

MATHEMATICS COURSE SYLLABUS

Course Title: Introduction to Statistics H2

(Summer 2015 Revision)

Department: Mathematics

Primary Course Materials:

Textbook: Elementary Statistics Fourth Edition

Publisher: Pearson Prentice Hall

Author: Larson, Farber

TI-Nspire Graphing Calculator Applications

Course Description:

This full-year course is designed for students who have successfully completed Advanced Algebra. The course will introduce students to statistical reasoning and methods that are relevant in the fields of medicine, business, education, political science, psychology and entertainment. Topics will include design of experiments and sampling techniques, data analysis and displays, probability and counting principles, discrete probability distributions, Normal probability distributions, confidence intervals, and hypothesis testing.

Students will be required to keep an organized notebook, read and interpret the textbook, and do independent work. Emphasis will be placed on investigating and solving real world problems that will include open response questions for a variety of applications.

Since this course will encourage the proper use of technology, the purchase of a TI-Nspire graphing calculator is strongly recommended.

Essential Questions:

1. How are descriptive statistics, inferential statistics, qualitative and quantitative data analyzed and modeled in real world applications in such disciplines as medicine, business, education, political science, psychology and entertainment?
2. How can probability and probability distributions be used to model and understand real world situations?
3. How can confidence intervals and hypothesis testing be used to understand and make conclusions about real world population proportions and population means?
4. How can technology be used to deepen and facilitate the understanding of applications in the areas of descriptive statistics, probability, probability distributions, and inferential statistics?

Course Objectives:

Common Goals:

Thinking and Communicating

- 1) Read information critically to develop understanding of concepts, topics and issues.
- 2) Write clearly, factually, persuasively and creatively in Standard English.
- 3) Speak clearly, factually, persuasively and creatively in Standard English.
- 4) Use computers and other technologies to obtain, organize and communicate information and to solve problems.
- 5) Conduct research to interpret issues or solve complex problems using a variety of data and information sources.

Gain and Apply Knowledge in and across the Disciplines

- 6) Gain and Apply Knowledge in:
 - a) Literature and Language
 - b) Mathematics
 - c) Science and Technology
 - d) Social Studies, History and Geography
 - e) Visual and Performing Arts
 - f) Health and Physical Education

Work and Contribute

- 7) Demonstrate personal responsibility for planning one's future academic and career options.
- 8) Participate in a school or community service activity.
- 9) Develop informed opinions about current economic, environmental, political and social issues affecting Massachusetts, the United States and the world and understand how citizens can participate in the political and legal system to affect improvements in these areas.

Learning Standards from the Massachusetts Curriculum Framework:

A chart is attached identifying which of the standards from the Massachusetts Curriculum Frameworks will be assessed in this course.

Additional Learning Objectives Beyond the Curriculum Framework:

21st Century Skills:

Instructional practices support the achievement of 21st C. Learning Expectations by: <i>(check those that apply to the Unit)</i>	<input checked="" type="checkbox"/> personalizing instruction <input checked="" type="checkbox"/> engaging students in cross disciplinary learning <input checked="" type="checkbox"/> engaging students as active and self directed learners <input checked="" type="checkbox"/> emphasizing inquiry, problem solving and higher order thinking <input checked="" type="checkbox"/> applying knowledge and skills in authentic tasks <input checked="" type="checkbox"/> engaging students in self assessment and reflection <input checked="" type="checkbox"/> integrating technology
Other	

Content Outline:

1. An overview of Statistics 7 days

- **Key Terms**
- **Data Classification and Levels of Measurement**
- **Experimental Design and Sampling Techniques**

Activities to Support Instruction: Rating Television Shows in the United States

2. Descriptive Statistics 18 days

- **Frequency Distributions and Their Graphs**
- **Other Common Graphs and Displays**
- **Measures of Central Tendency (Mean, Median, and Mode)**
- **The Shape of Distributions**
- **Measures of Variation (Range, Variance, and Standard Deviation)**
- **The Empirical Rule**
- **Mean for Grouped Data**
- **Percentiles and Quartiles**
- **Box and Whisker Plots**
- **z-Scores**

**Activities to Support Instruction: The Day the Sky Roared (Computer Lab Activity)
Earnings of Athletes
Dairy Farmers of America - Monthly Milk Production
Sunglass Sales in the United States
Using Technology: Raw Data
Using Technology: Grouped Data**

3. Probability 12 days

- **Fundamental Concepts of Probability and Counting**
- **Classical, Empirical, and Subjective Probability**
- **Law of Large Numbers**
- **Range of Probabilities Rule**
- **Complementary Events**
- **Conditional Probability and the Multiplication Rule**
- **Independent versus Dependent Events**
- **The Addition Rule**
- **Mutually Exclusive Events**
- **Permutations and Combinations**

**Activities to Support Instruction: Use of TI-Nspire Calculator Features
Probability and Parking Lot Strategies
The Case of the Body in the Bag
Drug Testing**

