Honors Statistics
Curriculum
Grades 10-12

NEPTUNE TOWNSHIP SCHOOL DISTRICT
Office of the Superintendent
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Neptune, NJ 07753-4836
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NEPTUNE TOWNSHIP SCHOOL DISTRICT

HONORS STATISTICS
GRADES 10-12
CURRICULUM

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NEPTUNE TOWNSHIP SCHOOL DISTRICT

Honors Statistics

Acknowledgements

The Neptune Township School District Statistics Honors Curriculum guide for grades 11-12 was developed through the efforts of Erin Seneca, teacher of mathematics, under the guidance of Dawn Reinhardt, Department Chairperson, and Sally A. Millaway, Ed.D., Director for Curriculum, Instruction and Assessment.

This curriculum was written in alignment with the 2016 New Jersey Student Learning Standards for Mathematics and the increased rigor that those standards bring to the teaching and learning of mathematics. The teacher is commended for her dedication in creating this curriculum and formatting it into UbD and her expertise in the area of statistical mathematics. It is our hope that this curriculum will serve as a valuable resource for the staff members who teach this course and that they will continue to make recommendations for improvement to the document.
NEPTUNE TOWNSHIP SCHOOL DISTRICT

DISTRICT MISSION STATEMENT

The primary mission of the Neptune Township School District is to prepare students for a life-long learning process in a complex and diverse world. It is with high expectations that our schools foster:

• A strong foundation in academic and modern technologies.

• A positive and varied approach to teaching and learning.

• An emphasis on critical thinking skills and problem-solving techniques.

• A respect for and an appreciation of our world, its resources, and its people.

• A sense of responsibility, good citizenship, and accountability.

• An involvement by the parents and the community in the learning process.
Neptune Township School District

Educational Outcome Goals

The students in the Neptune Township schools will become life-long learners and will:

- Become fluent readers, writers, speakers, listeners, and viewers with comprehension and critical thinking skills.
- Acquire the mathematical skills, understandings, and attitudes that are needed to be successful in their careers and everyday life.
- Understand fundamental scientific principles, develop critical thinking skills, and demonstrate safe practices, skepticism, and open-mindedness when collecting, analyzing, and interpreting information.
- Become technologically literate.
- Demonstrate proficiency in all New Jersey Student Learning Standards (NJSLS).
- Develop the ability to understand their world and to have an appreciation for the heritage of America with a high degree of literacy in civics, history, economics and geography.
- Develop a respect for different cultures and demonstrate trustworthiness, responsibility, fairness, caring, and citizenship.
- Become culturally literate by being aware of the historical, societal, and multicultural aspects and implications of the arts.
- Demonstrate skills in decision-making, goal setting, and effective communication, with a focus on character development.
- Understand and practice the skills of family living, health, wellness and safety for their physical, mental, emotional, and social development.
- Develop consumer, family, and life skills necessary to be a functioning member of society.
- Develop the ability to be creative, inventive decision-makers with skills in communicating ideas, thoughts and feelings.
- Develop career awareness and essential technical and workplace readiness skills, which are significant to many aspects of life and work.
HONORS STATISTICS CURRICULUM

COURSE DESCRIPTION

(5 credits)

In this course, students develop strategies for collecting, organizing, analyzing, and drawing conclusions from data. Students design, administer, and tabulate results from surveys and experiments. Probability and simulations aid students in constructing models for chance behavior. Sampling distributions provide the logical structure for confidence intervals and hypothesis tests. Students use a TI graphing calculator, available statistical software (eg. Minitab, Excel), and Web-based java applets to investigate statistical concepts. To develop effective statistical communication skills, students are required to prepare frequent written and oral analyses of real data.

Prerequisites:
- Successful completion of Algebra II
- Successful completion of pre-calculus (recommended)
Unit Plan Title | Descriptive Statistics
--- | ---
Suggested Time Frame | 12 days

### Overview / Rationale

In this unit, students will learn ways to organize and describe data sets. Students will use frequency distributions, graphs, measures of central tendency, measures of variation, and the 5-number summary to describe data sets. The goal of this unit is to make data easier to understand by making it easier to see trends, averages and variations. At the end of this unit students will be able to collect, analyze and describe findings of data.

### Stage 1 – Desired Results

#### 2016 New Jersey Student Learning Standards for Mathematics

- **N-Q.2** Define appropriate quantities for the purpose of descriptive modeling.
- **N-Q.3** Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
- **S-IC.3** Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.
- **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.
Standards for Mathematical Practice
1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Essential Questions:
• What are some of the various ways we can graphically represent frequency distributions? How are they similar? How do they differ?
• What determines whether data is qualitative or quantitative?
• What are the measures of central tendency? How are they determined? How are they similar? How do they differ?
• How can measures of variation be determined and interpreted?

Enduring Understandings:
Students will understand that...
• Qualitative data identify as a category for each case and quantitative data record values and measurements. Sometimes a variable can treated as either qualitative or quantitative depending on what we want to learn from it.
• Measures of central tendency are the mean, median and mode. Determining these values will tell you about the center of the data.
• Measures of variation are standard deviation, variation, and range. These values will describe the spread of the data. This will help to determine the accuracy of our measures of central tendency.
### Knowledge:

*Students will know…*

- A relative frequency is the ratio of the number of times an event occurs to the number of occasions on which it might occur in the same period.
- A cumulative frequency distribution is the sum of the class and all classes below it in a frequency distribution.
- How to construct a frequency histogram.
- Distribution shapes are identified as symmetric, uniform or skewed.
- How to differentiate between qualitative and quantitative data.
- The mean is the average that is used to derive the central tendency of the data in question.
- The median is a simple measure of central tendency. To find the median, we arrange the observations in order from smallest to largest value. If there is an odd number of observations, the median is the middle value. If there is an even number of observations, the median is the average of the two middle values.
- The mode of a set of data values is the value that appears most often.
- A weighted mean is a kind of average. Instead of each data point contributing equally to the final mean, some data points contribute more “weight” than others.
- How to interpret symmetric, uniform and skewed distributions.
- The Empirical Rule is used to estimate the percentage of observations falling between 1, 2, and 3 standard deviations from the mean.

