Advanced Placement (AP) Statistics

COURSE OF STUDY

Course Rationale:

In colleges and universities, the number of students who take a statistics course is almost as large as the number of students who take a calculus course. A July 2002 article in the Chronicle of Higher Education reports that the enrollment in statistics courses from 1990 to 2000 increased by 45 percent — one testament to the growth of statistics in those institutions. An introductory statistics course, similar to the AP Statistics course, is typically required for majors such as social sciences, health sciences and business. Every semester about 236,000 college and university students enroll in an introductory statistics course offered by a mathematics or statistics
department. In addition, a large number of students enroll in an introductory statistics course offered by other departments. Science, engineering and mathematics majors usually take an upper-level calculus-based course in statistics, for which the AP Statistics course is effective preparation.
Westerville City Schools encourages the elimination of barriers that restrict access to AP courses for students from ethnic, racial, and socioeconomic groups that have been traditionally underrepresented in the AP Program and makes every effort to ensure that AP classes reflect the diversity of our student population.

Considerations for Cultural Relevancy, Inclusivity, and Diversity:
Where possible teachers will create opportunities to incorporate the histories, values, beliefs and perspectives of people from different cultural backgrounds to meet the needs of all learners. Strategies for meeting the needs of all learners including gifted students, English Language Learners and students with disabilities can be found at this ODEW site.

Considerations for Intervention and Acceleration:
This rigorous and highly relevant curriculum is built upon high quality, research-based instructional strategies.Teachers may need to provide targeted Tier II support (e.g., remediation of particular skills and concepts, as well as scaffolded or supplemental instruction) beyond the Tier I level of universal instruction to underachieving students. Intensive and individualized Tier III instruction (e.g., skill-specific intervention, one-on-one support).

Recommended Grade Levels: 10-12
Recommended Prerequisite: Algebra 2
Course Length: Full Year, 1 Period
Credits: 1.0
Course Weighting: 1.25
Course Fee:

Course Description:

Portrait of a Successful AP Statistics Student

Textbook:
Stats: Modeling the World second edition 2007
David E. Bock, Paul F. Velleman, and Richard D. De Veaux
Pearson/Addison Wesley
ISBN: 0-13-187621-X

Scope and Sequence:

Unit	Approximate Length
Exploring Data	39 days
Sampling and Experimentation	34 days
Anticipating Patterns	20 days
Statistical Inference	38 days
Test preparation and Review	20 days

College Board AP Statistics Content Standards

Big Idea 1: Exploring Data - Describing patterns and departures from patterns

Essential Questions:

- What is data?
- Are there any patterns in the data? Departures from that pattern?
- How can data be displayed?
- Is there a best way for a data set to be displayed?
- What conjectures can be drawn from a data set?
- Is there causation between the variables or only association?
- What are the measures of central tendency and what information do they provide?
- What is standard deviation and how is it used?

Enduring Understandings:

- Exploratory analysis of data makes use of graphical and numerical techniques to study patterns and departures from patterns. Numerical and graphical representations of data are the starting point for both descriptive and inferential statistical analysis.
- There are multiple ways to validly display the same data.
- Constant association does not imply causation.
- To get information from data, it has to be organized in ways that allow a researcher to ask questions of interest to her or him.
- Whether data result from observations of individual subjects, from experimentation, or possibly from a simulation, the center, variability, shape of the distribution, and unusual or interesting features of data are of fundamental importance.

