Lecture Contact Hours: 32-36; Homework Hours: 64-72; Total Student Learning Hours: 96-108
Laboratory Contact Hours: 48-54; Homework Hours: 0; Total Student Learning Hours: 48-54

CUYAMACA COLLEGE
COURSE OUTLINE OF RECORD

BIOLOGY 215 – STATISTICS FOR LIFE SCIENCES

2 hours lecture, 3 hours laboratory, 3 units

Catalog Description
Methods and experience in defining and solving quantitative problems in the life sciences. Emphasis is on the design of experiments and the application of a variety of parametric and nonparametric techniques to the analysis of data.

Prerequisite
"C" grade or higher or "Pass" in BIO 130, MATH 110 or equivalent

Entrance Skills
Without the following skills, competencies and/or knowledge, students entering this course will be highly unlikely to succeed:
1) Scientific Method
   a. Identify the goals, methods and limitations of science
   b. Recognize the predictive role of model building in science (e.g. Mendelian genetics)
2) Experimental Design: understand the role of hypothesis testing and experimentation in science
3) Biological Systems
   a. Recognize the inherent complexity and variability of biological systems
   b. Have some basic biological concepts and terminology (e.g., properties of life, cell structure and function, enzymes, metabolism, diversity)
4) Working with algebraic expressions
   a. Simplify and evaluate algebraic expressions
   b. Apply basic order of operations
5) Graphing
   a. Plot points on a two-dimensional graph
   b. Graph the equation of a line
   c. Calculate the slope and intercept of a line
6) Solving
   a. Solve formulae for specific variables
   b. Have some experience and strategies for solving word problems
7) Radicals and exponents: simplify expressions involving radicals and exponents

Course Content
1) Introduction: definitions, statistical thinking, basic concepts of biological statistics, descriptive vs. inferential statistics
2) Introduction to probability distributions: the normal probability distribution and the binomial distribution
3) Estimation and hypothesis testing:
   a. Distribution, variance of means and other statistics
   b. Student's "t" distribution: single, paired, nonpaired means
   c. Confidence limits and hypothesis testing
4) Analysis of variance:
   a. Variances of samples and their means, "F" distribution
   b. Null hypothesis, partitioning the total sum of squares and degrees of freedom

   c. Heterogeneity among sample means
5) Single classification ANOVA: comparison of means (a priori and a posteriori testing)
6) Two way ANOVA with and without replicating; significance testing
7) Assumptions of analysis of variance: nonparametric methods in lieu of ANOVA
8) Regression: basic computations, tests of significance, uses
9) Correlation: produce-moment correlation coefficient, significance tests, applications, nonparametric methods
10) Analysis of frequencies: tests for goodness of fit, e.g., Chi-Square

Course Objectives
Students will be able to:
1) Use a variety of statistical techniques to analyze representative data from the life sciences.
2) Compose written discussions of statistical problems which:
   a. Integrate statistical hypothesis testing into the framework of scientific methodology.
   b. Explain the statistical decision relative to probabilities.
   c. Evaluate the limitations of statistical inference.
3) Apply statistical considerations to the formulation of hypotheses and the specific design of experiments.

Method of Evaluation
A grading system will be established by the instructor and implemented uniformly. Grades will be based on demonstrated proficiency in subject matter determined by multiple measurements for evaluation, one of which must be essay exams, skills demonstration, or where appropriate, the symbol system.
1) Quizzes, exams, final exam
2) Evaluations requiring written discussion of solutions

Special Materials Required of Student
Calculator capable of the four functions of arithmetic, square root function and at least two memory storages

Minimum Instructional Facilities
Smart classroom with writing boards

Method of Instruction
1) Lecture and discussion
2) Supervised problem solving

Out-of-Class Assignments
1) Reading assignments
2) Projects and reports

Texts and References
1) Required (representative examples):
   a. Triola, Mario F., et al. *Biostatistics for the Biological and Health Sciences*. 2nd edition. Pearson, 2017.
   b. Witte, Robert S. *Statistics*. 11th edition. Wiley, 2016.
2) Supplemental: None

Exit Skills
Students having successfully completed this course exit with the following skills, competencies and/or knowledge:
1) Statistical experimental design for biological and behavioral sciences
   a. Identify the types of variables used in biological and behavioral sciences

   b. Describe some basic experimental designs used in these sciences
2) Univariate descriptive statistics
   a. Calculate mean, median and mode
   b. Interpret standard deviation, variance, range
3) Probability
   a. Illustrate the basic laws of discrete, finite probability problems
   b. Apply the calculation of combinations and permutations to word problems
   c. Distinguish between theoretically and empirically-derived probability values
   d. Solve problems using theories of binomial and normal probability distribution
4) Calculating point estimates of population parameters: calculate sample statistics and confidence intervals for populations parameters
5) Inferential statistics: calculations, assumptions and limitations: determine the appropriate statistical test, check assumptions, calculate and make inferences for word problems involving:
   a. T-Tests
   b. One-way analysis of variance
   c. Chi-Square analysis
   d. Linear correlation
   e. Simple linear regression
6) Role of the computer in statistical work
   a. Enter data on a spreadsheet and use the computer to perform appropriate calculations (e.g., descriptive statistics, inferential statistics)
   b. Interpret results from computer calculations
   c. Recognize the power and limits of using computers in statistics (e.g., gigo principle)

Student Learning Outcomes

Students will be able to:

1) Use a variety of statistical techniques to analyze representative data from the life sciences.
2) Compose written discussions of statistical problems which:
   a. Integrate statistical hypothesis testing into the framework of scientific methodology.
   b. Explain the statistical decision relative to probabilities.
   c. Evaluate the limitations of statistical inference.
3) Apply statistical considerations to the formulation of hypotheses and the specific design of experiments.