College of San Mateo
Official Course Outline

1. **COURSE ID:** PSYC 121 **TITLE:** Basic Statistical Concepts **C-ID:** MATH 110 or SOCI 125
   Units: 3.0 units **Hours/Semester:** 48.0-54.0 Lecture hours; and 96.0-108.0 Homework hours
   Method of Grading: Letter Grade Only
   Prerequisite: MATH 120, or MATH 190 or appropriate score on the college math placement test.
   Recommended Preparation:
   PSYC 100 or SOCI 100 and eligibility for ENGL 838 or ENGL 848 or ESL 400.

2. **COURSE DESIGNATION:**
   Degree Credit
   Transfer credit: CSU; UC
   AA/AS Degree Requirements:
   CSM - COMPETENCY REQUIREMENTS: C1 Math/Quantitative Reasoning Basic Competency
   CSU GE:
   CSU GE Area B: SCIENTIFIC INQUIRY AND QUANTITATIVE REASONING: B4 - Mathematics/Quantitative Reasoning
   IGETC:
   IGETC Area 2: MATHEMATICAL CONCEPTS AND QUANTITATIVE REASONING: A: Math

3. **COURSE DESCRIPTIONS:**
   Catalog Description:
   Introduction to basic descriptive techniques and statistical inferences used in the behavioral sciences. Basic statistics includes measures of central tendency, variability, probability, hypothesis testing, correlation, and experimental and quasi-experimental designs.

4. **STUDENT LEARNING OUTCOME(S) (SLO'S):**
   Upon successful completion of this course, a student will meet the following outcomes:
   1. Critically evaluate claims relating to psychology and behavioral sciences research generally;
   2. Evaluate with precision scientific evidence;
   3. Critically compare and contrast research experiments and results in the social and behavioral sciences;
   4. Perform basic statistical tests involved in analysis of data from behavioral experiments and observed data;
   5. Demonstrate proficiency in using appropriate tables to determine statistical significance of behavioral data.

5. **SPECIFIC INSTRUCTIONAL OBJECTIVES:**
   Upon successful completion of this course, a student will be able to:
   1. Critically evaluate claims relating to psychology and the behavioral sciences generally;
   2. Compare and contrast experiments in the social and behavioral sciences;
   3. Perform basic statistical tests involved in analysis of data from behavioral experiments and observed data;
   4. Distinguish among different scales of measurement and their implications;
   5. Demonstrate proficiency in using appropriate tables to determine statistical significance of behavioral data.
   6. Identify the standard methods of obtaining data and identify advantages and disadvantages of different sampling techniques and techniques for obtaining data;
   7. Interpret data displayed in tables and graphs;
   8. Determine measures of central tendency and variability for a given data set;
   9. Calculate measures of central tendency and variability for discrete distributions;
   10. Apply concepts of sample space and probability;
   11. Calculate probabilities using normal and t-distributions;
   12. Explain the difference between sample and population distributions and the role played by central limit theorem;
   13. Calculate z-scores;
   14. Construct standardized distributions from z-scores;
   15. Construct and interpret confidence intervals;
   16. Explain the basic concept of hypothesis testing, including Type I and II errors;
   17. Interpret levels of statistical significance, including p-values;
   18. Compute by hand and interpret data from many types of statistical tests, including the z-test, the single-sample t-test, the independent samples t-test, the repeated measures t-test, one-way ANOVA, pearson's correlation, spearman's correlation, linear regression, and chi-square;

19. Compute using software, such as SPSS, Excel, or R, and interpret data from many types of statistical tests, including the z-test, the single-sample t-test, the independent samples t-test, the repeated measures t-test, one-way ANOVA, pearson's correlation, spearman's correlation, linear regression, and chi-square;
20. Interpret the output of a computer-based statistical analysis from programs, such as SPSS, Excel, or R;
21. Formulate a hypothesis test (e.g., choose the forms of null and alternative hypotheses) involving samples from two populations;
22. Use appropriate statistical techniques to analyze and interpret applications based on data from at least two of the following disciplines: business, economics, political science, administration of justice, life science, physical science, health science, information technology, and education;
23. Apply simple regression analysis for estimation, inference, and interpret the associated statistics;
24. Calculate and interpret measures of effect size for many different types of statistical tests, including but not limited to single-sample t-test, independent samples t-test, repeated measures t-test, one-way ANOVA, pearson's r, and chi-square.

