



Mathematics
Grade 10-12
AP Statistics

Dr. Mark Toback, Superintendent
Committee: Nancy Mahoney
Compliance Update Completed on June 2022

*This curriculum may be modified through varying techniques, strategies,
and materials as per an individual student's Individualized Educational
Plan (IEP)*

**Approved by the Wayne Township Board of Education at the regular
meeting held on November 15, 2018.**

Wayne School District Curriculum Format

Content Area/ Grade Level/ Course:	Statistics 10 - 12 AP Statistics
Unit Plan Title:	Unit 1: Organizing Data
Time Frame	55 Days
Anchor Standards/Domain* *i.e: ELA: reading, writing i.e.: Math: Algebra	
<p>S-ID.1 - 4 Summarize, represent, and interpret data on a single count or measurement variable</p> <p>S-ID.5- 6 Summarize, represent, and interpret data on two categorical and quantitative variables</p> <p>S-ID.7- 9 Interpret linear models</p>	
Unit Overview	
<ul style="list-style-type: none"> ● Visually display and compare data in various graphical forms and look for overall patterns/skewness including outliers ● Measure center: Mean and Median, Spread: IQR, identify outliers, standard deviation ● Measure Position: Percentiles, Cumulative Relative Frequency Graphs ,z-scores ● Standard Normal Distribution (z -score) ● Assess Normality ● Define a density curve and explain where the mean and median of a density curve are found ● Use a graphing calculator to obtain summary statistics as well as to graph data ● Recognize the shape and characteristics of a normal curve ● Measuring linear association: correlation ● Find and analyze regression lines & use to predict values and assess appropriateness of these predictions ● Calculate residual values and use these residual plots to recognize unusual patterns and the appropriateness of a linear model and when to transform a nonlinear model and its advantages ● Recognize the limitations of linear regression ● Identify the presence of confounding variables ● Interpret a two-way table and use to find marginal and conditional probabilities ● Recognize and explain Simpson's paradox 	
Standard Number(s) * i.e: Math: F.LE.A.4 i.e.: NJLSA.R4.	
<ul style="list-style-type: none"> ● S-ID.1. Represent data with plots on the real number line (dot plots, histograms, and box plots). ● S-ID.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. ● S-ID.3. Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers). 	

- **S-ID.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 procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate areas under the normal curve.
- **S-ID.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.
- **S-ID.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. a) Fit a function to the data; use functions fitted to data to solve problems in the context of the data. Use given functions or choose a function suggested by the context. Emphasize linear, quadratic, and exponential models. b) Informally assess the fit of a function by plotting and analyzing residuals. c) Fit a linear function for a scatter plot that suggests a linear association.
- **S-ID.7.** Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data. **S-ID.8.** Compute (using technology) and interpret the correlation coefficient of a linear fit.
- **S-ID.9.** Distinguish between correlation and causation.
- **CRP2.** Apply appropriate academic and technical skills.
- **CRP4.** Communicate clearly and effectively and with reason.
- **CRP11.** Use technology to enhance productivity.
- **8.1.12.DA.5:** Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena.
- **8.1.12.DA.6:** Create and refine computational models to better represent the relationships among different elements of data collected from a phenomenon or process.
- **8.1.12.AP.1:** Design algorithms to solve computational problems using a combination of original and existing algorithms.
- **9.1.12.PB.2:** Prioritize financial decisions by considering alternatives and possible consequences.
- **9.2.12.CAP.4:** Evaluate different careers and develop various plans (e.g., costs of public, private, training schools) and timetables for achieving them, including educational/training requirements, costs, loans, and debt repayment.
- **9.4.12.CI.1:** Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).
- **9.4.12.CT.2:** Explain the potential benefits of collaborating to enhance critical thinking and problem solving (e.g., 1.3E.12 prof.CR3.a)
- **9.4.12.IML.3:** Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions (e.g., S-ID.B.6a., 8.1.12.DA.5, 7.1.IH.IPRET.8)
- **9.4.12.TL.1:** Assess digital tools based on features such as accessibility options, capacities, and utility for accomplishing a specified task (e.g., W.11-12.6.).
- **RST.9-10.3./RST.11-12.3.** Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

- RST.9-10.7. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.
- RST.9-10.4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.

