

# Course Outline of Record

Los Medanos College

2700 East Leland Road

Pittsburg CA 94565

(925) 439-2181

Course Title: Algebra for Statistics

Subject Area/Course Number: MATH-027

New Course  OR Existing Course

Instructor(s)/Author(s): Myra Snell

Subject Area/Course No.: MATH-027

Units: 6

Course Name/Title: Algebra for Statistics

Discipline(s): Mathematics

Pre-Requisite(s):

Co-Requisite(s):

Advisories:

**Catalog Description:** This is an accelerated course that prepares students for transfer-level Statistics. Topics include ratios, rates, and proportional reasoning, arithmetic reasoning using fractions, decimals and percents, evaluating expressions, analyzing algebraic forms to understand statistical measures, functions, use of linear and exponential functions to model bivariate data, use of logarithms, logarithmic scales and semi-log plots, graphical and numerical descriptive statistics for quantitative and categorical data. This course is designed for students who do not plan to major in math, science, computer science, or business.

**Schedule Description:** Is there a relationship between income and education? Do banks practice discriminatory lending practices? How can concepts from arithmetic, algebra, and introductory statistics help us answer these questions? This course is an accelerated one-semester course that prepares you for transfer-level Statistics (Math 34). We will study core concepts from arithmetic, algebra, and introductory statistics that are needed to understand the basics of college-level statistics. This is a new approach designed for students who do NOT plan to major in math, science, computer science, or business.

Hours/Mode of Instruction: Lecture 90 Lab 54 Composition \_\_\_\_\_ Activity \_\_\_\_\_ Total Hours 144  
(Total for course)

Credit  Credit Degree Applicable (DA)  
 Credit Non-Degree (NDA)  
(If Non-Credit desired, contact Dean.)

Grading  Pass/No Pass (P/NP)  
 Letter (LR)  
 Student Choice (SC)

Repeatability  0  
 1  
 2  
 3

Please apply for:

LMC General Education Requirement and/or Competency & Graduation Requirement(s): yes

Transfer to:  CSU  UC  IGETC LDTP Course is Baccalaureate Level:  Yes  No

Signatures:

Department Chair \_\_\_\_\_ Date \_\_\_\_\_

Librarian \_\_\_\_\_ Date \_\_\_\_\_

Dean/Sr. Dean \_\_\_\_\_ Date \_\_\_\_\_

Curriculum Committee Chair \_\_\_\_\_ Date \_\_\_\_\_

President/Designee \_\_\_\_\_ Date \_\_\_\_\_

CCCCD Approval Date (Board or Chancellor's Office) \_\_\_\_\_ Date \_\_\_\_\_

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**For Curriculum Committee Use only:**

**STAND ALONE COURSE:**

YES

NO

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**FOR OFFICE OF INSTRUCTION ONLY. DO NOT WRITE IN THE SECTION BELOW.**

Begin in Semester \_\_\_\_\_

Dept. Code/Name: \_\_\_\_\_

ESL Class: Yes / No

Class Code

- A Liberal Arts & Sciences
- B Developmental Preparatory
- C Adult/Secondary Basic Education
- D Personal Development/Survival
- E For Substantially Handicapped
- F Parenting/Family Support
- G Community/Civic Development
- H General and Cultural
- I Career/Technical Education
- J Workforce Preparation Enhanced
- K Other non-credit enhanced
- Not eligible for enhanced

Catalog year 20\_\_\_\_/20\_\_\_\_

T.O.P.s Code: \_\_\_\_\_

DSPS Class: Yes / No

SAM Code

- A Apprenticeship
- B Advanced Occupational
- C Clearly Occupational
- D Possibly Occupational
- E\* Non-Occupational
- F Transfer, Non-Occupational
- \*Additional criteria needed
- 1 One level below transfer
- 2 Two levels below transfer
- 3 Three levels below transfer

Class Max: \_\_\_\_\_

Crossover course 1/ 2: \_\_\_\_\_

Coop Work Exp: Yes / No

Remediation Level

- B Basic Skills
- NBS Not Basic Skills

Course approved by Curriculum Committee as Baccalaureate Level: Yes / No

LMC GE or Competency Requirement Approved by the Curriculum Committee: \_\_\_\_\_