### Skills:

*Students will be able to…*

- Analyze and interpret sets of data and graphically represent the data in frequency distributions that are appropriate for the data given including relative frequency distributions, bar graphs, pie charts, Pareto charts, Time Series, Contingency tables, Conditional Distributions, and Marginal Distributions.
- Compare and contrast the various ways we can graphically represent frequency distributions.
- Calculate classes and midpoints to construct relative frequency charts, cumulative frequency charts, and frequency histograms.
- Determine distribution shapes by creating appropriate distribution charts and identifying outliers.
- Classify a variable as quantitative or qualitative depending on its use.
- Calculate mean, median, mode and weighted means. Use these values to describe a distribution center.
- Describe a distribution as skewed or uniform using measures of center and spread.
- Calculate range, standard deviation and variance.
- Use the Empirical rule to determine percentages of observations falling above, below or between any values in a normal distribution.
### Integrated Social and Emotional Learning Competencies

*The following social and emotional competencies are integrated in this curriculum document:

#### Self-Awareness
- ☐ Recognize one’s own feelings and thoughts
- ☐ Recognize the impact of one’s feelings and thoughts on one’s own behavior
  - ☒ Recognize one’s personal traits, strengths and limitations
  - ☒ Recognize the importance of self-confidence in handling daily tasks and challenges

#### Self-Management
- ☐ Understand and practice strategies for managing one’s own emotions, thoughts and behaviors
  - ☒ Recognize the skills needed to establish and achieve personal and educational goals
- ☐ Identify and apply ways to persevere or overcome barriers through alternative methods to achieve one’s goals

#### Social Awareness
- ☐ Recognize and identify the thoughts, feelings, and perspectives of others
- ☐ Demonstrate an awareness of the differences among individuals, groups, and others’ cultural backgrounds
  - ☒ Demonstrate an understanding of the need for mutual respect when viewpoints differ
  - ☒ Demonstrate an awareness of the expectations for social interactions in a variety of setting

#### Responsible Decision Making
  - ☒ Develop, implement and model effective problem solving and critical thinking skill
  - ☒ Identify the consequences associated with one’s action in order to make constructive choices
- ☐ Evaluate personal, ethical, safety and civic impact of decisions

#### Relationship Skills
  - ☒ Establish and maintain healthy relationships
  - ☒ Utilize positive communication and social skills to interact effectively with others
  - ☒ Identify ways to resist inappropriate social pressure
  - ☒ Demonstrate the ability to present and resolve interpersonal conflicts in constructive ways
  - ☒ Identify who, when, where, or how to seek help for oneself or others when needed
In this unit plan, the following 21st Century Life and Careers skills are addressed:

<table>
<thead>
<tr>
<th>Check ALL that apply – 21st Century Themes</th>
<th>Indicate whether these skills are:</th>
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<tbody>
<tr>
<td>CRP1. Act as a responsible and contributing citizen and employee.</td>
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<td>CRP2. Apply appropriate academic and technical skills.</td>
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<tr>
<td>CRP3. Attend to personal health and financial well-being.</td>
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<tr>
<td>CRP4. Communicate clearly and effectively and with reason.</td>
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<tr>
<td>CRP5. Consider the environmental, social and economic impacts of decisions.</td>
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<tr>
<td>CRP6. Demonstrate creativity and innovation.</td>
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<tr>
<td>CRP7. Employ valid and reliable research strategies.</td>
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<td>CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.</td>
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<td>CRP9. Model integrity, ethical leadership and effective management.</td>
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<td>CRP10. Plan education and career paths aligned to personal goals.</td>
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<tr>
<td>CRP11. Use technology to enhance productivity.</td>
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<tr>
<td>CRP12. Work productively in teams while using cultural global competence.</td>
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**Career Awareness, Exploration, and Preparation**

- Human Resources Analyst
- Data Analysis
- Physical Education Program Assistant
- Statistician / Biostatistician
- Qualitative Research Consultant
- Epidemiologist
### Interdisciplinary Connections

**New Jersey Student Learning Standards - ELA**

- **R.1**: Read closely to determine what the text say as explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.
- **W.1**: Write arguments to support claims in an analysis of substantive topics or texts using valid reasoning and relevant and sufficient evidence.
- **W.2**: Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selections organization, and analysis of content.

### Technology Integration

**New Jersey Student Learning Standards for Technology**

**NJSLS 8.1 Educational Technology**: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.

- Google Suite: Docs, Sheets, Slides, Forms
- Microsoft Platform: Word, EXCEL, PowerPoint
- Online Subscriptions: Minitab
- Assessment(s): *LinkIt! Statistics Midterm 2019*
- Devices:
  - Chromebooks
  - Texas Instruments (TI-89) Calculators
  - SMART / Promethean Interactive Boards
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<td>- \texttt{www.khanacademy.com}</td>
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<td>- \texttt{www.apstatsmonkey.com}</td>
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<td>- \texttt{www.mathxl.com}</td>
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<td>- \texttt{www.statsci.org}</td>
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<td>- \texttt{www.amstat.org}</td>
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<td>- \texttt{<a href="https://www.learner.org/courses/againstalodds/%7D">https://www.learner.org/courses/againstalodds/}</a></td>
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<tr>
<td><strong>Worksheets:</strong> Teacher created worksheets</td>
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<td><strong>Videos:</strong></td>
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### Stage 2 – Assessment Evidence