Intended Outcomes - {Essential Questions}

- How do we communicate data?
- How do we understand data?
- How can modeling data help us to understand patterns?
- Identify real-life situations in which a transformation can be used to linearize data from an exponential model
- How can situations in which a transformation is required to linearize a power model be identified?
- Is correlation ever causation?
- What is a random variable? How can they be combined?

Enduring Understandings

- How to support all answers with numerical evidence
- Statistical ideas build upon one another
- How to apply statistics to real world problems

In this unit plan, the following 21st Century themes and skills are addressed.

<i>Check all that apply.</i> 21st Century Themes		<i>Indicate whether these skills are E-Encouraged, T-Taught, or A-Assessed in this unit by marking E, T, A on the line before the appropriate skill.</i> 21st Century Skills	
X	Global Awareness	ET A	Creativity and Innovation
X	Environmental Literacy	ET A	Critical Thinking and Problem Solving
X	Health Literacy	ET A	Communication
X	Civic Literacy	E	Collaboration
X	Financial, Economic, Business, and Entrepreneurial Literacy		

Student Learning Targets/Objectives (Students will know/Students will understand)

What is the z-score corresponding to an x -value of 48 for a normal distribution with a mean of 41 and a standard deviation of 5?

The duration of routine operations in a certain hospital has approximately a normal distribution with an average of 130 minutes and a standard deviation of 20 minutes. Approximately what percentage of operations last longer than 90 minutes?

Make an ordered stem-and-leaf plot of the data. Then make a box-and-whisker plot of the data.
17 in., 22 in., 36 in., 19 in., 24 in., 27 in., 31 in., 26 in., 28 in.

Assessments (Pre, Formative, Summative, Other)

*Denote required common assessments with an **

- Tests
- Quizzes
- Clickers
- Communicators
- Discussions
- Labs
- Homework

Teaching and Learning Activities

<i>Activities</i>	http://www.learner.org/resources/series65.html ; programs 1 to 9 www.shodor.org www.explorellearning.org http://www.khanacademy.org/math/statistics
<i>Differentiation Strategies</i>	
<i>Honors</i>	

Resources

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- <http://www.khanacademy.org/math/statistics>
- http://bcs.whfreeman.com/tps4e/#t_628644
- http://coedpages.uncc.edu/rglamber/AP%20Materials/internet_resources_for_ap_statist.htm

**Wayne School District
Curriculum Format**

Content Area/ Grade Level/ Course:	Statistics 10 - 12 AP Statistics
Unit Plan Title:	Unit 2: PRODUCING DATA – SAMPLING & EXPERIMENTAL DESIGN
Time Frame	12 Days
Anchor Standards/Domain*	*i.e: ELA: reading, writing i.e.: Math: Algebra

- **S-IC.3** Make inferences and justify conclusions from sample surveys, experiments, and observational studies
- **S-ID.9.** Distinguish between correlation and causation.

Unit Overview

- **Recognize simple random samples & other sampling methods and the strengths/weakness of each**
- **Recognize various types of bias**
- **Distinguish between an experiment versus a study**
- **Recognize when the double-blind technique should be used**
- **Understand the placebo effect**
- **Use the experimental design principles: randomization, replication and control**
- **Generate an outline for a completely randomized design**
- **Distinguish between blocking and matched pairs designs**
- **Explain why a randomized comparative experiment gives good evidence for cause-effect relationships**
- **Simulate experiments with the use of random digits table/and graphing calculator**

Standard Number(s) * i.e: Math: F.LE.A.4 i.e.: NJSLSA.R4.

