

# AP Statistics Scope and Sequence

## Course Overview:

The purpose of the AP course in statistics is to introduce students to the major concepts and tools for collecting, analyzing and drawing conclusions from data. Students are exposed to four broad conceptual themes:

1. Exploring Data: Describing patterns and departures from patterns
2. Sampling and Experimentation: Planning and conducting a study
3. Anticipating Patterns: Exploring random phenomena using probability and simulation
4. Statistical Inference: Estimating population parameters and testing hypotheses

\*Note: Topics included in the text but that should be skipped because they are not considered part of the AP curriculum are marked with an asterisk. This information is based on emails and conversations with MMSI AP Stat personnel.

Text: Stats, Modeling the World. Bock, Velleman, De Veaux. 3<sup>rd</sup> Edition, 2010.

Unit 1 Exploring and Understanding Data			
<p><b>Enduring Understandings:</b></p> <ul style="list-style-type: none"> <li>• The <i>Who, What, Where, Why, and How</i> of the data are important information that must be depicted in each given data set.</li> <li>• The shape, center, and spread should be described for every distribution.</li> <li>• The normal distribution is used to model the spread of data.</li> </ul> <p><b>Essential Questions:</b></p> <ul style="list-style-type: none"> <li>• What is data? How do we understand and communicate data?</li> <li>• What assumptions can be made from data?</li> <li>• How can graphical displays be manipulated to present misleading information?</li> <li>• Why is the normal distribution essential to the study of statistics?</li> <li>• How does the normal distribution apply to the real world?</li> </ul>			
Pacing	Topics	Resources	Assessments
12 Days	Exploring Data: Describing patterns and departures from patterns	Text Chapters 1 – 6	<ul style="list-style-type: none"> <li>• Investigative Tasks</li> <li>• Quiz</li> <li>• Test</li> </ul>

	<p>A. Constructing and interpreting graphical displays of distributions of univariate data (dotplot, stemplot, histogram, cumulative frequency plot)</p> <ol style="list-style-type: none"> <li>1. Center and spread</li> <li>2. Clusters and gaps</li> <li>3. Outliers and other unusual features</li> <li>4. Shape</li> </ol> <p>B. Summarizing distributions of univariate data</p> <ol style="list-style-type: none"> <li>1. Measuring center: median, mean</li> <li>2. Measuring spread: range, interquartile range, standard deviation</li> <li>3. The normal distribution <ol style="list-style-type: none"> <li>i. Properties of the normal distribution</li> <li>ii. Using tables of the normal distribution</li> <li>iii. The normal distribution as a model for measurements</li> <li>iv. Measuring position: quartiles, percentiles, standardized scores (z-scores)</li> </ol> </li> <li>4. Using boxplots</li> <li>5. The effect of changing units on summary measures</li> </ol> <p>C. Comparing distributions of univariate data (dotplots, back-to-back stemplots, parallel boxplots)</p> <ol style="list-style-type: none"> <li>1. Comparing center and spread: within group, between group variation</li> <li>2. Comparing clusters and gaps</li> <li>3. Comparing outliers and other unusual features</li> <li>4. Comparing shapes</li> </ol> <p>D. Exploring categorical data</p> <ol style="list-style-type: none"> <li>1. Frequency tables and bar charts</li> <li>2. Marginal and joint frequencies for two-way tables</li> <li>3. Conditional relative frequencies and association</li> <li>4. Comparing distributions using bar charts</li> </ol>	<p>*Simpson's Paradox pg 34-35</p> <p>*Normal Probability Plots Pg 124</p>	
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**Unit 2** Gathering Data**Enduring Understandings:**

- Careful planning is essential to obtaining valid data.
- Clarifying the question leads to the appropriate methodology.
- The analysis is only as good as the data.
- Well-designed experiments can allow us to reach appropriate cause-and-effect conclusions

**Essential Questions:**

- How do we obtain data? Why is it important?
- How can bias be identified and prevented?
- To what extent does data collection methodology affect results?