Learning Objectives:

Constructing and interpreting graphical displays of distributions of univariate data (dotplot, stemplot, histogram, cumulative frequency plot)

1. Center and spread
2. Clusters and gaps
3. Outliers and other unusual features
4. Shape

Summarizing distributions of univariate data

1. Measuring center: median, mean
2. Measuring spread: range, interquartile range, standard deviation
3. Measuring position: quartiles, percentiles, standardized scores (z-scores)
4. Using boxplots
5. The effect of changing units on summary measures

Comparing distributions of univariate data (dotplots, back-to-back stemplots, parallel boxplots)

1. Comparing center and spread: within group, between group variation
2. Comparing clusters and gaps
3. Comparing outliers and other unusual features
4. Comparing shapes

Exploring bivariate data

1. Analyzing patterns in scatterplots
2. Correlation and linearity
3. Least-squares regression line
4. Residual plots, outliers and influential points
5. Transformations to achieve linearity: logarithmic and power transformations

Exploring categorical data

1. Frequency tables and bar charts
2. Marginal and joint frequencies for two-way tables
3. Conditional relative frequencies and association
4. Comparing distributions using bar charts

Content Elaboration: In examining distributions of data, students should be able to detect important characteristics, such as shape, location, variability and unusual values. Emphasis should be placed on interpreting information from graphical and numerical displays and summaries. From careful observations of patterns in data, students can generate conjectures about relationships among variables. The notion of how one variable may be associated with another permeates almost all of statistics, from simple comparisons of proportions through linear regression. The difference between association and causation must accompany this conceptual development throughout.

Vocabulary: univariate data, bivariate data.measures of center and spread, mean, median, mode, range, outlier, quartile, interquartile range, standard deviation, standardized scores (z-scores), boxplot, histogram,stemplot,

Assessments:
Teacher created unit assessments with guidance from AP Statistics Teacher Community

Instructional Strategies and Resources:
*This section will be completed once teachers have been trained on the new curricular materials and can access the related learning management system.

Big Idea 2: Sampling and Experimentation - Planning and conducting a study

Essential Questions:	**Enduring Understandings:**
● How can data be collected to obtain valid information? ● How can bias be identified and prevented? ● What place to the concept of randomness play is data collecting?	● 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

● What conclusions can be drawn from data? ● Can the conclusions drawn from a data set be generalized?	and analysis. ● Bias exists in every experiment, the experimenter must identify their bias and take steps to prevent that bias from influencing their results.

Learning Objectives:

Overview of methods of data collection

1. Census
2. Sample survey
3. Experiment
4. Observational study

Planning and conducting surveys

1. Characteristics of a well-designed and well-conducted survey
2. Populations, samples and random selection
3. Sources of bias in sampling and surveys
4. Sampling methods, including simple random sampling, stratified random sampling and cluster sampling

Planning and conducting experiments

1. Characteristics of a well-designed and well-conducted experiment
2. Treatments, control groups, experimental units, random assignments and replication
3. Sources of bias and confounding, including placebo effect and blinding
4. Completely randomized design
5. Randomized block design, including matched pairs design generalizability of results and types of conclusions that can be drawn from observational studies, experiments and surveys

Content Elaboration: If data are to be collected to provide an answer to a question of interest, a careful plan must be developed. Both the type of analysis that is appropriate and the nature of conclusions that can be drawn from that analysis depend in a critical way on how the data was collected. Collecting data in a reasonable way, through either sampling or experimentation, is an essential step in the data analysis process.

Vocabulary: sampling methods: simple random, stratified random, cluster. Bias, placebo effect, blinding,

Assessments:
Teacher created unit assessments with guidance from AP Statistics Teacher Community

Instructional Strategies and Resources:
*This section will be completed once teachers have been trained on the new curricular materials and can access the related learning management system.

Big Idea 3: Anticipating Patterns - Exploring random phenomena using probability and simulation

Essential Questions:

- What is the Law of Large Numbers?
- What is the normal distribution and what are its usages?
- How can probability be used to model events?
- Can modeling be used to predict the future?

Enduring Understandings:

- Probability is the tool used for anticipating what the distribution of data should look like under a given model.
- Law of Large Numbers is an important concept when using probabilistic models.
- Understand the concept of randomness and its application to probability and statistics.