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Distribution: Original: Office of Instruction  
Copies: Admissions Office, Department Chairperson  
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## Institutional Student Learning Outcomes

Check the institutional student learning outcomes (or category of outcomes) below that are reflected in your course:

- General Education SLOs (Recommended by GE Committee)**  
At the completion of the LMC general education program, a student will:
1. Read critically and communicate effectively as a writer and speaker.
  2. Understand connections among disciplines and apply interdisciplinary approaches to problem solving.
  3. Think critically and creatively
  4. Consider the ethical implications inherent in knowledge, decision-making and action.
  5. Possess a worldview informed by diverse social, multicultural and global perspectives.
- Occupational Education SLOs (Recommended by Occupational Education Committee)**  
At the completion of the LMC occupational certificate or degree, a student will:
1.  Be academically prepared to **obtain an entry-level or a mid-level position** in their industry.
  2.  Apply **critical thinking** to research, evaluate, analyze and synthesize information.
  3.  Demonstrate strong **communication skills** (written and/or oral) and **interpersonal skills** (customer service and team work).
  4.  Appropriately apply **industry materials and technology**.
  5.  Demonstrate the skills and knowledge necessary to take and pass **certification exams** for career **advancement** in their industry.
- Developmental Education SLOs (Recommended by Developmental Education Committee)**  
At the completion of the LMC Developmental Education Program, a student will:
1.  Demonstrate the skills necessary for the first transfer level courses in English and Math or for the English and Math competencies for the Certificate of Achievement.
  2.  Think critically to construct meaning and solve problems.
  3.  Read with comprehension.
  4.  Communicate effectively both in writing and orally.
  5.  Demonstrate the characteristics, habits, and attitudes of an effective learner.
- Student Services SLOs**
1. LMC students will demonstrate proficiency in the use of college on-line services.
  2. LMC students will demonstrate proficiency in self-advocacy.
- Library and Learning Support Services SLOs**  
LMC students utilizing various Library and Learning Support Services will:
1. Access and effectively utilize available campus Library and Learning Support Services.
  2. Apply knowledge learned and competencies gained from using Library and Learning Support Services to academic coursework and assignments.
  3. Demonstrate information competency skills needed to meet the research demands of academic course work and life long learning.
- None of the Above**

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## Program-Level Student Learning Outcomes (PSLOs)

- 1. Problem-solving abilities:** Students will use mathematical reasoning to solve problems and a generalized problem solving process to work word problems.
  - a. The student can apply standard problem-solving methods and use relevant concepts to solve problems.
  - b. The student uses a generalized problem-solving rubric if such a rubric is used in the class.
  - c. The student's written work demonstrates a conceptual understanding of course concepts.
  - d. The student's written work supports his/her solution.
  - e. The student evaluates the reasonableness of his/her answer.
  
- 2. Mathematical versatility:** Students will use verbal, graphical, numerical, and symbolic representations of mathematical ideas to solve problems.
  - a. Students will use a variety of representations to demonstrate their understanding of mathematical concepts.
  - b. Students will use a multi-prong approach to problem solving.
  - c. Students will use appropriate technology to solve mathematical problems and judge the reasonableness of their results.
  
- 3. Communication skills:** Students will read, write, listen to, and speak mathematics with understanding.
  - a. Students will read and listen to mathematical presentations and arguments with understanding.
  - b. Students will communicate both in speaking and in writing their understanding of mathematical ideas and procedures using appropriate mathematical vocabulary and notation.
  - c. Students will coherently communicate their own mathematical thinking to others.
  
- 4. Preparation:** Students will recognize and apply math concepts in a variety of relevant settings and demonstrate the math skills and knowledge necessary to succeed in subsequent courses.
  
- 5. Effective Learning Attributes:** Students will demonstrate the characteristics of an effective learner.
  - a. Student has the will to succeed and demonstrates the characteristics of a successful student: motivation, responsibility, focus, perseverance, the ability to cope with anxiety, a good attitude toward learning, and time management skills.
  - b. Student has the skills to succeed. (S)he uses appropriate resources to improve learning and reach goals.
  - c. Student self-monitors and self-regulates. (S)he assesses personal strengths and weaknesses in his/her learning process and then seeks and implements a strategy for improving learning.