Pacing	Topics	Resources	Assessments
10 Days	<p>Sampling and Experimentation: Planning and conducting a study</p> <p><i>Data must be collected according to a well-developed plan if valid information on a conjecture is to be obtained. This plan includes clarifying the question and deciding upon a method of data collection and analysis.</i></p> <p>A. Overview of methods of data collection</p> <ol style="list-style-type: none"> <li>1. Census</li> <li>2. Sample survey</li> <li>3. Experiment</li> <li>4. Observational study</li> </ol> <p>B. Planning and conducting surveys</p> <ol style="list-style-type: none"> <li>1. Characteristics of a well-designed and well-conducted survey</li> <li>2. Populations, samples and random selection</li> <li>3. Sources of bias in sampling and surveys</li> <li>4. Sampling methods, including simple random sampling, stratified random sampling and cluster sampling</li> </ol> <p>C. Planning and conducting experiments</p> <ol style="list-style-type: none"> <li>1. Characteristics of a well-designed and well-conducted experiment</li> <li>2. Treatments, control groups, experimental units, random assignments and replication</li> </ol>	Text Chapters 11 - 13	<ul style="list-style-type: none"> <li>• Investigative Tasks</li> <li>• Quiz</li> <li>• Test</li> </ul>

	<ul style="list-style-type: none"><li>3. Sources of bias and confounding, including placebo effect and blinding</li><li>4. Completely randomized design</li><li>5. Randomized block design, including matched pairs design</li></ul> <p>D. Generalizability of results and types of conclusions that can be drawn from observational studies, experiments and surveys</p>		
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**Unit 3 Randomness and Probability**

**Enduring Understandings:**

- Probability models are useful tools for making decisions and predictions.
- Probability is the basis of statistical inference.
- The notion and behavior of a random variable is foundational to understanding probability distributions.
- The Law of Large Numbers is an important concept when simulating probability experiments.
- Probability models are useful tools for making decisions and predictions.

**Essential Questions:**

- How can we base decisions on chance?
- How can probability be used to simulate events and to predict future happenings?
- What are the benefits of simulating events as opposed to gathering real data?
- How can modeling predict the future?

Pacing	Topics	Resources	Assessments
<p><b>12 days</b></p>	<p>Anticipating Patterns: Exploring random phenomena using probability and simulation.</p> <p><i>Probability is the tool used for anticipating what the distribution of data should look like under a given model.</i></p> <p>A. Probability</p> <ol style="list-style-type: none"> <li>1. Interpreting probability, including long-run relative frequency interpretation</li> <li>2. “Law of Large Numbers” concept</li> <li>3. Addition rule, multiplication rule, conditional probability and independence</li> <li>4. Discrete random variables and their probability distributions, including binomial and geometric</li> <li>5. Simulation of random behavior and probability distributions</li> <li>6. Mean (expected value) and standard deviation of a random variable, and linear transformation of a random variable</li> </ol> <p>B. Combining independent random variables</p> <ol style="list-style-type: none"> <li>1. Notion of independence versus dependence</li> <li>2. Mean and standard deviation for sums and differences of independent random variables</li> </ol>	<p>Text Chapters 14 -17</p> <p>*Bayes Rule Pg 358</p>	<ul style="list-style-type: none"> <li>• Investigative Tasks</li> <li>• Quiz</li> <li>• Test</li> </ul>

**Unit 4 Sampling Distributions and Inference for Proportions**

**Enduring Understandings:**

- Variation can be expected in the results of random samples and is affected by the design of the sample or experiment.
- Tests of significance and confidence intervals drive decision making in our world.
- Error analysis is a critical component of significance testing.
- Significance tests determine the likelihood of a sample.
- Confidence intervals are effective tools for estimating the proportion of a population.

**Essential Questions:**

- How can modeling predict the future?
- How much evidence do you need before you are able to make a reasonable conjecture?
- How is statistical inference used to draw conclusions from data?
- How is probability used to express the strength of our conclusions?