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<tr>
<th>Performance Task(s):</th>
<th>Other Evidence:</th>
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</table>
| **M&M’s Data Collection**  
  - Students will collect data from mini bags of milk chocolate M&M’s.  
  - This data will be used later in the next M&M activity.  
  - This is used to gauge basic understandings of statistical concepts and to describe the 4 main themes of Statistics: Describing Data, Collection of Data, Probability and Inference.  | **Pre-Assessment**  
  **Formative Assessments**  
  **Exit Slips**  
  **Self-Assessment**  
  **Informal Observations**  
  **LinkIt! Statistics Midterm 2019**  
  **Summative Assessments: Quizzes, Unit Tests, Final Assessment** |
| **The Great M&M’s Experiment**  
  - Students will determine the percentage of orange M&M’s in their data set and create a dot plot using all other students data.  
  - They will then determine if the data they have is normal or skewed and explain why. | |

### Stage 3 – Learning Plan

<table>
<thead>
<tr>
<th>Suggested Learning Activities</th>
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</table>
| **Frequency distribution constructions of collected data**  
**Interpreting frequency distributions**  
**Graphing data sets**  
**Interpreting graphically represented data sets**  
**Working with measures of central tendency**  
**Using measure of position to represent and interpret data sets** |
<table>
<thead>
<tr>
<th><strong>Unit Plan Title</strong></th>
<th>Exploring Relations Between Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Suggested Time Frame</strong></td>
<td>11 days</td>
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</tbody>
</table>

**Overview / Rationale**

In this unit, students will be able to generate graphs and numerical displays for bivariate data (scatterplots). Students will be able to look at the relationship between two quantitative variables such as correlation and simple linear regression. By the end of this unit they will be able to predict and present correlated data sets using computer programs.

**Stage 1 – Desired Results**

### 2016 New Jersey Student Learning Standards for Mathematics

- **N-Q.2** Define appropriate quantities for the purpose of descriptive modeling.
- **N-Q.3** Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
- **S-ID.6** Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.
- **S-ID.6.A** Fit a function to the data (including with the use of technology); 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 and exponential models.*
- **S-ID.6.B** Informally assess the fit of a function by plotting and analyzing residuals, including with the use of technology.
- **S-ID.6.C** Fit a linear function for a scatter plot that suggests a linear association.
- **S-ID.C.7** Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.
- **S-ID.C.8** Compute (using technology) and interpret the correlation coefficient of a linear fit.
- **S-ID.C.9** Distinguish between correlation and causation.

### Standards for Mathematical Practice

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.
### Essential Questions:
- When looking at data collected between two variables, how can we judge their correlations?
- How are correlation and causation related to each other?
- If two variables are correlated, how can we predict one variable’s value given the value of the other variable?

### Enduring Understandings:
*Students will understand that…*
- The level of correlation between two pairs of ordered data can be evaluated.
- Correlation does not signify causation. Scatterplots and Correlation never prove causation. Correlation can show an association but it takes years to provide evidence of causation.
- High levels of linear correlation can be used to predict values for non-sampled situations using linear regression techniques.

### Knowledge:
*Students will know…*
- Relationships between correlation, explanatory variables and response variables.
- How to distinguish between correlation and causation.
- A line of best fit is used to attempt to represent data with the equation of a straight line in order to predict values that may not be displayed on the plot. The line of best fit is determined by the correlation between the two variables on a scatter plot.

### Skills:
*Students will be able to…*
- Construct a scatter plot with the explanatory variable on the x-axis and the response variable on the y-axis then calculate the correlation coefficient using the paired variables.
- Determine the strength of a correlation coefficient and find lurking variables that could have an effect on either the explanatory or response variables.
- Find the equation of a regression line and predict y-values using a regression equation. This is the line of best fit and it is used to predict response values.
## Integrated Social and Emotional Learning Competencies

The following social and emotional competencies are integrated in this curriculum document:

### Self-Awareness
- ☐ Recognize one’s own feelings and thoughts
- ☐ Recognize the impact of one’s feelings and thoughts on one’s own behavior
- ☒ Recognize one’s personal traits, strengths and limitations
- ☒ Recognize the importance of self-confidence in handling daily tasks and challenges

### Self-Management
- ☐ Understand and practice strategies for managing one’s own emotions, thoughts and behaviors
- ☒ Recognize the skills needed to establish and achieve personal and educational goals
- ☐ Identify and apply ways to persevere or overcome barriers through alternative methods to achieve one’s goals

### Social Awareness
- ☐ Recognize and identify the thoughts, feelings, and perspectives of others
- ☐ Demonstrate an awareness of the differences among individuals, groups, and others’ cultural backgrounds
- ☒ Demonstrate an understanding of the need for mutual respect when viewpoints differ
- ☒ Demonstrate an awareness of the expectations for social interactions in a variety of setting

### Responsible Decision Making
- ☒ Develop, implement and model effective problem solving and critical thinking skill
- ☒ Identify the consequences associated with one’s action in order to make constructive choices
- ☐ Evaluate personal, ethical, safety and civic impact of decisions

### Relationship Skills
- ☒ Establish and maintain healthy relationships
- ☒ Utilize positive communication and social skills to interact effectively with others
- ☒ Identify ways to resist inappropriate social pressure
- ☒ Demonstrate the ability to present and resolve interpersonal conflicts in constructive ways
- ☒ Identify who, when, where, or how to seek help for oneself or others when needed

DOE document – August 2017
In this unit plan, the following 21st Century Life and Careers skills are addressed:

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<td>● E – encouraged</td>
</tr>
<tr>
<td></td>
<td>● T – taught</td>
</tr>
<tr>
<td></td>
<td>● A – assessed</td>
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</tbody>
</table>

### Career Ready Practices

#### 9.1 Personal Financial Literacy

- **Income and Careers**
  - CRP1. Act as a responsible and contributing citizen and employee.
- **Money Management**
  - CRP2. Apply appropriate academic and technical skills.
- **Credit and Debt Management**
  - CRP3. Attend to personal health and financial well-being.
- **Planning, Saving, and Investing**
  - CRP4. Communicate clearly and effectively and with reason.

