American University of Beirut
Faculty of Arts and Sciences
Department of Biology
BIOLOGY 310
QUANTITATIVE METHODS IN BIOLOGY,
Spring 2009-10

Intsructor: R.A.Sadek
Prerequisite: Consent of instructor.

Course description

This course starts from elementary concepts of statistics even though students may have already completed some introductory course in statistics,. It starts with descriptive statistics and data summary. Normal distributions are described followed by the basic concepts of hypothesis testing as well as types i and II errors. This paves th way for one-sample, two-sample and multi-sample hypotheses and tests. Non-parametric tests for these hypotheses are also covered. There is also a comprehensive coverage of linear regression and correlation as well as curve-fitting techniques for various non-linear relationships. The last part covers goodness-of-fit tests which are then applied to binomial and Poisson distributions.

The lab sessions include the intensive use of Microsoft Excel and SPSS whereby all the procedures and functions related to the statistical tests covered in the course are applied as appropriate.

Learning Objectives:

By the end of the course the student is expected to be able to:

- Demonstrate an ability to formulate hypotheses and design experiments,
- analyze data, understand and interpret data or results generated by his own research work and that of other researchers.
- use and apply major statistical techniques and methods that are necessary to analyze scientific data and make meaningful and valid conclusions.
- Become able to use certain computer programs and applications to organize, input and analyze data, output results and interpret them.

Resources Available to Students:

Main textbook: Zar J.H. 2010 – *Biostatistical Analysis.* 5th (International) Edition. Pearson Prentice Hall , N.J.

Additional reference Books:

Daniel, W.W., 2005 - *Biostatistics, a Foundation for Analysis in the Helath Sciences.* 8th Ed. Wiley.

Keen, R.E. and J.E. Spain, 1992 – *Computer Simulation in Biology, A Basic Introduction*. Wiley-Liss, Inc. N.Y.

Sokal R.R. and F.J. Rohlf, 1969 – *Biometry*. W.H. Freeman & Co.

Computer Software used: Excel, SPSS.

Course Contents

Week	Topics covered
1	Introduction: Types of data; frequency distributions; Hypotheses and testing. Populations and sampling, Measures of central tendency, dispersion and variability.
2	Normal Distribution: Symmetry, kurtosis; Principles of hypothesis-testing.
3	One sample Hypotheses: two-tailed, one-tailed tests, t-tests
4	Two-Sample hypotheses: Differences between means, t-tests; non-parametric tests. Mann-Whitney tests.
5	Paired-Sample Hypotheses: t-tests; testing by ranks, Wilcoxon test, McNemar test. Multi-sample Hypotheses: Analysis of variance; single factor ANOVA; Non-parametric ANOVA, Kruskall-Wallis tests by ranks.
6	Multiple Comparisons: Tukey test, Newman-Keuls test, Dunnett's test, Scheffe's test.
7	Two-factor ANOVA: tests with equal and unequal replications; ANOVA Models I, II and III. Experimental designs: Randomized Blocks, Repeated-Measures; Non-parametric ANOVA, Friedman's analysis by ranks, Cochran's Q test. Multiway factorial ANOVA: Experimental Designs: Blocked and repeated measures; Equal and unequal replications. Nested designs and ANOVA
8	Regression Analysis: simple linear regression; t-tests and ANOVA for regressions coefficients;; Comparing regression equations.
9	Data Transformations: Logarithmic, Square root, Arcsine and other transformations.
10	Data transformations, Curve-fitting
11	Correlation: Simple linear correlation., Comparisons; Rank correlation: Spearman's and Kendall's rank correlation coefficients; Concordance.
12	Multiple regression and correlation: computations and ANOVA; Partial correlation. Polynomial regression
13	Testing for Goodness of fit: Chi-square tests, heterogeneity; Kolmogorov-Smirnoff test; Contingency tables.
14	Binomial probabilities and Distributions: Binomial test, Sign test, Fisher Exact test. Logistic regression. Testing for Randomness: Poisson distributions.

Grading Criteria

- **Lab exercises and homeworks** **12%**
- **Take-home exam** **15%**
- **In-Class exam** **22%**
- **Final exam** **45%**
- **General assessment** **6%**

Schedule

Weekly Program: 2 Lecture Hours + 3-hour lab session (Computer Application)
The topics and exercises of the weekly lab sessions are closely synchronized with the lecture topics.

Course Policy

Attendance will be taken regularly. Excessive absenteeism from lectures or labs may affect the general assessment and eventually subject the student to being dropped from the course.

Absence from exams is only justified by a valid excuse.