- **S-IC.3.** Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.
- **S-ID.9.** Distinguish between correlation and causation.
- **S.MD.6** Use probability to evaluate outcomes of decisions. Use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator).
- **CRP2.** Apply appropriate academic and technical skills.
- **CRP4.** Communicate clearly and effectively and with reason
- **CRP5.** Consider the environmental, social and economic impacts of decisions.
- **CRP11.** Use technology to enhance productivity.
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Intended Outcomes - {Essential Questions}

- How do we obtain data?
- To what extent does data collection methodology affect results?
- To what extent can data be purposefully biased?
- How does one decide between an observational study, an experiment and a simulation?
- How can variability be eliminated through randomization?

Enduring Understandings

- How to draw connections between all aspects of the statistical process, including design, analysis and conclusions
- How to support all answers with numerical evidence
- Statistical ideas build upon one another
- How to apply statistics to real world problems

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X	Global Awareness	ET A	Creativity and Innovation
X	Environmental Literacy	ET A	Critical Thinking and Problem Solving

X	Health Literacy
X	Civic Literacy
X	Financial, Economic, Business, and Entrepreneurial Literacy

ET	Communication
ET	Collaboration

Student Learning Targets/Objectives (Students will know/Students will understand)

- A state senator wants to know what citizens think about the senate bill. The Senator has people call in to take a survey. What type of sample is this?
- Raj studies the number of pets owned by students at his school. He finds the more dogs a student has, the more birds the student tends to have. a) Are the number of dogs and the number of birds positively correlated, negatively correlated, or neither? b) Does this mean that an increase in one quantity causes an increase in the other? Explain.

Assessments (Pre, Formative, Summative, Other)

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**Wayne School District
Curriculum Format**

Content Area/ Grade Level/ Course:	Statistics 10 - 12 AP Statistics
Unit Plan Title:	Unit 3: Probability
Time Frame	40 Days
Anchor Standards/Domain* *i.e: ELA: reading, writing i.e.: Math: Algebra	
<ul style="list-style-type: none"> ● S-CP.1. to 5. Understand independence and conditional probability and use them to interpret data ● S-CP.6. to 9. Use the rules of probability to compute probabilities of compound events in a uniform probability model 	
Unit Overview	
<ul style="list-style-type: none"> ● Define Probability versus statistics ● Discuss the Gambler's Fallacy ● Use Probability Models and rules ● Generate Venn Diagrams and Tree Diagrams ● Use of simulations to estimate probabilities using graphing calculator and /or table of random digits ● Distinguish between Discrete and Continuous random variables ● Calculate the mean and variance of discrete random variables and use the rules to find sum/difference/linear combination of rv ● Understand the Law of Large Numbers 	

- Distinguish between Binomial and Geometric rv
- Calculate binomial and geometric probabilities by formula/calculator and graphically display the distributions
- Use the normal approximation to the binomial
- Distinguish between Parameter and Statistic; preparing for inference
- Interpret a sampling distribution of a sample mean, including bias and variability and how to influence each
- Understand how to use the Central Limit Theorem to approximate a normal distribution

Standard Number(s) * i.e: **Math: F.LE.A.4** i.e.: **NJLSA.R4.**

- **S-CP.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”).
- **S-CP.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.
- **S-CP.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 .
- **S-CP.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. *For example, collect data from a 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*
- **S-CP.5.** Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations. *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*
- **S-CP.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.
- **S-CP.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.
- **S-CP.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
- **S-CP.9.** Use permutations and combinations to compute probabilities of compound events and solve problems
- **S.MD.1** Calculate expected values and use them to solve problems. 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.

- S.MD.6 Use probability to evaluate outcomes of decisions. Use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator).
- S.MD.7 Use probability to evaluate outcomes of decisions. Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game).
- 8.1.12.DA.5: Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena.
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- CRP2. Apply appropriate academic and technical skills.
- CRP4. Communicate clearly and effectively and with reason.
- CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.
- CRP11. Use technology to enhance productivity.