Pacing	Topics	Resources	Assessments
12 days	<p>Sampling distributions</p> <ol style="list-style-type: none"> <li>1. Sampling distribution of a sample proportion</li> <li>2. Sampling distribution of a sample mean</li> <li>3. Central Limit Theorem</li> <li>4. Sampling distribution of a difference between two independent sample proportions</li> </ol> <p>Statistical Inference: Estimating population parameters and testing Hypotheses. <i>Statistical inference guides the selection of appropriate models.</i></p> <p>A. Estimation (point estimators and confidence intervals)</p> <ol style="list-style-type: none"> <li>1. Estimating population parameters and margins of error</li> <li>2. Properties of point estimators, including unbiasedness and variability</li> <li>3. Logic of confidence intervals, meaning of confidence level and confidence intervals, and properties of confidence intervals</li> <li>4. Large sample confidence interval for a proportion</li> <li>5. Large sample confidence interval for a difference between two proportions</li> </ol>	<p>Text Chapters 18 – 22</p> <p>* Calculations of Type II error or power (concentrate on concepts, interpretations, and interactions with alpha, sample size, and effect size)</p>	<ul style="list-style-type: none"> <li>• Investigative Tasks</li> <li>• Quiz</li> <li>• Test</li> </ul>

	<p>B. Tests of significance</p> <ol style="list-style-type: none"><li>1. Logic of significance testing, null and alternative hypotheses; p-values;</li><li>2. one- and two-sided tests; concepts of Type I and Type II errors; concept of power</li><li>3. Large sample test for a proportion</li><li>4. Large sample test for a difference between two proportions</li></ol>		
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**Unit 5 Inference for Means****Enduring Understandings:**

- Significance tests determine the likelihood of a sample.
- Confidence intervals are effective tools for estimating the proportion or the mean of a population.
- Inference is a tool for validating a claim about a population parameter.
- Inference is a tool for estimating an unknown population parameter.

**Essential Questions:**

- How do you determine if there is a statistically significant difference between two claims?
- What does it mean to make an inference?

<b>Pacing</b>	<b>Topics</b>	<b>Resources</b>	<b>Assessments</b>
<b>9 days</b>	Confidence interval for a mean A. Confidence interval for a difference between two means (unpaired and paired)  Test for a mean A. Test for a difference between two means (unpaired and paired) B. Simulation of t-distribution	Text Chapters 23 - 25	<ul style="list-style-type: none"><li>• Investigative Tasks</li><li>• Quiz</li><li>• Test</li></ul>

**Unit 6 Bivariate Data****Enduring Understandings:**

- Correlations does not imply causation.
- A linear model can be used to represent relationships between bivariate data.

**Essential Questions:**

- What is association? What is correlation? How are they connected?
- Does association imply causation?
- How can modeling data help us to understand patterns?
- When is it appropriate to use extrapolation to predict the future?

<b>Pacing</b>	<b>Topics</b>	<b>Resources</b>	<b>Assessments</b>
<b>14 days</b>	Exploring bivariate data <ol style="list-style-type: none"><li>1. Analyzing patterns in scatterplots</li><li>2. Correlation and linearity</li><li>3. Least-squares regression line</li><li>4. Residual plots, outliers and influential points</li><li>5. Transformations to achieve linearity: logarithmic and power transformations</li></ol>	Text Chapters 7 - 10	<ul style="list-style-type: none"><li>• Investigative Tasks</li><li>• Quiz</li><li>• Test</li></ul>

**Unit 7** Inference for Related Variables**Enduring Understandings:**

- Significance tests can also determine the likelihood of a sample from a series of proportions.
- Significance tests can also determine whether two variables are independent.
- Confidence intervals can estimate the variation in a bivariate sample's slope.

**Essential Questions:**

- How can we verify that two variables are independent?
- How do you find critical values for a chi-square test?

<b>Pacing</b>	<b>Topics</b>	<b>Resources</b>	<b>Assessments</b>
<b>7 days</b>	Inference For Regression <ol style="list-style-type: none"><li>1. Confidence interval for the slope of a least-squares regression line</li><li>2. Test for the slope of a least-squares regression line</li></ol> Chi-Squared Distributions <ol style="list-style-type: none"><li>1. Simulation of Chi-square distribution</li><li>2. Chi-square test for goodness of fit, homogeneity of proportions, and independence (one- and two-way tables)</li></ol>	Text Chapters 26, 27	<ul style="list-style-type: none"><li>• Investigative Tasks</li><li>• Quiz</li><li>• Test</li></ul>