BIOMETRICS Lecture Topics for Spring 2009
Biology 454/554 and MATH 354E
DR. WYNGAARD & DR. JAHAN
Chapters refer to Whitlock & Schulter except where indicated

This course discusses the role of statistics in biological research and interpretation of biological phenomena. The course will cover topics of sampling, regression analysis, correlation, tests of hypotheses, commonly observed distributions in natural populations, nonparametric tests, and ANOVA. A major emphasis of the course is to dissect the statistical analysis of biological publications. In order to fully comprehend the statistical analysis of those publications, students will review approximately half a dozen publications from different fields of biology.

Lecture topics:
Week 1
Definition of Biometry, How Statistics Revolutionized Science in the 20th Century Revolution:
Historical Development and Contribution of Biometry to Methodology of Research and Interpretation of Phenomena;
Descriptive versus inferential statistics
Statistical Inference (Ch 1.1, 1.2); Samples and Populations
Sample statistics versus population parameters
Assign reading about Salk vaccine and questions its dependence upon the scientific method

Statistics and the Scientific Method (Ch 6.1, 6.2)
Sampling Biological Populations (Ch 1.3)
Making Observations and Measurements – Defining Biological Variables
Class Discussion of Salk Vaccine in the context of the Scientific Method

Week 2
Building a Probability Distribution, the notion of randomness
Laws of Probability ((for review Ch 5.3, 5.4, 5.5, 5.6)
Probability distributions (discrete & continuous)
Class Discussion of Homework on Probability

Distributions Commonly Observed in Natural Populations
Binomial distributions (Ch 7.1, 7.2; 7.3, 7.5), Power of the Test
Type I and Type II Errors (Ch 6.3, Article by Feinberg)

Week 5
Chi Square distributions (Ch 8.1, 8.2, 8.3, 8.4)
Poisson distributions (Ch 8.6. 8.7)

Week 6
  Contingency analysis: associations between categorical data (9.1, 9.2, 9.3, 9.4, 9.5, 9.6)

Week 7 & 8
  Normal distributions and Standard Normal Distributions (Ch 10)
    Means, Standard Deviations, Standard Errors
    Use of standard normal table
    Central limit theorem
    Sampling distributions of sample mean and sample proportion
    Normal approximation for binomial distribution
    Detecting deviations from normality (Ch 13)
    Graphical methods: Normal probability plot
    Tests for normality

Week 9 and later
  Student's t distributions (Ch 11.1, 11.2, 11.3, 11.4, 12.1, 12.2, 12.3, 12.4) - 2 sample t
  test, paired t test (Ch 12.2)
  Nonparametric tests – (13.3) Mann Whitney U test (13.4, 13.5)

Simple Linear Correlation (Ch 16.1, 16.2, 16.3, 16.4)

Regression Analysis (Ch 17.1, 17.2**,** 17.3, 17.4, 17.5)

One Way Analysis of Variance (ANOVA) (Ch 15, 15.1, 15.2, 15.3, 15.4, 15.5)
  Multiple comparison tests

Replication and Pseudoreplication in Biological Experiments
  Statistical Transformations Commonly Used on Biological Data (Ch 17.6; Supplement from
  Dowdy & Wearden, 2001)

Ethical issues: the Sibley-Alquist controversy; fraudulent electronic images
  Assign Sibley & Alquist papers; Background Information about Cot Curves and
  Phylogenetic Trees.