#### X Becoming a Critical Consumer
- CRP5. Consider the environmental, social and economic impacts of decisions.

#### 9.2 Career Awareness, Exploration, and Preparation

- **Civic Financial Responsibility**
  - CRP6. Demonstrate creativity and innovation.
- **Insuring and Protecting**
  - CRP7. Employ valid and reliable research strategies.
- **CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.**

- **X Career Awareness**
  - CRP9. Model integrity, ethical leadership and effective management.
- **X Career Exploration**
  - CRP10. Plan education and career paths aligned to personal goals.
- **X Career Preparation**
  - CRP11. Use technology to enhance productivity.
  - CRP12. Work productively in teams while using cultural global competence.

### Career Awareness, Exploration, and Preparation

- Business Manager
- Financial Analyst
- Computer Programmer
- Research Scientist
Interdisciplinary Connections

New Jersey Student Learning Standards - ELA

R.1- Read closely to determine what the text say as explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.

W.1- Write arguments to support claims in an analysis of substantive topics or texts using valid reasoning and relevant and sufficient evidence.

W.2- Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selections organization, and analysis of content.

Technology Integration

New Jersey Student Learning Standards for Technology

NJ SLS 8.1 Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.

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- Microsoft Platform: Word, EXCEL, PowerPoint
- Online Subscriptions: Minitab
- Assessment(s): LinkIt! Statistics Midterm 2019
- Devices:
  - Chromebooks
  - Texas Instruments (TI-89) Calculators
  - SMART / Promethean Interactive Boards
### Student Resources

|-------------------------|----------------------------------------------------------------------------------------------------------------------------------|

### Teacher Resources

**Texts:**

**Supplemental Workbooks:**

**Websites:**
- [www.khanacademy.com](http://www.khanacademy.com)
- [www.apstatsmonkey.com](http://www.apstatsmonkey.com)
- [www.mathxl.com](http://www.mathxl.com)
- [www.statsci.org](http://www.statsci.org)
- [www.amstat.org](http://www.amstat.org)
- [https://www.learner.org/courses/againstallodds/](https://www.learner.org/courses/againstallodds/)

**Worksheets:** Teacher created worksheets

**Videos:**
- [www.khanacademy.com](http://www.khanacademy.com)
- Teacher created videos
### Stage 2 – Assessment Evidence

<table>
<thead>
<tr>
<th>Performance Task(s):</th>
<th>Other Evidence:</th>
</tr>
</thead>
</table>
| **Spring Break Project**  
  - Students will research possible spring break destinations and the cost of travel.  
  - They will create a scatterplot and regression line to determine the best cost-effective destination and explain in writing why. |  
  - Pre-Assessment  
  - Formative Assessments  
  - Exit Slips  
  - Self-Assessment  
  - Informal Observations  
  - LinkIt! Statistics Midterm 2019  
  - Summative Assessments: Quizzes, Unit Tests, Final Assessment |
| **DOW Jones 80 year Trend Project**  
  - The goal in this project is to study the trend in the DJIA since 1930 and create an appropriate model.  
  - Students will be using Microsoft Excel to create a spreadsheet and appropriate displays of the data. | |

### Stage 3 – Learning Plan

<table>
<thead>
<tr>
<th>Suggested Learning Activities</th>
<th></th>
</tr>
</thead>
</table>
| - Using Excel or other statistical software to create a scatterplot.  
  - Using statistical software or TI-84 to calculate the correlation coefficient and the linear regression line.  
  - Interpret the Line of Best Fit and Predict future trends using technology. | |
Unit Plan Title | Gathering Data
Suggested Time Frame | 9 days

Overview / Rationale

This unit will show students how to design and conduct a study of data, collected according to a well developed plan. This plan includes clarifying the question and deciding upon a method of data collection and analysis. At the end of this unit students will be able to explain what method to use for an experiment and/or study, how to conduct the collection of data, and provide reasoning as to why it is the best option.

Stage 1 – Desired Results

2016 New Jersey Student Learning Standards for Mathematics

- S-IC.A Understand and evaluate random processes underlying statistical experiments.
- S-IC.A.1 Understand statistics as a process for making inferences about population parameters based on a random sample from that population.

Standards for Mathematical Practice

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.
**Essential Questions:**
- How do you plan and conduct a survey or experiment to collect data?
- How do we obtain data? Why is it important?

**Enduring Understandings:**
*Students will understand that...*
- Data can be collected in a variety of ways, each of which can impact the results obtained. Experiments must be carefully designed in order to detect a cause-and-effect relationship between variables.
- 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.

**Knowledge:**
*Students will know...*
- The techniques used to conduct a study of data using a well-developed plan.
- Principles of experimental design include comparison with a control group, randomization, and blindness.

**Skills:**
*Students will be able to...*
- Investigate and describe sampling techniques, such as simple random sampling, stratified sampling, and cluster sampling. Identify biased sampling methods.
- Compare controlled experiments and observational studies and the conclusions one can draw from each.
**Integrated Social and Emotional Learning Competencies**

*The following social and emotional competencies are integrated in this curriculum document:*

### Self-Awareness
- ☐ Recognize one’s own feelings and thoughts
- ☐ Recognize the impact of one’s feelings and thoughts on one’s own behavior
- ✒ Recognize one’s personal traits, strengths and limitations
- ✒ Recognize the importance of self-confidence in handling daily tasks and challenges

### Self-Management
- ☐ Understand and practice strategies for managing one’s own emotions, thoughts and behaviors
- ✒ Recognize the skills needed to establish and achieve personal and educational goals
- ☐ Identify and apply ways to persevere or overcome barriers through alternative methods to achieve one’s goals

### Social Awareness
- ☐ Recognize and identify the thoughts, feelings, and perspectives of others
- ☐ Demonstrate an awareness of the differences among individuals, groups, and others’ cultural backgrounds
- ✒ Demonstrate an understanding of the need for mutual respect when viewpoints differ
- ✒ Demonstrate an awareness of the expectations for social interactions in a variety of setting

