

American University of Beirut
Faculty of Arts and Sciences
Department: Biology
Course Number and Title: BIOLOGY 310
QUANTITATIVE METHODS IN BIOLOGY,

Prerequisite: Consent of instructor.

Course description

Even though it is assumed that a student may have already completed an introductory course in statistics, this course starts from elementary concepts. It starts with descriptive statistics and data summary and then covers one-sample, two-sample and multi-sample hypotheses and tests. Non-parametric tests are also applied to these hypotheses. Non-parametric tests for these hypotheses are also covered. There is also a coverage of linear regression and correlation as well as curve-fitting techniques for 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 use of various software. The programs that are intensively used in this course are Microsoft Excel and SPSS but, in addition, general looks at other options available in other programs (e.g. SigmaPlot, SigmaStat, InStat, Statistica, NTSYS) is also occasionally given.

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 application of 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 and analyze data and output results.

Resources Available to Students:

Main textbook: Zar J.H. 1996 – *Biostatistical Analysis*. 4th Edition. Prentice Hall, N.J.

Additional reference Books:

- **Brown D. and P.Rothery 1993 – *Models in Biology: Mathematics, Statistics and Computing*. J.Wiley and Sons.**
- Keen, R.E. and J.E. Spain, 1992 – *Computer Simulation in Biology, A Basic Introduction*. Wiley-Liss, Inc. N.Y.

Computer Software used: Excel Spreadsheet, SPSS, in addition to overview of . SigmaPlot, SigmaStat, InStat, Statistica, NTSYS

Grading Criteria

- **Lab exercises** 8%
- **Homeworks** 12%
- **Take-home exam** 12%
- **In-Class exam** 18%
- **Final exam** 50%

Schedule

Weekly Program: 2 Lecture Hours + 3 Lab hours (Computer Application)

The topics and exercises of the weekly lab sessions are closely synchronized with the lecture topics.

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
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, Kruskal-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. Testing for Randomness: Poisson distributions.