4. Discrete Probability Distributions

13 days

- Random Variables
- Necessary Conditions for a Probability Distribution
- Mean, Variance, and Standard Deviation for a Probability Distribution
- Expected Value
- Binomial Experiments and the Binomial Probability Formula
- Constructing and Graphing a Binomial Distribution
- Mean, Variance, and Standard Deviation for a Binomial Distribution
- The Geometric Distribution

Activities to Support Instruction: Use of TI-Nspire Calculator Features and Table Methods
Binomial Distribution of Airplane Accidents
Jury Selection
Consumer Reports: QA in Customer Relations
Should We Convict?
Powerball
Expected Value Game
Using Technology: Binomial Distributions

5. Normal Probability Distributions

22 days

- Properties of Normal Distributions
- The Standard Normal Distribution
- Finding Probabilities for Normal Distributions
- Finding Normal percentiles
- Transforming a z-Score to an x-Value
- Properties of Sampling Distributions of Sample Means
- The Central Limit Theorem

Activities to Support Instruction: Use of TI-Nspire Calculator Features and Table Methods
Birth Weights in America
Age Distribution in the United States
A Tale of Blood Chemistry and Health
Consumer Reports: Sunscreens
How Much Time Do You Spend in a Day?

6. Confidence Intervals

14 days

- Confidence Intervals for Means
- Point versus Interval Estimates
- Margin of Error
- Finding a Minimum Sample Size to Estimate the Mean
- The t-Distribution
- Confidence Intervals for Population Proportions

Activities to Support Instruction: Use of TI-Nspire Calculator Features and Table Methods
Shoulder Heights of Appalachian Black Bears
The Gallup Organization
The Search for a Fire-Safe Cigarette

7. Hypothesis Testing with One Sample

24 days

- **Introduction to Hypothesis Testing**
- **Type I and Type II Errors**
- **Level of Significance and the P-value**
- **Hypothesis Testing for the Mean**
- **Hypothesis Testing for Proportions**

Activities to Support Instruction: **Use of TI-Nspire Calculator Features and Table Methods**
Human Body Temperature: What’s Normal?
The Case of the Vanishing Women
How Old is Stonehenge?

8. Hypothesis Testing with Two Samples (time permitting)

10 days

- **Testing the Difference Between Means (Independent Samples)**
- **Testing the Difference Between Means (Dependent Samples)**
- **Testing the Difference Between Proportions**

Activities to Support Instruction: **Use of TI-Nspire Calculator Features and Table Methods**
Diets and Weight Loss
Tails Over Heads

Major Evaluation Strategies:

Name of Assessment	Type of Assessment		Common Goals Assessed	Standards Assessed	Other Objectives Assessed
	Test	Performance Assessment			
Chapter Tests and Quizzes	<input checked="" type="checkbox"/>	<input type="checkbox"/>	1,2,4,5,6b,6c,7,9	listed under course objectives for all assessments	
Take-Home Problem Sets	<input type="checkbox"/>	<input checked="" type="checkbox"/>	1,2,4,5,6b,6c,7,9		
Activities: Rating Television shows in the United States Earnings of Athletes Monthly Milk Production Using Technology: Raw Data Using Technology: Grouped Data Use of TI-Nspire Calculator Features Probability and Parking Lot Strategies Binomial Distribution of Airplane Accidents Consumer Reports: QA in Customer Relations Should We Convict? Powerball	<input type="checkbox"/>	<input type="checkbox"/>	1,2,4,5,6b,6c,7,9		

<p>Expected Value Game Using Technology: Binomial Distributions Birth Weights in America Age Distribution in the United States Consumer Reports: Sunscreens How Much Time Do You Spend in a Day? Shoulder Heights of Appalachian Black Bears The Gallup Organization Human Body Temperature: What's Normal? The Case of the Vanishing Women Diets and Weight Loss Tails Over Heads</p>					
Homework/Class Participation	<input type="checkbox"/>	<input type="checkbox"/>	1,2,4,5,6b,6c,7,9		
Common Final Exam	<input checked="" type="checkbox"/>	<input type="checkbox"/>	1,2,4,5,6b,6c,7,9		
<p>Common Assessments: The Day the Sky Roared Sunglass Sales in the United States The Case of the Body in the Bag Drug Testing Jury Selection A Tale of Blood Chemistry and Health The Search for a Fire-Safe Cigarette How Old is Stonehenge?</p>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	1,2,4,5,6b,6c,7,9		

High School Content Standards

Conceptual Category: Number and Quantity	
N-Q	<p>Quantities</p> <hr/> <p>Reason quantitatively and use units to solve problems.</p> <ol style="list-style-type: none"> 1. Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. ★ 2. Define appropriate quantities for the purpose of descriptive modeling. ★ 3. Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. ★ <p>MA.3.a. Describe the effects of approximate error in measurement and rounding on measurements and on computed values from measurements. Identify significant figures in recorded measures and computed values based on the context given and the precision of the tools used to measure. ★</p>
Conceptual Category: Algebra	
A-SSE	<p>Seeing Structure in Expressions</p> <hr/> <p>Interpret the structure of expressions.</p> <ol style="list-style-type: none"> 1. Interpret expressions that represent a quantity in terms of its context. ★ <ol style="list-style-type: none"> a. Interpret parts of an expression, such as terms, factors, and coefficients. b. Interpret complicated expressions by viewing one or more of their parts as a single entity. <i>For example, interpret $P(1 + r)^n$ as the product of P and a factor not depending on P.</i>
Conceptual Category: Statistics & Probability	
S-ID	<p>Interpreting Categorical and Quantitative Data</p> <hr/> <p>Summarize, represent, and interpret data on a single count or measurement variable.</p> <ol style="list-style-type: none"> 1. Represent data with plots on the real number line (dot plots, histograms, and box plots).★ 2. Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets. ★ 3. Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).★ 4. Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a