### Responsible Decision Making
- ✒ Develop, implement and model effective problem solving and critical thinking skill
- ✒ Identify the consequences associated with one’s action in order to make constructive choices
- ☐ Evaluate personal, ethical, safety and civic impact of decisions

### Relationship Skills
- ✒ Establish and maintain healthy relationships
- ✒ Utilize positive communication and social skills to interact effectively with others
- ✒ Identify ways to resist inappropriate social pressure
- ✒ Demonstrate the ability to present and resolve interpersonal conflicts in constructive ways
- ✒ Identify who, when, where, or how to seek help for oneself or others when needed

DOE document – August 2017
In this unit plan, the following 21st Century Life and Careers skills are addressed:

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<tr>
<th>Check ALL that apply – 21st Century Themes</th>
<th>Indicate whether these skills are:</th>
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<tbody>
<tr>
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<td>● T – taught</td>
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<td>● A – assessed</td>
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<tr>
<th>Career Ready Practices</th>
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<tr>
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<td>CRP4. Communicate clearly and effectively and with reason.</td>
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<tr>
<td>CRP5. Consider the environmental, social and economic impacts of decisions.</td>
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<tr>
<td>ET CRP6. Demonstrate creativity and innovation.</td>
</tr>
<tr>
<td>ETA CRP7. Employ valid and reliable research strategies.</td>
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<tr>
<td>ETA CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.</td>
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<tr>
<td>CRP9. Model integrity, ethical leadership and effective management.</td>
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<tr>
<td>CRP10. Plan education and career paths aligned to personal goals.</td>
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<tr>
<td>CRP11. Use technology to enhance productivity.</td>
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<tr>
<td>CRP12. Work productively in teams while using cultural global competence.</td>
</tr>
</tbody>
</table>

### Career Awareness, Exploration, and Preparation

- Data Analyst
- Business Analyst
- Project Manager
# Interdisciplinary Connections

**New Jersey Student Learning Standards - ELA**

- **R.1**- Read closely to determine what the text say as explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.

- **W.1**- Write arguments to support claims in an analysis of substantive topics or texts using valid reasoning and relevant and sufficient evidence.

- **W.2**- Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selections organization, and analysis of content.

---

# Technology Integration

**New Jersey Student Learning Standards for Technology**

**NJSLS 8.1 Educational Technology:** All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.

- Google Suite: Docs, Sheets, Slides, Forms
- Microsoft Platform: Word, EXCEL, PowerPoint
- Online Subscriptions: Minitab
- Assessment(s): *LinkIt!* Statistics Midterm 2019
- Devices:
  - Chromebooks
  - Texas Instruments (TI-89) Calculators
  - SMART / Promethean Interactive Boards
### Student Resources

|-------------------------|--------------------------------------------------------------------------------------------------|

### Teacher Resources

**Texts:**

**Supplemental Workbooks:**

**Websites:**
- [www.khanacademy.com](http://www.khanacademy.com)  
- [www.apstatsmonkey.com](http://www.apstatsmonkey.com)  
- [www.mathxl.com](http://www.mathxl.com)  
- [www.statsci.org](http://www.statsci.org)  
- [www.amstat.org](http://www.amstat.org)  
- [https://www.learner.org/courses/againstallodds/](https://www.learner.org/courses/againstallodds/)

**Worksheets:** Teacher created worksheets

**Videos:**
- [www.khanacademy.com](http://www.khanacademy.com)  
- Teacher created videos
### Stage 2 – Assessment Evidence

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<th>Performance Task(s):</th>
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| **Investigative Task - Backhoes & Forklifts**  
  - The student will design the experiment by specifying the procedure the company should use for their study.  
  - Students will use the appropriate vocabulary throughout the description. | • Pre-Assessment  
• Formative Assessments  
• Exit Slips  
• Self-Assessment  
• Informal Observations  
• *LinkIt!* Statistics Midterm 2019  
• Summative Assessments: Quizzes, Unit Tests, Final Assessment |

### Stage 3 – Learning Plan

<table>
<thead>
<tr>
<th>Suggested Learning Activities</th>
<th>Overview of methods of data collection</th>
</tr>
</thead>
</table>
|                             | • Census  
• Sample survey  
• Experiment  
• Observational study |

#### Planning and conducting surveys
- Characteristics of a well-designed and well-conducted survey  
- Populations, samples and random selection  
- Sources of bias in sampling and surveys  
- Sampling methods, including simple random sampling, stratified random sampling and cluster sampling

#### Planning and conducting experiments
- Characteristics of a well-designed and well-conducted Experiment  
- Treatments, control groups, experimental units, random assignments and replication
**Unit Plan Title** | Randomness and Probability  
---|---
**Suggested Time Frame** | 19 days  
---|---

**Overview / Rationale**

Statistics and probability do not deal with 100 percent certainty. The elements of chance happen in almost all of the natural world. When we cannot expect something with true certainty, we must rely on probability to guide us. In this unit students will learn to apply the rules of probability to real-life phenomena. By the end of this unit students will be able to complete the casino lab project, determining the probability of winning at casino and other popular games of chance.

**Stage 1 – Desired Results**

**2016 New Jersey Student Learning Standards for Mathematics**

- **N-Q.2** Define appropriate quantities for the purpose of descriptive modeling.
- **N-Q.3** Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
- **S-CP.A** Understand independence and conditional probability and use them to interpret data. **S-CP.A.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.A.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.A.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.A.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.A.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.B.** Use the rules of probability to compute probabilities of compound events in a uniform probability model.

- **S-CP.B.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.B.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.B.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.B.9.** (+) Use permutations and combinations to compute probabilities of compound events and solve problems.

- **S-MD.A.** Calculate expected values and use them to solve problems.

- **S-MD.A.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.

- **S-MD.A.2.** (+) Calculate the expected value of a random variable; interpret it as the mean of the probability distribution.

- **S-MD.A.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. *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.A.4.** (+) 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.B.** Use probability to evaluate outcomes of decisions.