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## **Course-Level Student Learning Outcomes (CSLOs):**

This course includes learning outcomes and objectives typically found in arithmetic, prealgebra, elementary algebra, intermediate algebra, and introductory statistics. These concepts are taught through the context of descriptive data analysis. Core arithmetic and algebra skills that are needed to understand the concepts, formulas, and graphs used in transfer-level Statistics are investigated in a “just-in-time” approach, rather than in the standard sequence found in the traditional algebra path.

At the end of the course students will be able to

CSLO 1: formulate questions that can be addressed with data, then organize, display, and analyze relevant data to address these questions and communicate results. (PSLOS 1, 2, 3, 4)

CSLO 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. (PSLOS 3, 4)

CSLO 3: demonstrate numerical and algebraic reasoning skills to support statistical analysis. (PSLOS 1, 2, 3, 4)

CSLO 4: construct, use, and interpret mathematical models, specifically linear and exponential functions, to represent relationships in quantitative data. (PSLOS 1, 2, 3, 4)

CSLO 5: use effective learning strategies for success in college. (PSLO 5)

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## Assessment Criteria

At the end of the course students will be able to

CSLO 1: formulate questions that can be addressed with data, then organize, display, and analyze relevant data to address these questions and communicate results.

Assessment Criteria: We will know that students can perform exploratory data analysis if they

- graphically represent the distribution of categorical and quantitative data;
- use graphical representations to investigate patterns and trends in data;
- compare different graphical representations of the same data and evaluate how well each representation shows important aspects of the data;
- compare related data sets using numerical measures and appropriate graphical representations and communicate findings in the context of the data;
- 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;
- set up two-way tables for bivariate categorical data and use appropriate marginal and conditional percents to investigate relationships and answer questions.

CSLO 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.

Assessment Criteria: We will know that students apply the basic principles of study design if they can state, explain and give examples to illustrate the following concepts:

- the purpose of randomization in the experiment design
- explanatory, response, and confounding variables
- simple random sample
- statistical bias
- bias due to under-coverage, non-response, interviewer behavior or characteristics, question wording, or aspects of the survey that influence responders
- difference between correlation and causation and the connection of these concepts to observational studies and random, controlled experiments.

CSLO 3: demonstrate numerical and algebraic reasoning skills to support statistical analysis.

Assessment Criteria: We will know that students are exhibiting numerical reasoning skills if they

- understand the place-value structure of the base-ten number system and are able to represent and compare rational numbers (including negative rationals) in decimal form and find their approximate location on a number line;
- recognize, generate, and fluently use equivalent forms of fractions, decimals, and percents;
- identify, compare, and explain the contextual meaning of fractions that represent the marginal distribution of a single categorical variable;
- identify, compare, and explain the contextual meaning of fractions that represent the relationship of two categorical variables in conditional distribution.

Assessment Criteria: We will know that students can reason algebraically if they

- understand the concept of a variable and the concept of a function, and interpret functions as communicating relationships between variables;
- recognize the difference between variables and parameters in general forms of linear and exponential models (e.g. in  $y = mx + b$ ,  $x$  and  $y$  are variables, but  $m$  and  $b$  are parameters that define a specific line);
- identify relationships that are proportional, define the constant of proportionality in the context of the problem, and use proportional reasoning to solve problems;
- relate proportionality to linearity ( $y=kx$ ) and also to the concept of slope ( $\Delta y = k\Delta x$ )

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- identify functions as linear or exponential and contrast their properties by relating their symbolic form to verbal descriptions, tables of values, or graphs;
- use the order of operations to evaluate statistical formulas by hand and with technology;
- describe a statistical measure (e.g. mean, variance, standard deviation, "least squares", correlation coefficient) and its characteristics by referencing its symbolic form;

CSLO 4: construct, use, and interpret mathematical models, specifically linear and exponential functions, to represent relationships in quantitative data.

