College of San Mateo
Official Course Outline

1. **COURSE ID:** MATH 200 **TITLE:** Elementary Probability and Statistics **C-ID:** MATH 110
   Units: 4.0 units **Hours/Semester:** 64.0-72.0 Lecture hours; and 128.0-144.0 Homework hours
   Method of Grading: Letter Grade Only
   Prerequisite: MATH 120, or MATH 190 or placement by other college approved methods
   Recommended Preparation:
   Eligibility for ENGL 100, or Eligibility for ENGL 105

2. **COURSE DESIGNATION:**
   Degree Credit
   Transfer credit: CSU; UC
   AA/AS Degree Requirements:
   CSM - COMPETENCY REQUIREMENTS: C1 Math/Quantitative Reasoning Basic Competency
   CSM - GENERAL EDUCATION REQUIREMENTS: E2b. Communication and Analytical Thinking
   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:
   Representation and interpretation of data, use and misuse of statistics, graphical display of distributions, measures of central tendency and dispersion, probability, sampling distributions, statistical inference (including ANOVA), contingency tables, regression and correlation.

4. **STUDENT LEARNING OUTCOME(S) (SLO'S):**
   Upon successful completion of this course, a student will meet the following outcomes:
   1. Distinguish among different scales of measurement and their implications;
   2. Interpret data displayed in tables and graphically;
   3. Apply concepts of sample space and probability;
   4. Calculate measures of central tendency and variation for a given data set;
   5. Identify the standard methods of obtaining data and identify advantages
   6. Calculate the mean and variance of a discrete distribution;
   7. Calculate probabilities using normal and student’s t-distributions;
   8. Distinguish the difference between sample and population distributions and analyze the role played by the Central Limit Theorem;
   9. Construct and interpret confidence intervals;
   10. Determine and interpret levels of statistical significance including p-values;
   11. Interpret the output of a technology-based statistical analysis;
   12. Identify the basic concept of hypothesis testing including Type I and II errors;
   13. Formulate hypothesis tests involving samples from one and two populations;
   14. Select the appropriate technique for testing a hypothesis and interpret the result;
   15. Use linear regression and ANOVA analysis for estimation and inference, and interpret the associated statistics; and
   16. Use appropriate statistical techniques to analyze and interpret applications based on data from disciplines including business, social sciences, psychology, life science, health science, and education.

5. **SPECIFIC INSTRUCTIONAL OBJECTIVES:**
   Upon successful completion of this course, a student will be able to:
   1. Distinguish among different scales of measurement and their implications;
   2. Interpret data displayed in tables and graphically;
   3. Apply concepts of sample space and probability;
   4. Calculate measures of central tendency and variation for a given data set;
   5. Identify the standard methods of obtaining data and identify advantages and disadvantages of each;
   6. Calculate the mean and variance of a discrete distribution;
   7. Calculate probabilities using normal and student’s t-distributions;

8. Distinguish the difference between sample and population distributions and analyze the role played by the Central Limit Theorem;
9. Construct and interpret confidence intervals;
10. Determine and interpret levels of statistical significance including p-values;
11. Interpret the output of a technology-based statistical analysis;
12. Identify the basic concept of hypothesis testing including Type I and II errors;
13. Formulate hypothesis tests involving samples from one and two populations;
14. Select the appropriate technique for testing a hypothesis and interpret the result;
15. Use linear regression and ANOVA analysis for estimation and inference, and interpret the associated statistics; and
16. Use appropriate statistical techniques to analyze and interpret applications based on data from disciplines including business, social sciences, psychology, life science, health science, and education.

6. **COURSE CONTENT:**

Lecture Content:

1. Basic language and concepts: data, variable, value, distribution of a variable, quantitative and categorical variables.
2. Describing distributions of a single variable
   A. Graphical techniques for describing distributions of categorical and quantitative variables.
   B. The calculation and interpretation of numerical techniques for describing the center and spread of distributions, including the mean, median, variance, standard deviation.
   C. Language for describing the shape of distributions, and the relationship between the shape of distributions and numerical measures.
   D. Levels/scales of measurement
   E. Modelling distributions by theoretical distributions, specifically using the binomial and normal distributions.
3. Describing bivariate relationships.
   A. The production of graphical and numerical techniques for comparing the distributions of a quantitative variable by the categories of a categorical variable, and the interpretation of these relationships.
   B. The production and interpretation of graphics to show the relationship between two quantitative variables, specifically scatterplots.
   C. The calculation and interpretation of measures of association between quantitative variables, and specifically the Pearson Correlation Coefficient.
   D. The modelling of bivariate quantitative data using linear least squares regression.
   E. Techniques for analyzing the relationship between two categorical variables, and specifically the interpretation of tables of counts.
4. The language, logic and uses of probability.
   A. Language and basic facts about probability: sample spaces, simple events, events, compliments, unions and intersections of events; $0 \leq P(E) \leq 1$, $P(E) = 1$
   B. Conditional probability, independence and the multiplication rule.
   C. Simple probability calculations using the general addition formula and general multiplication formula.
5. Language and concepts necessary for understanding inference.
   A. The distinction between sample and population, parameter and statistic in the context of real data.
   B. The idea of randomness, random sampling or random allocation (as in experimental settings).
   C. The definition of simple random sample.
   D. Independent sample designs and matched pair designs.
6. More concepts involving inference.
   A. Random variables for discrete and continuous variables, and distributions of random variables.
   B. Theoretical probability distributions of random variables, including the normal, binomial and uniform distributions; mean and standard deviation of a theoretical distribution.
   C. The concept and use of the idea of a sampling distribution of a statistic.
   D. The sampling distribution of a sample mean (center, shape and spread, including standard error of the mean), and the Central Limit Theorem.
   E. The logic of estimation and of hypothesis testing, including Type I and Type II error, and the idea of power.
7. Inference for quantitative variables, and especially means.
   A. Logic language, calculation and interpretation of interval estimates (confidence intervals) for a single mean.
   B. Logic, language, calculation and interpretation of hypothesis testing for a single mean; one and two

