

PALOMAR COLLEGE
COURSE OUTLINE OF RECORD FOR
DEGREE CREDIT COURSE

 X Transfer course X A.A. degree applicable course
(check all that apply)

COURSE NUMBER AND TITLE: BIOL 215 "Introduction to Biostatistics"

UNIT VALUE: 4 units

MINIMUM NUMBER OF SEMESTER HOURS: 96

BASIC SKILLS REQUIREMENTS: Appropriate language and computational skills

ENTRANCE REQUIREMENTS:

PREREQUISITES: A minimum grade of C in Math 110, and a minimum grade of C in Biol 201

COREQUISITE: None

RECOMMENDED PREPARATION: None

SCOPE OF COURSE:

An introduction to the quantitative analysis of biological data. Founded on the principles of the scientific process, this course provides experience in the design of biological experiments and the appropriate analysis and interpretation of biological data. *This course does not qualify for mathematics credit.*

SPECIFIC COURSE OBJECTIVES:

Upon completion of this course, successful students will be able to

1. Identify the various forms in which biological variables can be described and quantified.
2. Graph biological data in the form of histograms, line graphs, stem plots, scatter plots, and box plots.
3. Estimate the parameters of biological populations; their mean, median, variance, and standard deviation.
4. Design biological experiments taking into consideration the type of data to be collected, size of the sample, and the appropriate data analysis.
5. Apply the principles of the normal distribution to the evaluation of sampling distributions.
6. Interpret the meaning of probability distributions and their relevance in interpreting biological events.
7. Calculate the probability of occurrence for biological events.
8. Test hypotheses involving one biological variable using the z probability distribution.
9. Analyze the difference between two biological variables, or two population means using t -tests.
10. Distinguish between Type I and Type II errors in the process of hypothesis testing.
11. Evaluate the differences between the means of three or more biological populations using analysis of variance (ANOVA) and F -tests.
12. Measure the strength of the relationship between two biological variables using correlation analysis.
13. Apply linear regression models to assess the biological interaction between two variables.
14. Identify the limitations of parametric tests such as t -tests, F -tests, and linear correlation in the analysis of biological data, and appropriately use non-parametric tests to analyze discrete biological variables.
15. Apply Chi-squared tests to assess the fitness between predicted and observed values in biology.

CONTENT IN TERMS OF SPECIFIC BODY OF KNOWLEDGE:

The contents of this course include the most important tools used in the biological sciences to observe, measure, investigate, and analyze biological phenomena, and may not be limited to the following:

- I. The importance of statistics in biology.
 - A. Statistical analysis in science and biology
 - B. Measuring and analyzing biological data
 - C. The nature and role of variability in biological data
 - D. Types of biological data
 1. Categorical
 2. Numerical: discrete vs. continuous
- II. Expressing biological data in the form of graphs
 - A. Categorical data displays: bar graphs, pie charts
 - B. Numerical data displays: line graphs, histograms, box plots
 - C. Biological inference using graphs
- III. Describing biological variables and populations
 - A. Measures of central tendency in biology: the mean, the mode, and the median
 - B. Measures of dispersal: the range, the variance, and the standard deviation
 - C. Describing the parameters of a biological population using estimates
- IV. Designing biological experiments
 - A. Designing appropriate samples
 - B. Comparative experiments in biology
 - C. Randomized experiments in biology
 - D. The logic of experimental design in biology
- V. The role of probability in biological phenomena
 - A. Understanding probability and the basic probability rules
 - B. The role of probability in the testing of biological hypotheses
 - C. Calculating the probabilities of biological events
- VI. Sampling and probability distributions in biology
 - A. Density curves
 - B. The normal distribution
 - C. The sampling distribution of a sample mean
 - D. Sampling variability and z-scores
 - E. The variability of a statistic
- VII. Statistical inference and making decisions about biological variables
 - A. Statistical confidence and confidence intervals
 - B. *P* values and the significance of a statistic
 - C. Choosing the level of significance
 - D. Choosing the sample size
- VIII. Hypothesis testing in biological research
 - A. Kinds of hypotheses and test procedures
 - B. The implications of statistical Errors in hypothesis testing
 - C. Hypothesis tests for the mean of a single biological population
 - D. Power and the probability of a Type II error