Assessment Criteria: We will know that students can model quantitative relationships using linear and exponential models if they

- identify trends in bivariate quantitative data and determine the class or classes of functions (linear, exponential, or none of these) that could reasonably model the data;
- define variables in a context using appropriate units;
- use linear regression on  $x$ ,  $y$  or  $x$ ,  $\log(y)$  to find an appropriate linear and exponential models;
- analyze what the model assumes about how one variable changes with respect to the other;
- draw reasonable conclusions about a situation being modeled;
- interpret the correlation coefficient as a measure of spread of data about the least squares regression line;
- interpret the square of the correlation as the percent of variation in  $y$  (or  $\log(y)$ ) that can be explained by  $x$ ;
- explain the difference between causation and correlation and identify the confusion of these concepts as a fallacy.

CSLO 5: use effective learning strategies for success in college.

Assessment Criteria: We will know that students are meeting this outcome if they

- Attend class regularly and are punctual in turning in assignments;
- Work productively with peers on group assignments;
- Seek help from peers, teacher, and other resources when necessary;
- Use rubric criteria to assess performance on assignments and make improvements;
- Meet with a counselor to develop an educational plan.

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## Assessments:

The table below shows the types of assignments that will be used to evaluate student achievement of the five course-level student learning outcomes.

CSLO	Assessment Instruments			
	In-class activities	Homework or quizzes	Data Analysis Projects	Exams (including a final exam)
1 Exploratory Data Analysis	x	x	x	x
2 Data Production	x	x	x	x
3 Numerical and Algebraic Reasoning	x	x	x	x
4 Mathematical Modeling with Functions	x	x	x	x
5 Effective Learning	x	x	x	

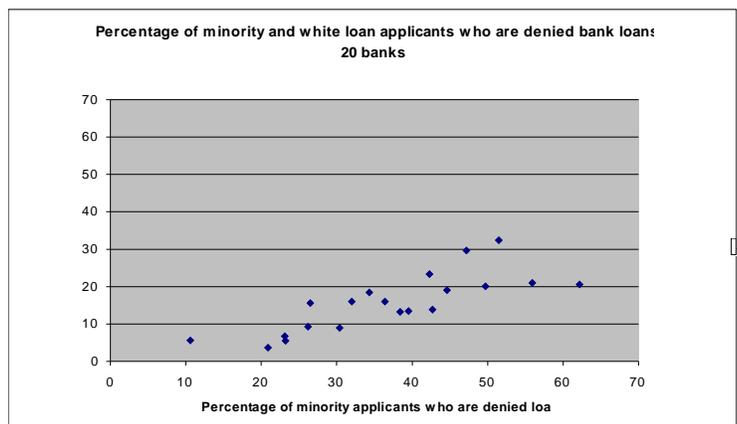
To demonstrate the ability to explore and represent data as described in CSLO 1 and to apply the basic principles of study design as described in CSLO 2, students will do at least one project (preferably in groups) that requires them to design and conduct a simple experiment or survey, then analyze the data using numerical measures and graphical representations. These CSLOs may also be assessed through class activities, homework exercises, exam questions, or projects that require graphical, numerical, and verbal descriptions of raw data.

CSLOs 3 and 4 describe skills that are integral to the type of reasoning that will be required in most class activities, homework assignments, exams, and projects.

CSLO 5 is indirectly assessed by the requirement that assignments be turned in on time, that in-class group and lab activities require that the student be present, and that success on data analysis assignments requires self-assessment of early drafts of work using a rubric. The student is also required to meet with a counselor to develop an educational plan.

*Sample assessment* that includes skills described in CSLO 1, 3, and 4:

ACORN is the acronym for the Association of Community Organizations for Reform Now. ACORN collected data on 20 banks. They compared the percentage of applicants of color who were denied loans to the percentage of whites who were denied loans. They only used applicants with similar incomes. ACORN presented their results to a Joint Congressional Hearing. The scatterplot below uses the ACORN data.



- Add the point ( 60 , 30 ) to the scatterplot. Explain what these numbers mean for a bank. (CSLO 1)
- The association between the percentage of applicants of color and the percentage of whites denied loans is **(positive, negative, or neither.)** This means that when the percentage of applicants of color that are denied loans increases, the percentage of whites denied loans **(increases, decreases, stays the same.)** (CSLO 1)
- Circle the point that describes a bank that denies loans to 30% of the applicants of color. If 1020 applicants of color apply for a loan at this bank, how many are denied loans? How many of the 1020 receive loans? (CSLO 3)

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- d. Draw a line you think best fits the data. Find the equation of your line. Explain what the slope tells us in the context of this problem. (CSLO 4)
- e. ACORN concluded from its study that “banks generally have exhibited a pervasive pattern of lending practices that have the effect, intended or not, of racial discrimination.” Explain how the scatterplot supports this conclusion. (CSLO 1)

## Method of Evaluation/Grading:

The instructor will assign homework, in-class lab work, or computer work on a regular basis, give at least three exams in addition to a final, and have students do at least one group project. Students should receive regular feedback on their progress toward course SLOs prior to major exams or projects. Feedback may include instructor’s written feedback, self- or peer-assessment, or computer-aided assessment.

