Lecture Contact Hours: 96-108; Homework Hours: 192-216; Total Student Learning Hours: 288-324

CUYAMACA COLLEGE
COURSE OUTLINE OF RECORD

MATHEMATICS 096 – PREPARATION FOR ELEMENTARY STATISTICS AND QUANTITATIVE REASONING

6 hours lecture, 6 units

Catalog Description
An accelerated one-semester course to transfer-level Elementary Statistics (Math 160) or Quantitative Reasoning (Math 120). Math 096 covers core concepts from arithmetic, pre-algebra, elementary and intermediate algebra, and descriptive statistics that are needed to understand the basics of college-level statistics. Concepts are taught through the context of descriptive data analysis. The core arithmetic and algebra skills needed to understand the concepts, formulas, and graphs used in transfer-level statistics are investigated in a "just-in-time" approach rather than the standard sequence found in the traditional algebra path. Additional emphasis is placed on solving and graphing linear equations; modeling with linear functions; solving contextualized problems; and dimensional analysis. This course is NOT intended for math, science, computer science, business, or engineering majors. **Pass/No Pass only. Non-degree applicable.**

Prerequisite
None

Course Content
1) Just-in-time topics from arithmetic and algebra
   a. Evaluate expressions using order of operations.
   b. Perform basic arithmetic operations: addition, subtraction, multiplication and division using positive and negative numbers.
   c. Perform calculations involving fractions, decimals and exponents. Understand and express numbers in scientific (exponential) notation.
   d. Calculate percent. Convert percentages into decimal form and vice versa.
   e. Calculate arithmetic average.
   f. Use a scientific calculator to perform the types of calculations described above in items 1-4.
   g. Solve linear algebraic equations; solve word problems involving linear equations.
   h. Determine the magnitudes of angles in units of degrees.
   i. Recognize plane geometric figures such as triangles and squares; differentiate among the terms linear, planar and three-dimensional.
   j. Perform calculations and solve equations involving ratio and proportion techniques.
   k. Perform dimensional analysis and interpret the result.
   l. Graphing of data in a rectangular coordinate system.
   m. Interpret graphs of linear functions.
2) Graphs of distributions of categorical data: bar charts and pie charts
3) Contingency tables: marginal and conditional distributions
4) Measures of center and associated measures of spread: mean, variance, standard deviation median, quartiles, percentiles
5) Graphs of univariate distributions of quantitative data: histograms, stem-and-leaf plots, boxplots
6) Graphs and models for bivariate distributions of quantitative variables, including interpreting scatterplots, linear regressions, use of least squares regression, calculation and interpretation of correlation coefficient r and r^2 as measures of strength and spread in linear regression
7) Data production:
   a. Sample and sample statistic vs. population and population parameter
   b. Observation vs. experiment
   c. Principles of responsible survey and experiment design
   d. Purpose of randomization vs. purpose of random sampling
   e. Simple random samples and other sampling designs

f. Randomized comparative experiments, matched pairs and block designs
g. Cautions about sample surveys and experimentation

8) Topics related to developing effective learning skills:
   a. Study skills: organization and time management, test preparation and test-taking skills
   b. Self-assessment: using performance criteria to judge and improve one's own work, analyzing and correcting errors on one's test
   c. Use of resources: strategies identifying, utilizing, and evaluating the effectiveness of resources in improving one's own learning, e.g., peer study groups, computer resources, lab resources, tutoring resources

Course Objectives

Students will be able to:

1) Solve problems involving the following skills and concepts from arithmetic and algebra.
   a. Evaluate expressions using the order of operations.
   b. Perform basic arithmetic operations: addition, subtraction, multiplication and division using positive and negative numbers.
   c. Perform calculations involving fractions, decimals and exponents. Understand and express numbers in scientific (exponential) notation.
   d. Calculate percent. Convert percentages into decimal form and vice versa.
   e. Calculate arithmetic average.
   f. Use a scientific calculator to perform the types of calculations described above in items 1-4.
   g. Solve linear algebraic equations; solve word problems involving linear equations.
   h. Determine the magnitudes of angles in units of degrees.
   i. Recognize plane geometric figures such as triangles and squares; differentiate among the terms linear, planar and three-dimensional.
   j. Perform calculations and solve equations involving ratio and proportion techniques.
   k. Perform dimensional analysis and interpret the result.
   l. Graphing of data in a rectangular coordinate system.
   m. Interpret graphs of linear functions.
2) (Exploratory data analysis) Formulate questions that can be addressed with data, then organize, display, and analyze relevant data to address these questions and communicate results. Students will demonstrate that they can perform exploratory data analysis if they:
   a. graphically represent the distribution of categorical and quantitative data;
   b. use graphical representations to investigate patterns and trends in data;
   c. compare different graphical representations of the same data and evaluate how well each representation shows important aspects of the data;
   d. compare related data sets using numerical measures and appropriate graphical representations and communicate findings in the context of the data;
   e. investigate relationships in bivariate quantitative data, display a scatterplot, describe its shape, and determine regression coefficients, regression equations, and correlation coefficients using technological tools and communicate findings in the context of the data; and
   f. set up two-way tables for bivariate categorical data and use appropriate marginal and conditional percents to investigate relationships and answer questions.
3) (Data collection) Apply the basic principles of study design to develop and analyze the validity of simple experiments and sampling plans related to a given situation and goal. Students will demonstrate application of the basic principles of study design if they can illustrate and/or explain:
   a. the purpose of randomization in the experiment design;
   b. explanatory, response, and confounding variables;
   c. simple random sample;
   d. statistical bias;
   e. bias due to under-coverage, non-response, interviewer behavior or characteristics, question wording, or aspects of the survey that influence responders; and
   f. the difference between correlation and causation and the connection of these concepts to observational studies and random, controlled experiments.
4) (Numerical and algebraic reasoning) Apply numerical and algebraic reasoning and computational skills to support statistical analysis. Students will exhibit numerical and algebraic reasoning and computational skills if they:

a. identify the place-value structure of the base-ten number system and are able to represent and compare rational numbers (including negative rationals) in decimal from and their approximate location on a number line;
b. recognize, generate, and fluently use equivalent forms of fractions, decimals, and percents;
c. identify, compare, and explain the contextual meaning of fractions that represent the marginal distribution of a single categorical variable;
d. identify, compare, and explain the contextual meaning of fractions that represent the relationship of two categorical variables in conditional distribution;
e. explain and apply the concept of variables as representations of quantities;
f. explain and apply the concept of a function and interpret functions as communicating relationships between variables;
g. recognize the difference between variables and parameters in general forms of linear models;
h. identify relationships that are proportional, define the constant of proportionality in the context of the problem, and use proportional reasoning to solve problems;
i. relate proportionality to linearity as well as the concept of the slope;
j. solve linear equations;
k. use the order of operations to evaluate statistical formulas by hand and with technology; and
l. describe statistical measure (e.g., mean, variance, standard deviation, "least squares", correlation coefficient) and its characteristics by referencing symbolic form.

5) (Mathematical modeling with functions) Construct, use, and interpret mathematical models, specifically linear functions to represent and communicate relationships in quantitative data. Students will demonstrate that they can model quantitative data using linear models if they:
   a. identify trends in bivariate quantitative data and determine the class or classes of functions (linear, curvilinear, or none of these) that could reasonably model the data;
   b. define variables in context using appropriate units;
   c. use linear scales to represent data;
   d. use linear regression to find appropriate linear models;
   e. analyze what the model assumes about how one variable changes with respect to the other;
   f. draw reasonable conclusions about a situation being modeled;
   g. interpret the square of the correlation as the percent of variation in y that can be explained by x; and
   h. explain the difference between causation and correlation and identify the confusion of these concepts as a fallacy.
6) (Effective learning strategies) Consistently apply effective learning strategies for success in college. Students will demonstrate that they can apply effective learning strategies if they:
   a. attend class regularly;
   b. turn in assignments on time;
   c. work productively with peers on group assignments;
   d. seek help from peers, teacher, and other resources when necessary;
   e. set up and maintain their math notebook;
   f. use rubric criteria to assess performance on assignments and make improvements; and
   g. meet with a counselor to develop an educational plan.

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) Group project(s), class activities, homework exercises, and exam questions which measure students' ability to explore and represent data and to apply the basic principles of study design.
2) Projects, class activities, homework assignments, and exams (including a comprehensive final exam) which measure students' ability to exhibit numerical and algebraic reasoning and computational skills, and model quantitative data using linear models.
3) In-class activities, homework, math notebook, and data analysis projects which demonstrate students' ability to apply effective learning strategies.

Special Materials Required of Student
1) Scientific calculator
2) Graphing calculator

Minimum Instructional Facilities
1) Smart classroom with writing boards covering three walls, overhead projector, graphing utility overhead viewing panels, projection screen
2) Basic skills math lab with 42 computers, writing board, overhead projector, projection screen; appropriate software for integrated computer instruction (word processing, spreadsheet and other workplace software)

Method of Instruction
1) Individualized instruction: computer aided instruction or in-class individualized tutoring
2) Collaborative learning: group work or peer review student work
3) Modeling: instructor led-demonstrations and discussion or guided-discovery
4) Active learning: use of manipulatives, interactive computer-based instruction, or in-class activities requiring student participation
5) Class activities and assignments developed by Myra Snell and a consortium organized by the Carnegie Foundation for the Advancement of Teaching
6) Computer-assisted instruction

