independent t-test
      1. Introduction of test parameter
      2. Standard error of test parameter (equal variances)
      3. Performing the test
      4. Power/sample size
   E. Nonparametric Methods
      1. The sign test
      2. The Wilcoxon signed rank test
      3. The Wilcoxon rank-sum test
      4. Comparison of parametric vs. nonparametric methods

Homework #3

Week 9  MIDTERM EXAMINATION and Preparation
Weeks 11-12

VIII. Introduction to one-way analysis of variance
   A. Introduction to the problem — what do we do if there are more than 3 groups?
   B. Introduction to sums of squares, and partitioning of error
   C. The F statistic and distribution
   D. Multiple comparison procedures

Weeks 13 – 14

IX. Contingency Table
   A. 2x2 table
   B. Chi-Square test
      1. Motivation and approach
      2. The test statistic
      3. The Chi-square distribution
      4. Assumptions and alternative approaches
         a. Odds Ratio
         b. Estimation and standard error
   C. The rxc table Chi Square test

Homework #4

FINAL EXAMINATION

Course Work and Evaluation
♦ Homework #1 (10%)
♦ Homework #2 (15%)
♦ Homework #3 (15%)
♦ MIDTERM EXAMINATION (20%)
♦ Homework #4 (15%)
♦ FINAL EXAMINATION (Finals Week 25%)

Grading
A  = 90% of total points
B  = 80% of total points
C  = 65% of total points
F  < 65% of total points