**STATISTICS 205**
**ELEMENTARY STATISTICS FOR THE BIOLOGICAL AND LIFE SCIENCES**

**BULLETIN INFORMATION**
STAT 205 - Elementary Statistics for the Biological and Life Sciences (3 credit hours)
**Course Description:**
Introduction to fundamental statistical methods with applications in the biological and life sciences. Includes descriptive statistics; probability; one and two-sample models for population means; contingency tables (including relative risk, odds ratios, case-control studies, and estimation of sensitivity and specificity); linear regression; logistic regression; aspects of survival analysis, and ANOVA.
Prerequisites: MATH 111 or higher or consent of department

**SAMPLE COURSE OVERVIEW**
This course gives students in biology, ecology, public health, pharmacy, nursing and other life sciences a non-calculus based introduction to the application of modern statistical methods including descriptive and inferential statistics. Statistics is a foundational research tool within the biological and life sciences. Topics include descriptive statistics, probability, and inference for statistical models including: one and two sample problems for continuous and discrete data, 2 x 2 tables (independence; comparing odds ratios, relative risks, and differences in proportions; diagnostic testing), one-way ANOVA, linear and logistic regression, and survival analysis.

**ITEMIZED LEARNING OUTCOMES**
<u>**Upon successful completion of Statistics 205, students will be able to:**</u>
1. Interpret common graphical displays and summary statistics from data
2. Apply the rules of probability to solve basic problems
3. Demonstrate understanding of one and two sample problems, including confidence intervals, hypothesis testing, sample size calculation, power, and checking assumptions,
4. Demonstrate understanding of basic ideas underlying one-way analysis of variance,
5. Demonstrate understanding of the simple linear regression model: least squares estimation, the normal-errors model, confidence interval and hypothesis tests for slope,
6. Demonstrate understanding of the logistic regression model and its use for analyzing Bernoulli outcomes with a continuous predictor
7. Demonstrate understanding of 2 x 2 contingency tables: relative risk, odds ratio, difference in proportions, case-control studies, independence, sensitivity, specificity, and prevalence, predictive values positive and negative, Simpson's paradox and the Cochran-Mantel-Haenszel test
8. Demonstrate ability to carry out common statistical methods on a variety of real biological data sets in a standard computing package such as R or Excel.

**SAMPLE REQUIRED TEXTS/SUGGESTED READINGS/MATERIALS**
1. Statistics for the Life Sciences, 4th Ed., by Samuels, M.L., Witmer, J.A., and Schaffner, A.A., Addison Wesley, 2011.

**SAMPLE ASSIGNMENTS AND/OR EXAM**
1. **Homework**:   Homework assignments will be posted on the course website each week, except exam weeks. Most of these homework assignments involve the analysis of real data, including choice of appropriate statistical model; validation of modeling assumptions through graphical and more formal means; and a coherent, concise write-up of findings relative to the scientific question being addressed by the data.

2. **Exams**: Two in-class midterm exams will be given, as well as a final exam. These exams will be based on textbook problems assigned as homework, but not collected.

**SAMPLE COURSE OUTLINE WITH TIMELINE OF TOPICS, READINGS/ASSIGNMENTS, EXAMS/PROJECTS**

**Class 1:**     Course expectations, statistics, evidence, random sampling, introduction to statistical computing. Sections 1.1, 1.3,& notes.

**Class 2:**     Variables, frequency distributions. Sections 2.1, 2.2

**Class 3:**     Measures of center, boxplots. Sections 2.3, 2.4

**Class 4:**     Relationships between variables, spread. Sections 2.5, 2.6

**Class 5:**     Statistical inference, introduction to probability. Sections 2.8, 3.2

**Class 6:**     Probability rules. Sections 3.3, 3.2

**Class 7:**     Continuous and discrete random variables. Sections 3.4, 3.5

**Class 8:**     Binomial & normal distributions. Sections 3.6, 4.1, 4.2

**Class 9:**     Normal distribution (continued). Sections 4.3, 4.4

**Class 10:**     Sampling distribution of sample mean. Sections 5.1, 5.2.  Review for Exam I

         **Exam I**: Material on Lectures 1 through 9.

**Class 11:**     Estimation, SE of the mean, CI for the population mean, study design. Sections 6.2, 6.3

**Class 12:**     CI for difference in means. Sections 6.6, 6.7

**Class 13:**     Two-sample hypothesis tests: permutation & t tests. Sections 7.1, 7.2

**Class 14:**     Test vs. CI, Type I & II errors, power, association vs. causation.  Sections 7.3, 7.4, 7.9

**Class 15:**     One-sided tests, sample size planning, Wilcoxon-Mann-Whitney test.  Sections 7.5, 7.7, 7.10

**Class 16:**     Paired observations. Sections 8.2, 8.4

**Class 17:**     CI for proportion.  Sections 9.2, 9.4. Review for Exam II

    **Exam II**: Material on Lectures 10 through 16.

**Class 18:**     Chi-square tests for independence. Sections 10.2, 10.3, 10.4

**Class 19:**     Difference in proportions, relative risk, odds ratios, case-control studies, Sections 10.7, 10.9

**Class 20:**     Stratified 2 x 2 tables, Cochran-Mantel-Haenszel statistic, Simpson's paradox. Notes

**Class 21:**     Analysis of variance. Sections 11.2, 11.3, 11.4, 11.5

**Class 22:**     Linear regression I. Sections 12.1, 12.2

**Class 23:**     Linear regression II. Sections 12.3, 12.4

**Class 24:**     Logistic regression. Section 12.8 & notes

**Class 25:**     Sensitivity, specificity, ROC curves.  Notes

**Class 26:**     Survival analysis.  Notes.

**Final Exam according to university exam schedule**: Material on lectures 17 through 26.