Out-of-Class Assignments
1) Problem sets
2) Exploratory activities and/or projects
3) Reading and/or writing assignments
4) Data analysis assignments

Texts and References
1) Required (representative examples):
   a. Descriptive statistics and data production chapters from any general statistic text such as Chapters 1 - 6 of *Statistics: Concepts and Controversies* by Moore and Notz, 8th edition, W. H. Freeman, 2012. ISBN-13: 9781429254892.
   b. To support course content, objectives, and learning outcomes, selected chapters from any pre-algebra text such as *Mathematics in Action: An Introduction to Algebraic, Graphical, and Numerical Problem Solving* by The Consortium for Foundation Mathematics, 4th edition, Pearson, 2011. ISBN-13: 978032169860.
   c. To support course content, objectives, and learning outcomes, selected chapters from any intermediate algebra text such as *Intermediate Algebra: Functions & Authentic Applications,* 4th edition, Pearson, 2010. ISBN-13: 9780321620958
2) Supplemental: None

Exit Skills
Students having successfully completed this course exit with the following skills, competencies, and/or knowledge:
1) Solve problems involving the following skills and concepts from arithmetic and algebra.
   a. Evaluate expressions using the order of operations.
   b. Perform basic arithmetic operations: addition, subtraction, multiplication and division using positive and negative numbers.
   c. Perform calculations involving fractions, decimals and exponents. Understand and express numbers in scientific (exponential) notation.
   d. Calculate percent. Convert percentages into decimal form and vice versa.
   e. Calculate arithmetic average.
   f. Use a scientific calculator to perform the types of calculations described above in items 1-4.
   g. Solve linear algebraic equations; solve word problems involving linear equations.
   h. Determine the magnitudes of angles in units of degrees.
   i. Recognize plane geometric figures such as triangles and squares; differentiate among the terms linear, planar and three-dimensional.

   j. Perform calculations and solve equations involving ratio and proportion techniques.
   k. Perform dimensional analysis and interpret the result.
   l. Graphing of data in a rectangular coordinate system.
   m. Interpret graphs of linear functions.
2) Construct and reading bar charts and pie charts.
3) Use fractions, decimals, and percents to interpret bar charts and pie charts.
4) Use contingency tables to:
   a. Identify fractions and percents that describe part of a whole (marginal distributions).
   b. Identify fractions and percents that describe the impact of one quantity on another (conditional distributions).
5) Compare relative and absolute differences.
6) Calculate and interpret measures of center and associated measures of spread (mean, variance, standard deviation median, quartiles, percentiles).
7) Compare and interpret fractions, decimals, percents, signed numbers as they relate to the formulas for mean, variance, standard deviation, median, quartiles, and percentiles.
8) Solve proportions.
9) Analyze algebraic structures and forms to understand measures of center and associated measures of spread.
10) Solve linear equations.
11) Analyze algebraic structures not typically taught in pre-algebra nor intermediate algebra such as but not limited to:
   a. $x-\overline{x}$ represents a signed distance from the mean,
   b. $\frac{\sum(x-\overline{x})^2}{n-1}$ represents an average of squared distances from the mean including , and
   c. Geometric interpretations relating why standard deviation is roughly an average distance from the mean and why positively associated data in a scatterplot gives positive correlation.
12) Create graphs of univariate distributions of quantitative data: histograms, stem-and-leaf plots, boxplots.
13) Create graphs and models for bivariate distributions of quantitative variables.
14) Interpret scatterplots using linear scales.
15) Use least squares regression to model linear relationships.
16) Calculate and interpret the correlation coefficient r and r^2 as measures of strength and spread in linear regression.
17) Use linear functions to model data.
18) Identify when data has a constant % change.
19) Graph and interpret initial value and growth or decay rates.
20) Use each of the following to create a sampling plan:
   a. Sample and sample statistic vs. population and population parameter.
   b. Observation vs. experiment.
   c. Principles of responsible survey and experiment design.
   d. Purpose of randomization vs. purpose of random sampling.
   e. Simple random samples and other sampling designs.
   f. Randomized comparative experiments, matched pairs and block designs.
   g. Cautions about sample surveys and experimentation.

Student Learning Outcomes

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

1) Formulate questions that can be addressed with data, then organize, display, and analyze relevant data to address these questions and communicate results.
2) Apply the basic principles of study design to develop and analyze the validity of simple experiments and sampling plans related to a given situation and goal.
3) Apply numerical and algebraic reasoning and computational skills to support statistical analysis.
4) Construct, use, and interpret mathematical models, specifically linear functions to represent and communicate relationships in quantitative data.