sided tests, p values, significance levels and the meaning of statistical significance.
C. The t distributions, the conditions ("assumptions") for their use in estimation and hypothesis testing (including t-tests for one and two populations); the idea of robustness, as well as practical guides to using the t procedures.
D. Calculation and interpretation of interval estimates (confidence intervals) and hypothesis tests for the difference of two means.
E. Analysis of Variance (ANOVA)
F. Techniques for situations where the conditions for t procedures are not met.

8. Inference for counts of categorical variables
   A. Logic, language, calculation and interpretation of interval estimates (confidence intervals) for a single population proportions.
   B. Logic, language, calculation and interpretation of hypothesis testing for a population proportion
   C. Calculation and interpretation of interval estimates (confidence intervals) and hypothesis tests for the difference of two proportions.
9. Logic and interpretation of tests of independence for contingency tables using the Chi square goodness of fit, and Chi square sampling distribution. Understanding of observed and expected values.
10. Applications using data from disciplines including business, social sciences, psychology, life science, health science and education
11. Statistical analysis using technology such as StatCrunch, Fathom, SPSS, EXCEL, Minitab or graphing calculators.

7. **REPRESENTATIVE METHODS OF INSTRUCTION:**
Typical methods of instruction may include:
A. Lecture
B. Other (Specify): A. Use texts and instructional materials that emphasize real data, including data collected during the semester. B. Lecture presentations to show coherence of the substantive material with the objectives of analyzing data to answer questions. C. Exercises in class and outside of class, using data, giving practice in the techniques, and the interpretation of the results in terms of the variables being measured D. Class and small group discussion of common misunderstandings of concepts, techniques, and interpretation. E. Cooperative small group problem solving exercises with results reported in written or oral form. F. Instructor feedback on errors in understanding, either from HW assignments, marked written assignments.

8. **REPRESENTATIVE ASSIGNMENTS**
Representative assignments in this course may include, but are not limited to the following:
Writing Assignments:
Written individual assignments and/or journal- to demonstrate individual student progress toward objectives.
Reading Assignments:
Instructor may assign text readings for discussion of a topic in class.
Other Outside Assignments:
Exercises in class and outside of class, using data, giving practice in the techniques, and the interpretation of the results in terms of the variables being measured.

9. **REPRESENTATIVE METHODS OF EVALUATION**
Representative methods of evaluation may include:
A. Class Participation
B. Exams/Tests
C. Group Projects
D. Homework
E. Quizzes
F. A. Written individual assignments and/or journal- to demonstrate individual student progress toward objectives. B. Small group presentations - to demonstrate student participation in problem solving process C. Written exams/quizzes - to reflect student knowledge of vocabulary, concepts, and application of concepts to problem solving as presented in lectures and discussion, small group sessions, and text readings; to include calculation of measures and models, but also interpretation of results in the context of the data being analyzed. D. Directed questions in quizzes and exams as to the meaning of various parts of formulas. E. A comprehensive and cumulative Final Examination - to reflect and demonstrate student knowledge of vocabulary, concepts, and applications of concepts to problem solving as presented in lectures and discussions, small group sessions, and text readings. F. Participation - to reflect student

involvement in class discussions, small group sessions and presentations, or in data collection.

10. **REPRESENTATIVE TEXT(S):**
    Possible textbooks include:
    A. Goud, Robert N. and Colleen N. Ryan. *Introductory Statistics* , 2nd ed. Pearson, 2016
    B. Moore, D. S. *The Basic Practice of Statistics*, ed. W.H. Freeman, 2021
    C. Rossman, A., B. Chance. *Workshop Statistics: Discovery with Data* , 4th ed. New York: John Wiley and Sons, 2011

Origination Date: November 2021
Curriculum Committee Approval Date: February 2022
Effective Term: Fall 2022
Course Originator: Christopher Walker