

MANCHESTER REGIONAL
HIGH SCHOOL

ADVANCED PLACEMENT
STATISTICS

Revised and adopted

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Manchester Regional High School Board of Education

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AP Statistics Syllabus

Primary Textbook

Cobb, George W., Scheaffer, Richard L., & Watkins, Ann E. *Statistics in Action: Understanding a World of Data*, Second Edition, Key Curriculum Press, Emeryville, CA, 2008.

Technology

- TI-83/TI-84 graphing calculators
- Excel spreadsheet
- Fathom Dynamic Data

Course Outline

Statistical Reasoning: Investigating a Claim of Discrimination

- Discrimination in the Workplace: Data Exploration
- Discrimination in the Workplace: Inference
- Hands-On Activities

Exploring Distributions

- Visualizing Distribution: Shape, Center, and Spread
 - Uniform Distributions
 - Normal Distributions
 - Skewed Distributions
 - Binomial Distributions
 - Outliers, Gaps, and Clusters
- Graphical Displays of Distribution
 - Cases and Variables, Quantitative and Categorical
 - Dotplots
 - Histograms
 - Stemplots
 - Bar Charts for Categorical Data
- Measures of Center and Spread
 - Measures of Center
 - Measuring Spread Around the Median: Quartiles and IQR
 - Five-Number Summaries, Outliers, and Boxplots
 - Measuring Spread Around the Means: The Standard Deviation
 - Summaries from a Frequency Table

- Working with Summary Statistics
 - Choosing Summary Statistics
 - The Effects of Changing Units
 - The Influence of Outliers
 - Percentile and Cumulative Relative Frequency Plots
- The Normal Distribution
 - The Standard Normal Distribution
 - Standard Deviations: The Standard Unit
 - Solving the Unknown Percentage Problem and the Unknown Value Problem
 - Central Intervals for Normal Distributions
- Hands-On Activities:

Relationships Between Two Quantitative Variables

- Scatterplots: Describing the Pattern in a Scatterplot
- Getting a Line on the Pattern
 - Lines as Summaries
 - Using Lines for Prediction
 - Least Square Regression Lines
 - Reading Computer Output
- Correlation: The Strength of a Line Trend
 - Estimating the Correlation
 - A Formula for the Correlation r
 - Correlation and the Appropriateness of a Linear Model
 - Relationship Between the Correlation and the Slope
 - Correlation & Causation
 - Interpreting r^2
 - Regression Toward the Mean
- Diagnostics: Looking for Features that the Summaries Miss
 - Outliers
 - Residual Plots: Putting Your Data Under a Microscope
- Shape-Changing Transformation
 - Exponential Growth and Decay
 - Exponential Functions and Log Transformations
 - Log-Log Transformation of Power Functions
 - Power Transformations
- Hands-On Activities:

Sample Survey and Experiments

- Why Take Samples, and How Not To
 - Census vs Sample

- Bias: A Potential Problem with Survey Data
- Random Sampling: Playing It Safe by Taking Chances
 - Simple Random Samples
 - Stratified Random Samples
 - Other Methods of Sampling
- Experiments and Inference About Cause
 - Cause and Effect
 - Confounding in Observational Studies
 - Factors and Levels
 - Randomization
 - Control or Comparison Group
 - Experimental Units and Replication
- Designing Experiments to Reduce Variability
 - Differences Between Treatments vs Variability Within Treatments
 - Design for Every Purpose
- Hands-On Activities:

Probability Models

- Constructing Models of Random Behavior
 - Sources of Probabilities
 - Sample Space
 - Data and Symmetry
 - The Law of Large Numbers
 - Fundamental Principle of Counting
- Using Simulation to Estimate Probabilities: Random Digits
- The Addition Rule and Disjoint Events
 - Disjoint and Complete Categories
 - Addition Rule
- Conditional Probability
 - Conditional Probability from the Sample Space
 - Multiplication Rule for $P(A \text{ and } B)$
 - Definition
 - Application: Medical Tests
 - Statistical Inference
- Independent Events
 - Multiplication Rule
 - Independence with Real Data

Probability Distributions

- Random Variables and Expected Value
 - Probability Distribution

- Expected Value and Standard Deviation
- Expected Value in Everyday Situation
- Rules for Means and Variances
- The Binomial Distribution
 - Binomial Probabilities
 - Shape, Center, and Spread
- The Geometric Distribution
 - Formula
 - Expected Value and Standard Deviation
- Hand On Activity