Department policy requires that a final exam be weighted at least 20% of the course grade. Here are suggested guidelines for weighting the other assessments:

In-class activities/labs/homework	10-30%
Exams	30-50%
Data Analysis projects (preferably one done in groups)	20-30%
Final exam	20%

A-level student work is consistently clear, accurate, precise, well-reasoned, complete and well-organized. For all CSLOs the work demonstrates conceptual understanding through appropriate use of concepts in a variety of contexts, effective use of different representations of concepts to illustrate and communicate ideas, and ability to discuss connections between concepts and procedures. A-level work on data analysis assignments also demonstrates an element of creativity, such as integrating outside resources relevant to the analysis, creating novel graphical representations that build on standard graphs covered in class, inventing a new variable that facilitates comparison, etc. A-level student work adheres to directions, is on time, and complete.

C-level student work is satisfactory in that the student successfully uses course concepts in appropriate settings, but the application of course ideas may be perfunctory. Work is inconsistently clear, accurate, precise and well-reasoned. It does not display depth of insight and may show inconsistent competence with some ideas. C-level work on data analysis assignments tends to be a list of observations with an indiscriminate use of procedures and concepts at times that demonstrates a lack of well-reasoned decision-making in the analysis. The C-level student completes all major assignments but work may be incomplete, fail to follow directions fully or be late.

Since multiple CSLOs are assessed in every type of assessment, guidelines for weighting CSLOs are given as suggested ranges. In addition, the skills and abilities described in the CSLOs are intertwined. For example, most assignments for CSLO 1 (Exploratory Data Analysis) will include elements of CSLO 3 (numerical and algebraic reasoning).

CSLO 1: 40-60%

CSLO 2: 5-10%

CSLO 3: 25-40%

CSLO 4: 10-25%

CSLO 5: 5-10%

## Suggested grading scale:

A: 90% – 100%

B: 80% – 89.9%

C: 70% – 79.9%

D: 60% – 69.9%

F: 0% – 59.9%

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## Course Content:

Viewed from the perspective of content topics, this course will include topics typically taught in prealgebra, elementary algebra, intermediate algebra, and introductory statistics. But these topics will be integrated under the umbrella of exploratory data analysis and principles of data production, instead of being covered in the traditional sequence as discrete skills. In this way the course will have the look and feel of a course in descriptive statistics, with frequent “just-in-time” investigations of core arithmetic and algebra skills that are needed to understand the concepts, formulas, and graphs used in descriptive statistical data analysis and data collection.

### CATEGORICAL VARIABLES:

1. Graphs of distributions of categorical data: bar charts and pie charts

**“Just-in-time” topics from arithmetic and prealgebra:**

- Constructing and reading bar charts and pie charts;
- Using fractions, decimals and percents to interpret bar charts and pie charts;
- Recognizing and generating equivalent forms of fractions, decimals, and percents;
- Comparing fractions with the same denominator;
- Comparing fractions, decimals, and percents.

2. Contingency tables: marginal and conditional distributions

**“Just-in-time” topics from arithmetic and prealgebra:**

- Comparing fractions with different denominators;
- Comparing fractions, decimals, percents;
- Identifying fractions and percents that describe part of a whole (marginal distributions);
- Identifying fractions and percents that describe the impact of one quantity on another (conditional distributions).

### QUANTITATIVE VARIABLES:

1. Measures of center and associated measures of spread: mean, variance, standard deviation; median, quartiles, percentiles

**“Just-in-time” topics from prealgebra and elementary algebra:**

- Computing with and interpreting fractions, decimals, percents, signed numbers as they relate to these formulas and concepts;
- Evaluating expressions using the order of operations;
- Analyzing algebraic structures and forms to understand these measures.