- **S-MD.B.5.** (+) Weigh the possible outcomes of a decision by assigning probabilities to payoff values and finding expected values.

- **S-MD.B.5.a.** 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.B.5.b.** 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.*
• **S-MD.B.6.** (+) Use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator).

• **S-MD.B.7.** (+) Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game).

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**Standards for Mathematical Practice**

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

---

**Essential Questions:**

- What is conditional probability?
- How can one determine if two events will occur in sequence?
- How can one determine if two events are mutually exclusive?
- How do you determine if a distribution is a probability distribution?

**Enduring Understandings:**

*Students will understand that...*

- How to find the probability of two events occurring in sequence (event A given event B occurred).
- To find the probability of two independent events that occur in sequence, find the probability of each event occurring separately, and then multiply the probabilities.
- If two events are disjoint, then the probability of them both occurring at the same time is 0. If two events are mutually exclusive, then the probability of either occurring is the sum of the probabilities of each occurring.
- A probability distribution must meet 2 critical criteria: all probabilities must be between 0 and 1 inclusively, the sum of all probabilities must add to 1.
### Knowledge:
*Students will know...*

- Probability can be classified as classical, empirical and subjective. Classical is limited in certain situations, empirical can only be used in experimental situations, and subjective is not reliable.
- The Law of Large Numbers.
- The difference between independent and dependent events.
- Conditional probability is the probability of an event \((A)\), given that another \((B)\) has already occurred.
- The multiplication rule.
- The Fundamental Counting Principle.
- Appropriate conditions for using a geometric, binomial, or normal model.

### Skills:
*Students will be able to...*

- Determine the type of probability in a given situation.
- Describe that the law of large numbers is a principle of probability according to which the frequencies of events with the same likelihood of occurrence even out, given enough trials or instances. As the number of experiments increases, the actual ratio of outcomes will converge on the theoretical, or expected, ratio of outcomes.
- Determine when two events are independent and dependent.
- Differentiate between permutation and combinations.
- Differentiate between inclusive and exclusive events.
- Differentiate between discrete and continuous.
- Determine the probability of an event using the multiplication rule.
- Find probabilities of mutually-exclusive events.
- Use the Fundamental Counting Principle to find the number of ways two or more events can occur.
- Calculate the number of ways a group of objects can be arranged in order. Find the number of ways to choose several objects from a group without regard to order.
- Find the probability model for a discrete random variable.
- Calculate geometric models.
- Calculate binomial probabilities.
### Integrated Social and Emotional Learning Competencies

*The following social and emotional competencies are integrated in this curriculum document:*

#### Self-Awareness
- [ ] Recognize one’s own feelings and thoughts
- [ ] Understand the impact of one’s feelings and thoughts on one’s own behavior
- [x] Recognize one’s personal traits, strengths and limitations
- [x] Recognize the importance of self-confidence in handling daily tasks and challenges

#### Self-Management
- [ ] Understand and practice strategies for managing one’s own emotions, thoughts and behaviors
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- [ ] Demonstrate an awareness of the expectations for social interactions in a variety of settings

#### Responsible Decision Making
- [x] Develop, implement and model effective problem solving and critical thinking skill
- [x] Identify the consequences associated with one’s action in order to make constructive choices
- [ ] Evaluate personal, ethical, safety and civic impact of decisions

#### Relationship Skills
- [x] Establish and maintain healthy relationships
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DOE document – August 2017
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<td>Credit and Debt Management</td>
<td>CRP4. Communicate clearly and effectively and with reason.</td>
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<td>Planning, Saving, and Investing</td>
<td>CRP5. Consider the environmental, social and economic impacts of decisions.</td>
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<tr>
<td>Becoming a Critical Consumer</td>
<td>CRP6. Demonstrate creativity and innovation.</td>
</tr>
<tr>
<td>Insuring and Protecting</td>
<td>ETA CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.</td>
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<thead>
<tr>
<th>9.2 Career Awareness, Exploration, and Preparation</th>
<th>CRP9. Model integrity, ethical leadership and effective management.</th>
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</thead>
<tbody>
<tr>
<td>21st Century Themes</td>
<td>CRP11. Use technology to enhance productivity.</td>
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Career Awareness, Exploration, and Preparation

- Actuary
- Biostatistician
- Ecological Statistician
- Financial Engineer
## Interdisciplinary Connections

**New Jersey Student Learning Standards - ELA**

- **R.1** Read closely to determine what the text say as explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.

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- [www.statsci.org](http://www.statsci.org)
- [www.amstat.org](http://www.amstat.org)
- [https://www.learner.org/courses/againstalldds/](https://www.learner.org/courses/againstalldds/)

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<tr>
<td><strong>Casino Lab</strong></td>
<td>• Pre-Assessment</td>
</tr>
<tr>
<td>• The purpose of this lab is to allow students to explore the rules of probability in the setting of real-life games.</td>
<td></td>
</tr>
<tr>
<td>• Students will simulate playing several casino type and other popular games of chance.</td>
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<tr>
<td>• Their task is to collect information/data about each game and answer the corresponding questions.</td>
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<tr>
<td>• Formative Assessments</td>
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## Stage 3 – Learning Plan

<table>
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<tr>
<th>Suggested Learning Activities</th>
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<tbody>
<tr>
<td>• Basic probability principles including complement, independence and mutually exclusive</td>
<td></td>
</tr>
<tr>
<td>• Simulating probability scenarios</td>
<td></td>
</tr>
<tr>
<td>• Addition, multiplication and conditional probability rules</td>
<td></td>
</tr>
<tr>
<td>• Videos:</td>
<td></td>
</tr>
<tr>
<td>• <em>21</em></td>
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<tr>
<td>• <em>Moneyball</em></td>
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</tbody>
</table>
Unit Plan Title | From the Data at Hand to the World at Large
---|---
**Suggested Time Frame** | 16 Days

**Overview / Rationale**

In this unit, students will learn that probability is a tool for anticipation of what the distribution of data should look like under a given model. They will learn how to calculate probability, combine independent random variables, use probability in normal distributions and sampling distributions. Students will understand what a confidence interval is, how to calculate it and how to interpret it. They will calculate confidence intervals for different levels and understand what happens at each level. Students will see differences based on sample size and understand how to use t-distributions and proportions for populations. By the end of this unit, students will be able to create a distribution, find a confidence interval for a proportion and use hypothesis testing to determine if results of an experiment are statistically significant using population and/or sample proportions.