Intended Outcomes - {Essential Questions}

- **When is probability a sure thing?**
- **How can we base decisions on chance?**
- **What is a random variable?**
- **How many random variables can be combined?**

- To what extent does our world exhibit binomial and geometric phenomena?
- How do sampling distributions relate to population distributions?
- What is a normal distribution?
- How does a normal distribution apply to the real world?

Enduring Understandings

- How to draw connections between all aspects of the statistical process, including design, analysis and conclusions
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X	Health Literacy	ET	Communication
X	Civic Literacy	ET	Collaboration
X	Financial, Economic, Business, and Entrepreneurial Literacy		

Student Learning Targets/Objectives (Students will know/Students will understand)

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Events A and B are independent. Find the missing probability.

$$P(A) = 0.9$$

$$P(B) = 0.75$$

$$P(A \text{ and } B) = \underline{\hspace{2cm}}$$

•

You randomly draw letter tiles from a bag containing the letters from the word PENNSYLVANIA. Find the probability that you draw an N from the bag and then, without replacing the first N, you draw another N. Then tell whether the events are *independent* or *dependent*.

If a coin is flipped twice, what is the probability that the result is heads both times?

Sheryl and Tess play basketball for the Tigers. The probability of Sheryl making a free throw is 0.25 and the probability of Tess making a free throw is 0.32. Find the probability of Sheryl making a free throw and Tess *not* making a free throw. Write your answer as a decimal.

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**Wayne School District
Curriculum Format**

Content Area/ Grade Level/ Course:	Statistics 10 - 12 AP Statistics
Unit Plan Title:	Unit 4: Introduction to Inference
Time Frame	35 Days
Anchor Standards/Domain*	*i.e: ELA: reading, writing i.e.: Math: Algebra

- **S-IC.1 & 2** Understand and evaluate random processes underlying statistical experiments
- **S-IC.3 - 6** Make inferences and justify conclusions from sample surveys, experiments, and observational studies

Unit Overview

- Explain what is meant by statistical inference
- Identify the basic form of all confidence intervals and verify the conditions that need to be met in order to construct a valid confidence interval, and interpret in context
- Obtain a confidence interval with a graphing calculator
- Explain what is meant by margin of error
- Understand the logic of significance tests
- Explain/list the differences between a null and alternative hypothesis
- Verify inference conditions and choose the appropriate significance test to carry out
- Determine the critical values, interpret P values and assess statistical significance by comparing values
- Distinguish among Type I, Type II errors and & power in significance testing
- Choose and carry out the appropriate chi-square procedure for a given situation
- Recognize when linear regression inference is appropriate for a set of data and carry out test; interpret results
- Interpret the regression from a computer output
- Explain what is meant by the standard error about the least squares line.

Standard Number(s) * i.e: Math: F.LE.A.4 i.e.: NJLSA.R4.

- **S-IC.1.** Understand statistics as a process for making inferences about population parameters based on a random sample from that population.
- **S-IC.3.** Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.
- **S-IC.4.** Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling.
- **S-IC.4.** Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling.
- **S-IC.6.** Evaluate reports based on data.
- **S.MD.2** Calculate expected values and use them to solve problems. Calculate the expected value of a random variable; interpret it as the mean of the probability distribution.
- **S.MD.3** Calculate expected values and use them to solve problems. Develop a probability distribution for a random variable defined for a sample space in which theoretical probabilities can be calculated; find the expected value. 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.
- **S.MD.4** Calculate expected values and use them to solve problems. Develop a probability distribution for a random variable defined for a sample space in which probabilities are assigned empirically; find the expected value. 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?

