Syllabus MATH 1531, BIOL 1531

3 hours lecture, 1 hour laboratory; 3 credits (4 contact hours)

Course Content: Foundational concepts of statistics applied to problems in biology, human health, and epidemiology, including the processing of quantitative data, probability distributions, sample estimation, hypothesis testing and power analysis, correlation and regression, analysis of variance, and nonparametric tests. Introduction to and use of the R statistical software and programming language for data analysis.

Prerequisite: MATH 1011 or MATH 1012 (Precalculus with or without recitation)
Objectives of Course/Learning Outcomes:

Students will learn to learn how to:

- Describe data using measures of central tendency and variation
- Apply basic probability rules and distributions
- Design statistically sound experiments
- Learn various statistical inference techniques and be able to select appropriate methods for specific data sets and scientific purpose
- Apply the course materials to real-life examples and data sets
- Carry out and interpret data analysis using R

Course Outline:

Week 1	• Describing and exploring data (Chapters 2-3 in the text) • Introduction to R • What is statistics? Introduction to the concept of hypothesis testing
Week 2	• Introduction to R continued • Basic Concepts of Probability (Chapter 4)
Week 3	• Basic Concepts of Probability continued (Chapter 4), including Bayes' Theorem • Discrete Probability Distributions (Chapter 5)
Week 4	• Normal probability distributions, the central limit theorem (Chapter 6)

Week 5	• Estimating parameters, determining sample sizes • Constructing confidence intervals, understanding margins of error (Chapter 7)
Week 6	• Basic concepts of hypothesis testing (Chapter 8), including establishing null and alternative hypotheses, selecting significance level, identifying appropriate test statistic, finding p-values and critical values or confidence intervals • Hypothesis testing continued: Type 1 & Type II errors, power of a hypothesis test, finding the right sample size (Chapter 8)
Week 7	• Hypothesis testing continued: testing a claim about a population proportion, testing a claim about a mean or standard deviation (including Student's t distribution, chi-square test) (Chapter 8) • Inferences from two samples, independent versus dependent samples (Chapter 9)
Week 8	• Inferences from two samples continued (Chapter 9) • Midterm
Week 9	• Correlation: basic definitions, correlation does not imply causality, testing for significance (Chapter 10) • Regression: basic concepts (Chapter 10)
Week 10	• Regression continued: prediction intervals, multiple regression, logistic regression (Chapter 10)
Week 11	• Goodness-of-fit, contingency tables and test of independence, Fisher's exact test (Chapter 11)

Week 12	• Analysis of variance: One-way and two-way ANOVA (Chapter 12)
Week 13	• Nonparametric tests (Chapter 13), including Wilcoxon signed-rank and rank-sum tests
Week 14	• Wrap-up and discussion: choosing an appropriate statistical test • Review

Method of evaluation: 11 homework assignments (which include coding in R) (35% of final grade), one midterm exam (30% of final grade), one final exam (30% of final grade). Faithful attendance and productive participation are required (5% of final grade).

Required text: Statistics for the Biological and Health Sciences, 2nd edition, by Triola, Triola, and Roy

Required software: R (free)