6. **COURSE CONTENT:**

Lecture Content:

1. Introduction: The language of statistics
   - A. Explain the definitions of statistics, science, and observation
   - B. Algebraic concepts & symbols
   - C. Square root
   - D. Populations and samples
   - E. Sampling methods
   - F. Advantages and disadvantages of sampling methods, including but not limited to random sampling, cluster sampling, stratified sampling, and convenience sampling
   - G. The scientific method and design of research studies
   - H. Variables and measurement
   - I. Scales of measurement as they relate to variables associated with psychology, sociology, social sciences, business, life sciences, health sciences, and education
   - J. Statistical notation
   - K. Overview of how statistical operations are applied to research within psychology, sociology, social sciences, business, life sciences, health sciences, and education
2. Frequency distribution and graphs
   - A. Frequency distribution tables and graphs
   - B. The shape of frequency distributions
   - C. Sample spaces
   - D. Histograms
   - E. Bar graphs
   - F. Frequency polygons
3. Measures of central tendency
   - A. Mean
   - B. Median
   - C. Mode
   - D. Computation and comparisons of above
   - E. Selecting a measure of central tendency
   - F. Measures of relative position
   - G. Binomial distributions
   - H. Random variables
   - I. Discrete distributions
   - J. Explanation for how to interpret means and "mean differences" that are reported in behavioral science literature
   - K. Central tendency and the shape of the distribution
   - L. Interpretations of behavioral aspects of data sets with different shapes and skews
   - M. How to report measures of central tendency in the literature using APA format
   - N. Applications of measures of central tendency using data sets from psychology, sociology, social sciences, business, life sciences, health sciences, and education
4. Variability
   - A. Range & interquartile range
   - B. Standard deviation & variance for a population and for samples--computation and applications
   - C. How to determine of a sample is biased or unbiased using variance
   - D. How to interpret the behavioral aspects of sample data sets with relatively small, medium, and large

standard deviations
   E. How to interpret the behavioral aspects of sample data sets by analyzing the relationship between the mean and the standard deviation
   F. How to report the standard deviation in the literature using APA format
   G. Applications of measures of variability using data sets from psychology, sociology, social sciences, business, life sciences, health sciences, and education
5. The normal curve and uses of the bell shaped curve
   A. Standard scores
   B. Central limit theorem
6. Hypothesis testing
   A. The logic of hypothesis testing within the behavioral sciences
   B. Uncertainty and errors in hypothesis testing
   C. Null and alternative hypothesis
   D. P-value and criteria for a decision of significance
   E. Z-test as an introduction to hypothesis testing
   F. Type I & II errors
   G. Single-sample z-test
   H. Levels of significance
   I. Comparison of how one-tailed and two-tailed tests are used within social and behavioral science research, including psychology, sociology, social sciences, business, life sciences, health sciences, and education
   J. Measuring effect size with Cohen's d
   K. Interpretations of Cohen's d
   L. Importance of effect size and reporting effect size
   M. Standard error of the mean
   N. Standard error of the difference between means
   O. t tests for independent means and application to experimental procedures
   P. Applications using data from at least two of the following disciplines: psychology, sociology, social sciences, administration of justice, business, life sciences, health sciences, and education
7. Correlation & Regression
   A. The pearson correlation: Computation, use, and interpretation of Pearson r
   B. Reliability and validity
   C. Uses and applications of the pearson correlation to research in the behavioral sciences, including study design, inter-rater reliability, concurrent validity, and construct validity
   D. Hypothesis tests and the pearson correlation
   E. The point-biserial correlation and measuring effect size with r-squared
   F. Spearman correlation
   G. Applications of pearson's r correlation and the spearman correlation using data sets from psychology, sociology, social sciences, business, life sciences, health sciences, and education
   H. Graphic representation (scatter plots)
   I. Introduction to regression and regression analysis
   J. Analysis and interpretation of data using statistical software such as SPSS, Excel, or R
8. Analysis of variance
   A. The logic of analysis of variance
   B. ANOVA notation and formulas
   C. Applications of one-way ANOVA to behavioral science research
   D. Distribution of F-ratios
   E. Examples of hypothesis testing and effect size with ANOVA
   F. Post-hoc tests
   G. Reporting the results of analysis of variance in the literature
   H. Analysis and interpretation of data using hand calculations and statistical software
   I. Technology based statistical analysis such as SPSS, Excel, or R
   J. Introduction to two-factor analysis of variance and how it is used within the behavioral sciences
9. Z-scores: Location of Scores and Standardized Distributions
   A. Definition and introduction to z-scores
   B. Z-scores and location in a distribution
   C. Using z-scores to standardize a distribution
   D. Other standardized distributions based on z-scores
   E. The connection between z-scores and inferential statistics
   F. Explanation of how inferential statistics are used in the behavioral sciences, such as psychology,

sociology, social sciences, business, life sciences, health sciences, and education