- S.MD.5 Use probability to evaluate outcomes of decisions. Weigh the possible outcomes of a decision by assigning probabilities to payoff values and finding expected values.
- S.MD.5a Find the expected payoff for a game of chance. For example, find the expected winnings from a state lottery ticket or a game at a fast-food restaurant.
- S.MD.5b Evaluate and compare strategies on the basis of expected values. 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.
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- CRP2. Apply appropriate academic and technical skills.
- CRP4. Communicate clearly and effectively and with reason.
- CRP5. Consider the environmental, social and economic impacts of decisions.
- CRP6. Demonstrate creativity and innovation.

- CRP7. Employ valid and reliable research strategies.
- CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.
- CRP11. Use technology to enhance productivity.
- CRP12. Work productively in teams while using cultural global competence.

Intended Outcomes - {Essential Questions}

- What is inference?
- How can decisions be based on chance and to what extent should decisions be made based on chance?
- When are tests of significance and confidence intervals used?
- How can one prepare for errors from significance tests?
- To what extent are significance tests reliable?
- How can we determine the mean/proportion of a population from a small sample?
- How can we test a series of proportions?
- How can significance tests and confidence intervals be used together to help draw conclusions about a population proportion?
- How can we verify that two variables are independent?
- How can we test a slope of a correlation?

Enduring Understandings

- How to draw connections between all aspects of the statistical process, including design, analysis and conclusions
- How to support all answers with numerical evidence
- Statistical ideas build upon one another
- How to apply statistics to real world problems

In this unit plan, the following 21st Century themes and skills are addressed.

<i>Check all that apply.</i> 21st Century Themes		<i>Indicate whether these skills are E-Encouraged, T-Taught, or A-Assessed in this unit by marking E, T, A on the line before the appropriate skill.</i> 21st Century Skills	
X	Global Awareness	ET A	Creativity and Innovation
X	Environmental Literacy	ET A	Critical Thinking and Problem Solving
X	Health Literacy	ET	Communication
X	Civic Literacy	ET	Collaboration

Student Learning Targets/Objectives (Students will know/Students will understand)

- A company conducts a poll for a governor's election. How many people did the company poll if the margin of error is +/- 2%?
- The drama club at Pioneer High School randomly surveyed 100 students and found that 62 students would attend the next drama production. Find the sample percent of students that would attend the production. Find the margin of error for the sample proportion. Then find an interval that is likely to contain the exact percent of all students at Pioneer High who would attend the next production.
- In a randomized comparative experiment two groups of students were given a math test covering a topic not found in the curriculum. Prior to taking the test, Group A was taught a lesson on the concepts being tested while Group B took the test without any previous exposure to the topic. Which group represents the control group?
- In a randomized comparative experiment two groups of adults who indicated they were considering voting in the upcoming mayoral election were randomly selected. In the experiment the individuals in Group A were left on their own while the individuals in Group B were offered a ride to the polling place on Election Day. Which group represents the treatment group?
- Marissa asked four classmates to name their favorite restaurant. Three classmates answered Big Burger, and one answered Salad Stop. Explain why the following statement is misleading: "Big Burger is the favorite restaurant of a majority of students".
- Identify the type of sample and describe the population. Then tell if the sample is biased. Explain your reasoning: A school newspaper is conducting a survey to predict who will win the next school election. The newspaper sets up a booth where the students can come to give their opinions.

Assessments (Pre, Formative, Summative, Other)*Denote required common assessments with an **

Tests
Quizzes
Clickers
Communicators
Discussions
Labs
Homework

Teaching and Learning Activities*Activities*

<http://www.learner.org/resources/series65.html>; programs 18 to 25
www.shodor.org
www.explorellearning.org
<http://www.khanacademy.org/math/statistics>

*Differentiation Strategies**Honors***Resources**

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- www.explorelearning.org
- <http://www.khanacademy.org/math/statistics>
- http://bcs.whfreeman.com/tps4e/#t_628644
- http://coedpages.uncc.edu/rglamber/AP%20Materials/internet_resources_for_ap_statis.htm