- ★ indicates Modeling standard.
 (+) indicates standard beyond College and Career Ready.
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	<p>procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate areas under the normal curve. *</p> <p>Summarize, represent, and interpret data on two categorical and quantitative variables.</p> <p>5. Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data. *</p>
S-IC	<p>Making Inferences and Justifying Conclusions</p> <p>Understand and evaluate random processes underlying statistical experiments.</p> <ol style="list-style-type: none"> 1. Understand statistics as a process for making inferences to be made about population parameters based on a random sample from that population. * 2. Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation. <i>For example, a model says a spinning coin falls heads up with probability 0.5. Would a result of 5 tails in a row cause you to question the model?*</i> <p>Make inferences and justify conclusions from sample surveys, experiments, and observational studies.</p> <ol style="list-style-type: none"> 3. Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each. *
S-CP	<p>Conditional Probability and the Rules of Probability</p> <p>Understand independence and conditional probability and use them to interpret data.¹</p> <ol style="list-style-type: none"> 1. Describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events (“or,” “and,” “not”). * 2. Understand that two events A and B are independent if the probability of A and B occurring together is the product of their probabilities, and use this characterization to determine if they are independent. ★ 3. Understand the conditional probability of A given B as $P(A \text{ and } B)/P(B)$, and interpret independence of A and B as saying that the conditional probability of A given B is the same as the probability of A, and the conditional probability of B given A is the same as the probability of B. ★ 4. Construct and interpret two-way frequency tables of data when two categories are associated with each object being classified. Use the two-way table as a sample space to decide if events are independent and to approximate conditional probabilities. <i>For example, collect data from a</i>

¹ Link to data from simulations or experiments.

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	<p><i>random sample of students in your school on their favorite subject among math, science, and English. Estimate the probability that a randomly selected student from your school will favor science given that the student is in tenth grade. Do the same for other subjects and compare the results. ★</i></p> <p>5. Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations. <i>For example, compare the chance of having lung cancer if you are a smoker with the chance of being a smoker if you have lung cancer. ★</i></p> <p>Use the rules of probability to compute probabilities of compound events in a uniform probability model.²</p> <p>6. Find the conditional probability of A given B as the fraction of B's outcomes that also belong to A, and interpret the answer in terms of the model. ★</p> <p>7. Apply the Addition Rule, $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$, and interpret the answer in terms of the model. ★</p> <p>8. (+) Apply the general Multiplication Rule in a uniform probability model, $P(A \text{ and } B) = P(A)P(B A) = P(B)P(A B)$, and interpret the answer in terms of the model. ★</p> <p>9. (+) Use permutations and combinations to compute probabilities of compound events and solve problems. ★</p>
S-MD	<p>Using Probability to Make Decisions</p> <hr/> <p>Calculate expected values and use them to solve problems.</p> <p>1. (+) Define a random variable for a quantity of interest by assigning a numerical value to each event in a sample space; graph the corresponding probability distribution using the same graphical displays as for data distributions. *</p> <p>2. (+) Calculate the expected value of a random variable; interpret it as the mean of the probability distribution. *</p> <p>3. (+) Develop a probability distribution for a random variable defined for a sample space in which theoretical probabilities can be calculated; find the expected value. <i>For example, find the theoretical probability distribution for the number of correct answers obtained by guessing on all five questions of a multiple-choice test where each question has four choices, and find the expected grade under various grading schemes.</i> *</p> <p>4. (+) Develop a probability distribution for a random variable defined for a sample space in which probabilities are assigned empirically; find the expected value. <i>For example, find a current data distribution on the number of TV sets per household in the United States, and calculate the expected number of sets per household. How many TV sets would you expect to find in 100 randomly selected households?</i> *</p> <p>Use probability to evaluate outcomes of decisions.</p> <p>5. (+) Weigh the possible outcomes of a decision by assigning</p>

² Introductory only.

	<p>probabilities to payoff values and finding expected values.*</p> <p>a. (+) Find the expected payoff for a game of chance. <i>For example, find the expected winnings from a state lottery ticket or a game at a fast-food restaurant.*</i></p> <p>b. (+) Evaluate and compare strategies on the basis of expected values. <i>For example, compare a high-deductible versus a low-deductible automobile insurance policy using various, but reasonable, chances of having a minor or a major accident.*</i></p> <p>6. (+) Use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator).*</p> <p>7. (+) Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game).^{3*}</p>
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³ Replacing the hockey goalie with an extra skater.
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