- IX. Comparing two biological populations
 - A. Comparing the means of two populations
 - B. The sampling distribution of the difference between two means
 - C. Two-sample t -tests in biology
 - D. Non-parametric alternative for testing two independent samples: Mann-Whitney U -test

- X. One-way analysis of variance: comparing several means
 - A. How to approach multiple comparisons
 - B. The use of one-way ANOVA and F -tests in biology
 - C. Interpreting the results of F -tests
 - D. Non-parametric alternative to ANOVA: Kruskal-Wallis one-way ANOVA

- XI. Measuring the relationship between biological variables
 - A. The linear regression model in biology
 - B. Inferences regarding the slope of the regression line
 - C. Testing the hypothesis of no linear relationship
 - D. Understanding the meaning of the population correlation coefficient
 - E. Non-parametric correlation analysis: Spearman's rank correlation

- XII. Analysis of categorical data in biology using goodness-of-fit tests
 - A. Chi-Squared tests for univariate categorical data
 - B. Tests for homogeneity and independence in two-way contingency tables
 - C. Interpreting the results of goodness-of-fit tests

REQUIRED READING:

Milton, J. Susan. Statistical Methods in the Biological and Health Sciences. Third Edition. Boston: McGraw Hill, 1999.

SUGGESTED READING:

Hassard, Thomas H. Understanding Biostatistics. St. Louis, Missouri: Mosby Year Book, Inc., 1991.

Zar, Jerrold H. Biostatistical Analysis. Fourth Edition. Upper Saddle River, New Jersey: Prentice Hall, 1999.

Selected articles from biological journals and other publications handed out by the instructor.

REQUIRED WRITING: Students will prepare three written reports based on the following independent research:

Experimental design and inference for the mean of a population.

Statistical comparison of two biological populations.

Significance of the linear relationship of two biological variables.

OUTSIDE ASSIGNMENTS: Students will work on the above reports outside classroom time.

INSTRUCTIONAL METHODOLOGY:

Check all that apply:

- lecture
- laboratory
- lecture-laboratory combination
- directed study

This course may be offered as a distance learning course and meets Title 5 regulations 55370, 55372, 55374, 55376, 55378, and 55380.

Yes No

If yes, check all that apply.

- Television Course (Video one-way, e.g. ITV, video cassette, etc.)
- Online Course (Text one-way, e.g. newspaper, correspondence, electronic file, etc.)
- Two-Way Video Conferencing (Two-way interactive video and audio)
- One-Way Video Conferencing (One-way interactive video and two-way interactive audio)
- Computer Assisted Instruction (A specialized form of mediated instruction relying primarily on student access to information and prepared lessons or teaching materials through a computer terminal, but not under immediate supervision of a qualified instructor.)

GRADING POLICY AND STANDARDS (include methods of determining whether the stated objectives have been met by students):

The mastering of course objectives by students will be evaluated using the following methods:

- Lecture exams: 50%
- Written reports: 20%
- Lab exercises 15%
- Lab quizzes 15%

Letter grades will be assigned based on the following scale: A = 100-90%, B = 89-80%, C = 79-70%, D = 69-60%, F = 59% and below.

IS COURSE REPEATABLE FOR REASON(S) OTHER THAN DEFICIENT GRADE?

Yes No Number of times course may be taken for credit: 1

If yes, identify specific provision of Title 5 Division 2 section(s), 55761-55763 and 58161 which qualifies course as repeatable:

CONTACT PERSON: Ruben Murcia. Life Sciences Department. Palomar College. Ext. 3071

SIGNATURES:

SIGNATURES ON FILE