10. Probability & Samples: The Distribution of Sample Means
    A. Explanation of the concept of probability using data sets that are exemplar to behavioral sciences
    B. Probability and the normal distribution
    C. Probabilities and proportions for scores in a normal distribution
    D. The connection between probability and inferential statistics
    E. Binomial and discrete distributions
    F. Random variables and expected value
    G. Samples and sampling error
    H. Distribution of sample means
    I. The standard error of the mean
    J. Rules for addition and multiplication
    K. Concepts of independence and mutual exclusivity
    L. The connection between the distribution of sample means and inferential statistics
    M. Pascal's triangle
    N. Binomial expansion
11. T-Test
    A. Hypothesis tests with a single-sample t-statistic (a t-test with one population)
    B. Applications of the single-samples t-statistics to research design in the behavioral sciences
    C. Measuring effect size for the single-sample t-statistic (cohen's d and r-squared)
    D. The Independent Samples T-Test (Between Subjects T-Test)
    E. Research design within the behavioral sciences for an independent-samples t-test (a t-test with two populations)
    F. Hypothesis tests and effect size with the independent-measures t-statistic
    G. The Repeated Measures T-Test (Within Subjects T-Test)
    H. Research design within the behavioral sciences for a repeated measures t-test (within subjects t-test), which is a t-test with two populations
    I. Hypothesis tests and effect size for the repeated-measures t-test
    J. Reporting, analysis, and interpretation of data
    K. Applications using data from at least two of the following disciplines: psychology, sociology, social sciences, business, life sciences, health sciences, and education
12. Estimation and Confidence Intervals
    A. Overview of estimation
    B. How to calculate and utilize confidence intervals
    C. Interpretation of confidence intervals using data sets that are exemplar to behavioral sciences
    D. Applications using data from at least two of the following disciplines: psychology, sociology, social sciences, business, life sciences, health sciences, and education
    E. Technology based statistical analysis, such as SPSS, Excel or R
13. Nonpararnetric tests
    A. Introduction to the non-parametric statistics
    B. Calculating the chi-square test by hand and also using statistical software such as SPSS, Excel, or R
    C. Calculating a chi-square test with no preference and from a known population
    D. Single factor and multiple factor (e.g., 2x2) chi-square tests
    E. Interpreting the results of chi-square tests
    F. Effect size measures of chi-square
    G. Assumptions and limitations of chi-square
    H. Applications using data from at least two of the following disciplines: psychology, sociology, social sciences, business, life sciences, health sciences, and education
    I. Binomial test
    J. Wilcoxen signed rank
14. Experimental applications
    A. Learning to choose the right test to suit the data
        a. Power of a test

7. **REPRESENTATIVE METHODS OF INSTRUCTION:**

Typical methods of instruction may include:

A. Lecture
B. Activity
C. Discussion
D. Other (Specify): Lecture/discussion. Social science statistical programs to enable students to have

computer-assisted experience in statistical methodology. Assignments in a computer laboratory. Textbook, workbook, and active learning assignments and exercises. Group and individual activities. In-class demonstrations of the mastery of concepts and methodology at the white (or black)board or on graph paper.

8. **REPRESENTATIVE ASSIGNMENTS**

Representative assignments in this course may include, but are not limited to the following:

Writing Assignments:

A research project requiring application of statistical concepts is required. Interpretations to data analysis and computing statistical analysis on data.

Reading Assignments:

Weekly readings from the assigned text. Reading and critically analyzing primary source research articles.

Other Outside Assignments:

Library orientation to psychology journals for research project.

9. **REPRESENTATIVE METHODS OF EVALUATION**

Representative methods of evaluation may include:

A. Class Participation
B. Class Work
C. Exams/Tests
D. Group Projects
E. Homework
F. Lab Activities
G. Papers
H. Projects
I. Quizzes
J. Written examination
K. Examinations and quizzes to assess mastery of concepts and methodology in the course. Papers can also be assigned and used in the evaluation of the student's mastery of the course material. Such papers would require the student to evaluate a published experiment and to carry out an experiment, complete a statistical analysis of the results and write up the experiment in accepted social science/behavioral science format.

10. **REPRESENTATIVE TEXT(S):**

Possible textbooks include:

A. Privitera, G.. *Statistics for the Behavioral Sciences.*, 3rd ed. SAGE Publications, 2017
B. Nolan, S. & Heinzen, T.. *Statistics for the Behavioral Sciences.*, 4th edition. ed. Worth Publishers, 2016
C. Gravetter, Frederick and Wallnau, Larry. *Essentials of Statistics for the Behavioral Sciences*, 10th ed. Cengage Publishing, 2016

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