**Stage 1 – Desired Results**

| 2016 New Jersey Student Learning Standards for Mathematics |
|---|---|
| **S-IC.A.** Understand and evaluate random processes underlying statistical experiments. |
| **S-IC.A.1.** Understand statistics as a process for making inferences about population parameters based on a random sample from that population. |
| **S-IC.A.2.** Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation. *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?* |
| **S-IC.B.** Make inferences and justify conclusions from sample surveys, experiments, and observational studies. |
| **S-IC.B.3.** Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each. |
| **S-IC.B.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.B.5.** Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant. |
| **S-IC.B.6.** Evaluate reports based on data. |
## Standards for Mathematical Practice

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

### Essential Questions:

- What is a confidence interval and how do we interpret it?
- What happens when we increase the level of confidence or sample size?
- How can we identify types of errors and their significance?
- How can the statistical method of hypothesis testing prove or disprove a given hypothesis statement?

### Enduring Understandings:

*Students will understand that…*

- Confidence intervals are a balance between the precision and the certainty of a statement about a model perimeter.
- The margin of error of a confidence interval for a proportion changes with the sample size and the level of confidence.
- Students will be able to interpret p-values, Type I and Type II errors in context.
- Statistical testing can be used to determine difference in means between populations.

### Knowledge:

*Students will know…*

- How to interpret a one-proportion z-test.
- The assumptions required for t-tests and t-based confidence intervals.
- We do not “accept” the null hypothesis; we fail to reject it. The difference between a null hypothesis and an alternative hypothesis.
- Type I and Type II errors, interpreting levels of significance.
- When to use a one-tailed or two-tailed statistical test.

### Skills:

*Students will be able to…*

- Construct and interpret a one-proportion z-interval without stating or suggesting the parameter of interest itself but rather the bounds of the confidence interval.
- Compute and interpret a t-test for the population mean using a statistics package, or working from summary statistics for a sample. Use a t-test to test a population proportion.
- Interpret the result of a test of a hypothesis about a population proportion.
- Write a claim for a hypothesis and use a z-test to test a proportion.
- Find and use P-values to test a mean.
Integrated Social and Emotional Learning Competencies

*The following social and emotional competencies are integrated in this curriculum document:*

### Self-Awareness
- ☐ Recognize one’s own feelings and thoughts
- ☐ Recognize the impact of one’s feelings and thoughts on one’s own behavior
- ☒ Recognize one’s personal traits, strengths and limitations
- ☒ Recognize the importance of self-confidence in handling daily tasks and challenges

### Self-Management
- ☐ Understand and practice strategies for managing one’s own emotions, thoughts and behaviors
- ☒ Recognize the skills needed to establish and achieve personal and educational goals
- ☐ Identify and apply ways to persevere or overcome barriers through alternative methods to achieve one’s goals

### Social Awareness
- ☐ Recognize and identify the thoughts, feelings, and perspectives of others
- ☐ Demonstrate an awareness of the differences among individuals, groups, and others’ cultural backgrounds
- ☒ Demonstrate an understanding of the need for mutual respect when viewpoints differ
- ☒ Demonstrate an awareness of the expectations for social interactions in a variety of setting

### Responsible Decision Making
- ☒ Develop, implement and model effective problem solving and critical thinking skill
- ☒ Identify the consequences associated with one’s action in order to make constructive choices
- ☐ Evaluate personal, ethical, safety and civic impact of decisions

### Relationship Skills
- ☒ Establish and maintain healthy relationships
- ☒ Utilize positive communication and social skills to interact effectively with others
- ☒ Identify ways to resist inappropriate social pressure
- ☒ Demonstrate the ability to present and resolve interpersonal conflicts in constructive ways
- ☒ Identify who, when, where, or how to seek help for oneself or others when needed

DOE document – August 2017
In this unit plan, the following 21st Century Life and Careers skills are addressed:

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<td>● A – assessed</td>
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Career Ready Practices

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<td>Act as a responsible and contributing citizen and employee.</td>
<td>Apply appropriate academic and technical skills.</td>
<td>Attend to personal health and financial well-being.</td>
<td>Communicate clearly and effectively and with reason.</td>
<td>Consider the environmental, social and economic impacts of decisions.</td>
<td>Demonstrate creativity and innovation.</td>
<td>Employ valid and reliable research strategies.</td>
<td>Utilize critical thinking to make sense of problems and persevere in solving them.</td>
<td>Model integrity, ethical leadership and effective management.</td>
<td>Plan education and career paths aligned to personal goals.</td>
<td>Use technology to enhance productivity.</td>
<td>Work productively in teams while using cultural global competence.</td>
</tr>
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Career Awareness, Exploration, and Preparation

- Business Manager
- Store Owner / Entrepreneur
- Software Analysis
- Game Creator
### Interdisciplinary Connections

**New Jersey Student Learning Standards - ELA**

- **R.1** - Read closely to determine what the text say as explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.
- **W.1** - Write arguments to support claims in an analysis of substantive topics or texts using valid reasoning and relevant and sufficient evidence.
- **W.2** - Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selections organization, and analysis of content.