Learning Objectives:

Probability

1. Interpreting probability, including long-run relative frequency interpretation
2. "Law of Large Numbers" concept
3. Addition rule, multiplication rule, conditional probability and independence
4. Discrete random variables and their probability distributions, including binomial and geometric
5. Simulation of random behavior and probability distributions
6. Mean (expected value) and standard deviation of a random variable, and linear transformation of a random variable

Combining independent random variables

1. Notion of independence versus dependence
2. Mean and standard deviation for sums and differences of independent random variables

The normal distribution

1. Properties of the normal distribution
2. Using tables of the normal distribution
3. The normal distribution as a model for measurements

Sampling distributions

1. Sampling distribution of a sample proportion
2. Sampling distribution of a sample mean
3. Central Limit Theorem
4. Sampling distribution of a difference between two independent sample proportions
5. Sampling distribution of a difference between two independent sample means
6. Simulation of sampling distributions
7. t-distribution
8. Chi-square distribution

Content Elaboration: Random phenomena are not haphazard: they display an order that emerges only in the long run and is described by a distribution. The mathematical description of variation is central to statistics. The probability required for statistical inference is not primarily axiomatic or combinatorial but is oriented toward using probability distributions to describe data.

Vocabulary: Law of Large Numbers, normal distribution, probability, addition rule, multiplication rule, conditional probability, independence, probability

distribution,
Assessments: Teacher created unit assessments with guidance from AP Statistics Teacher Community
Instructional Strategies and Resources: *This section will be completed once teachers have been trained on the new curricular materials and can access the related learning management system.

Big Idea 4: Statistical Inference - Estimating population parameters and testing hypotheses	
Essential Questions: ● What is the Central Limit Theorem? ● How can we verify that two variables are independent? ● What is the significance of standard error? ● What are the tests for statistical significance? ● What are confidence intervals?	**Enduring Understandings:** ● Statistical inference guides the selection of appropriate models. ● Constant conjunction does not imply causation.

• Does association imply causation?	

Learning Objectives:

Estimation (point estimators and confidence intervals)

1. Estimating population parameters and margins of error
2. Properties of point estimators, including unbiasedness and variability
3. Logic of confidence intervals, meaning of confidence level and confidence intervals, and properties of confidence intervals
4. Large sample confidence interval for a proportion
5. Large sample confidence interval for a difference between two proportions
6. Confidence interval for a mean
7. Confidence interval for a difference between two means (unpaired and paired)
8. Confidence interval for the slope of a least-squares regression line

Tests of significance

1. Logic of significance testing, null and alternative hypotheses; p-values; one- and two-sided tests; concepts of Type I and Type II errors; concept of power
2. Large sample test for a proportion
3. Large sample test for a difference between two proportions
4. Test for a mean
5. Test for a difference between two means (unpaired and paired)
6. Chi-square test for goodness of fit, homogeneity of proportions, and independence (one- and two-way tables)
7. Test for the slope of a least-squares regression line

Content Elaboration: Models and data interact in statistical work: models are used to draw conclusions from data, while the data are allowed to criticize and even falsify the model through inferential and diagnostic methods. Inference from data can be thought of as the process of selecting a reasonable model, including a statement in probability language, of how confident one can be about the selection.

Vocabulary: standard error, null hypothesis,Chi-square test, t-distributions, independence, homogeneity of proportions,

Assessments:
Teacher created unit assessments with guidance from AP Statistics Teacher Community

Instructional Strategies and Resources:
*This section will be completed once teachers have been trained on the new curricular materials and can access the related learning management system.

Considerations for Intervention and Acceleration:

The AP Computer Science Principles curriculum is built upon high quality, research-based instructional strategies. Teachers may to need to provide targeted Tier II support (e.g., remediation of particular skills and concepts, as well as scaffolded or supplemental instruction) beyond the Tier I level of universal instruction to underachieving students. Intensive and individualized Tier III instruction (e.g., skill-specific intervention, one-on-one teaching, enrichment activities) may be necessary for students with significant underachievement or learners who are excelling through the standard curriculum and need additional educational challenges.

Considerations for Cultural Diversity, Inclusivity and Relevancy:

Where possible teachers will create opportunities to incorporate the histories, values, beliefs and perspectives of people from different cultural backgrounds to meet the needs of all our learners.