**Extending algebraic reasoning not typically taught in elementary or intermediate algebra:**

- Analyzing algebraic structures geometrically, e.g.  $x - \bar{x}$  represents a signed distance from the mean;  $\frac{\sum (x - \bar{x})^2}{n - 1}$  represents an average of squared distances from the mean. Geometric interpretations relate to why standard deviation is roughly an average distance from the mean and why positively associated data in a scatterplot gives positive correlation.

2. Graphs of univariate distributions of quantitative data: histograms, stem-and-leaf plots, boxplots,

**“Just-in-time” topics from prealgebra and elementary algebra:**

- Graphing fractions, decimals, and signed numbers on a number line;
- Evaluating expressions
- Relative vs. absolute difference

3. Graphs and models for bivariate distributions of quantitative variables, including least-squares regression using linear and exponential models, transforming exponential into linear models using logarithms and

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logarithmic scales, along with correlation coefficient ( $r$ ) and  $r^2$  as measures of strength and spread in linear regression.

**“Just-in-time” topics from prealgebra, elementary and intermediate algebra:**

- A graph as the set of solutions to an equation;
- Graphing in the Cartesian coordinate system;
- Scatterplots;
- Functions;
- Linear functions, constant rate of change, graphing, interpreting slope and y-intercept in context;
- Proportions and linearity;
- Exponential functions, constant % change, graphing, interpreting initial value and growth or decay rates;
- Logarithmic scales, logarithmic conversion of exponential data into linear data, semi-log plots.

**DATA PRODUCTION:**

1. Sample and sample statistic vs. population and population parameter
2. Observation vs. experiment
3. Principles of responsible survey and experiment design
4. Purpose of randomization vs purpose of random sampling
5. Simple random samples and other sampling designs
6. Randomized comparative experiments, matched pairs and block designs
7. Cautions about sample surveys and experimentation

**TOPICS RELATED TO DEVELOPING EFFECTIVE LEARNING SKILLS (a combination of skills from LMC developmental math course outlines):**

1. Study skills: for example, organization and time management, test preparation and test-taking skills
2. Self-assessment: for example, using performance criteria to judge and improve one’s own work, analyzing and correcting errors on one’s test
3. Use of resources: for example, strategies for identifying, utilizing, and evaluating the effectiveness of resources in improving one’s own learning, e.g. peer study groups, computer resources, lab services

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## Instructional Methods:

- Lecture
- Lab
- Activity
- Problem-based Learning/Case Studies
- Collaborative Learning/Peer Review
- Demonstration/Modeling
- Role-Playing
- Discussion
- Computer Assisted Instruction
- Other (explain) \_\_\_\_\_

Math 27 will accommodate diversity in student learning styles through varied instructional methods utilized during 5 lecture hours and 3 in-class lab hours each week. The instructor will use at least three of the following:

- Individualized instruction: for example, computer-aided instruction or in-class individualized tutoring;
- Collaborative learning: for example, group work or peer review of student work;
- Modeling: for example, instructor-led demonstrations and discussion or guided-discovery;
- Active learning: for example, use of manipulatives, interactive computer-based instruction, or in-class activities requiring student participation;
- Computer Assisted instruction: for example, use of Tinkerplots and Fathom to analyze data

## Textbooks:

Class activities and assignments for this course are currently under development by Myra Snell and a consortium organized by the Carnegie Foundation for the Advancement of Teaching.

Descriptive statistics and data production chapters from any general statistics text:

Suggested texts:

Parts 1-3 of Seeing Through Statistics, 3<sup>rd</sup> edition (2005), Utts ISBN-10: 0-534-39402-7 (Parts 1-3)

Chapters 1-6 of Statistics Concepts and Controversies, 7<sup>th</sup> ed., Moore and Notz ISBN: 1-4292-2345-6

Units I-III of Workshop Statistics: Discovery with Data and Fathom 2<sup>nd</sup> ed., Rossman and Chance (2008) ISBN: 978-0-470-42331-8

Technology, in the form of computer software and/or graphing calculators, will be a part of the required materials.

Suggested technology:

Tinkerplots from Key Curriculum Press

Fathom from Key Curriculum Press