Sampling Distribution

- Generating Sampling Distributions
 - Shape, Center, and Spread
 - Exact Sampling Distribution
 - Properties of Point Estimator
- Sampling Distribution of the Sample Mean
 - Shape, Center and Spread of the Sampling Distribution of sample mean
 - Finding Probabilities Involving Sample Means
 - Using the Properties of the Sampling Distribution of the Mean
 - Finding Probabilities Involving Sample Totals
- Sampling Distribution of the Sample Proportion
 - Sampling Distribution of the Number of Successes
 - Shape, Center and Spread for Sample Proportions
 - Finding Probabilities Involving Proportions
- Hand On Activity

Inference for Proportions

- Estimating a Proportion with Confidence
 - Reasonably Likely Events
 - Meaning of a Confidence Interval
 - Deriving the Formula
 - Using the Formula
 - Capture Rate
 - Margin of Error and Sample Size
 - Determining Sample Size
- Testing a Proportion
 - Informal Significance Testing
 - Test Statistic
 - P-Values

- Critical Values and Level of Significance
- Components of Test of Significance
- Types of Errors
- Power and Type II Errors
- One-Sided Test of Significance
- A Confidence Interval for the Difference of Two Proportions
- A Significance Test for the Difference of Two Proportions
 - Sampling Distribution of the Difference
 - Theoretical Foundation
- Inference for Experiments
 - Confidence Interval for a Difference in Proportions from an Experiment
 - Significance Test for a Difference in Proportions from an Experiment
 - Inference for an Observational Study
- Hand On Activity

Inference for Means

- A Confidence Interval for a Mean
 - The Effect of Estimating σ
 - How to Adjust for Estimating σ
 - Constructing a Confidence Interval for a Mean
 - Interpreting a Confidence Interval
 - Margin of Error
- A Significance Test for a Mean
 - Test Statistic
 - Constructing a t-Distribution
 - P-Values
 - Type I Error
 - The t-Test
 - Meaning of “Reject” and “Do Not Reject”
 - One-Sided Test
- When Things Aren’t Normal
 - Effect of Skewness and Outliers
 - Dealing with Not Normal Population
- Inference for the Difference Between Two Means
 - Confidence Interval for the Difference Between Two Means
 - Significance Test for the Difference of Two Means
 - Increasing Power in the Two-Sample t-Test
- Paired Comparisons
 - Two Independent Samples vs Paired Observations
 - Case When Difference Don’t Appear Normal

- o Importance of Comparing Means
- Hand On Activity

Chi-Square Test

- Testing a Probability Model: The Chi-Square Goodness-of-Fit-Test
 - o A Test Statistic
 - o Chi-Square Distribution
 - o Using Chi-Square Distribution and the Calculator Built-In Function
 - o Chi-Square Goodness of Fit
 - o Rationale Why Each Expected Frequency Must Be 5 or More
 - o Condition When Chi-Square Test is Equivalent to the z-Test
- The Chi-Square Test of Homogeneity
 - o Categorical Data with Two Variables
 - o Computing Expected Frequencies
 - o Computing the Chi-Square Statistic
 - o Test Procedure
 - o Degrees of Freedom: Information About Error
- The Chi-Square Test of Independence
 - o Tabular and Graphical Displays of the Data
 - o Expected Frequencies in a Chi-Square Test of Independence
 - o Test Procedure
 - o Homogeneity vs Independence
 - o Strength of Association and Sample Size
- Hand On Activity

Inference for Regression (Total Time: 12 days)

- Variation in the Slope from Sample to Sample
 - o Linear Models
 - o Variability of b_1 from Sample to Sample
 - o Standard Error of the Slope
- Making Inferences About Slopes
 - o Test Statistic for a Slope
 - o Significance Test for a Slope
 - o Confidence Interval Estimation
 - o Degrees of Freedom, Part II
- Transforming for a Better Fit
 - o Checking the Fit of the Model
 - o Transformation to Improve Linearity

Statistics Seminar

The students, as part of the requirements for this course, will investigate a topic of their own choosing; decide which appropriate data to use; organize and explore the

data using statistical tools and analysis studied in the class; and present their findings before the student body and teachers in a seminar during the class period assigned to the AP Statistics class. The Library will be utilized to hold the seminar, depending upon the numbers attending.

Since this may be a huge undertaking for some of the students, they will be guided accordingly. From day one they will be encouraged to start thinking about a topic to investigate. As statistical topics are discussed in class, they will be expected to examine the suitability of incorporating them into their projects as well as deciding which ones would better serve their investigations, like using primary or secondary data, types of graphs, kinds of analyses, and uses of technology, i.e. Fathom's Survey.