### Technology Integration

**New Jersey Student Learning Standards for Technology**

**NJSLS 8.1 Educational Technology:** All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.

- Google Suite: Docs, Sheets, Slides, Forms
- Microsoft Platform: Word, EXCEL, PowerPoint
- Online Subscriptions: Minitab
- Assessment(s): LinkIt! Statistics Midterm 2019
- Devices:
  - Chromebooks
  - Texas Instruments (TI-89) Calculators
  - SMART / Promethean Interactive Boards
### Student Resources

|-------------------------|----------------------------------------------------------------------------------------------------------------------------------|
| Supporting Text pages | American Statistical Association Journals - [AmStat - Journals](#)  

### Teacher Resources

**Texts:**

**Supplemental Workbooks:**

**Websites:**
- [www.khanacademy.com](http://www.khanacademy.com)  
- [www.apstatsmonkey.com](http://www.apstatsmonkey.com)  
- [www.mathxl.com](http://www.mathxl.com)  
- [www.statsci.org](http://www.statsci.org)  
- [www.amstat.org](http://www.amstat.org)  
- [https://www.learner.org/courses/againstallodds/](http://https://www.learner.org/courses/againstallodds/)  

**Worksheets:** Teacher created worksheets

**Videos:**
- [www.khanacademy.com](http://www.khanacademy.com)  
- Teacher created videos
### Stage 2 – Assessment Evidence

<table>
<thead>
<tr>
<th>Performance Task(s):</th>
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<tbody>
<tr>
<td><strong>Taste the Difference</strong></td>
<td>• Pre-Assessment</td>
</tr>
<tr>
<td>• To model a taste test to the binomial distribution and perform a hypothesis test for proportions.</td>
<td>• Formative Assessments</td>
</tr>
<tr>
<td>• The student is to gather data and use the binomial probability density function and model the binomial distribution with the standard normal distribution.</td>
<td>• Exit Slips</td>
</tr>
<tr>
<td>• The TI-83 calculator (or equal), the binomial-pdf, and binomial-cdf functions will be used.</td>
<td>• Self-Assessment</td>
</tr>
<tr>
<td><strong>Confidence Interval Project</strong></td>
<td>• Informal Observations</td>
</tr>
<tr>
<td>• Students will choose one of 5 topics to research sample data and provide a presentation of their findings using confidence intervals.</td>
<td>• <em>LinkIt!</em> Statistics Midterm 2019</td>
</tr>
<tr>
<td></td>
<td>• Summative Assessments: Quizzes, Unit Tests, Final Assessment</td>
</tr>
</tbody>
</table>

### Stage 3 – Learning Plan

<table>
<thead>
<tr>
<th>Suggested Learning Activities</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>• Data Collection to Determine Approaching Normal Distributions</td>
<td></td>
</tr>
<tr>
<td>• Applications of Normal Distributions Presentation</td>
<td></td>
</tr>
<tr>
<td>• Confidence intervals for one and two proportions</td>
<td></td>
</tr>
<tr>
<td>• Hypothesis testing for one and two proportions</td>
<td></td>
</tr>
<tr>
<td>• Type I and II errors and power</td>
<td></td>
</tr>
</tbody>
</table>
**Unit Plan Title**  
Learning About the World

**Suggested Time Frame**  
15 days

**Overview / Rationale**

Students will understand how to apply confidence intervals and hypothesis testing to population means. Students will incorporate what they learned in the previous unit and apply this knowledge to means. They will be able to interpret whether or not results are statistically significant and clearly explain their reasoning behind it. They will understand the errors that are associated with sampling distributions and their results and know what type of test to use given a distribution. By the end of this unit, they will be able to infer information about population and sample means. Students will determine statistically significant results as applied to means and pooled data.

**Stage 1 – Desired Results**

**2016 New Jersey Student Learning Standards for Mathematics**

- **S-IC.A.** Understand and evaluate random processes underlying statistical experiments.
- **S-IC.A.1.** Understand statistics as a process for making inferences about population parameters based on a random sample from that population.
- **S-IC.A.2.** Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation. *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?*
- **S-IC.B.** Make inferences and justify conclusions from sample surveys, experiments, and observational studies.
- **S-IC.B.3.** Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.
- **S-IC.B.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.B.5.** Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.
- **S-IC.B.6.** Evaluate reports based on data.
### Standards for Mathematical Practice

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

<table>
<thead>
<tr>
<th>Essential Questions:</th>
<th>Enduring Understandings:</th>
</tr>
</thead>
<tbody>
<tr>
<td>- How do you interpret a decision based on the results of a significance test?</td>
<td></td>
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<tr>
<td>- How is a model used to draw conclusion from data?</td>
<td></td>
</tr>
<tr>
<td>- How confident can we be that the model is appropriate?</td>
<td></td>
</tr>
<tr>
<td>- What does it mean to make an inference?</td>
<td></td>
</tr>
<tr>
<td>- Statistical significance does not measure the importance or magnitude of an effect. Recognize when others misinterpret statistical significance as proof of practical importance.</td>
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</tr>
<tr>
<td>- There are important assumptions and conditions we must check before using any statistical inference procedure.</td>
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<tr>
<td>- Although the calculator computes numerical test results, it is necessary to also interpret the results both graphically and verbally in the context of the original question.</td>
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<tr>
<td>- Inference is a tool for validating a claim about a population parameter.</td>
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</tbody>
</table>
### Knowledge:

*Students will know...*

- How to interpret a one-proportion $z$-test.
- The assumptions required for $t$-tests and $t$-based confidence intervals.
- We do not “accept” the null hypothesis, we fail to reject it.
- How to examine your data for violations of conditions that would make inference about the difference between two population means unwise or invalid.
- The difference between a null hypothesis and an alternative hypothesis.
- Type I and Type II errors, interpreting levels of significance.
- When to use a one-tailed or two-tailed statistical test.

### Skills:

*Students will be able to...*

- Construct and interpret a one-proportion $z$-interval without stating or suggesting the parameter of interest itself but rather the bounds of the confidence interval.
- Compute and interpret a $t$-test for the population mean using a statistics package, or working from summary statistics for a sample.
- Interpret the result of a test of a hypothesis about a population mean.
- Interpret a test of the null hypothesis that the means of two independent groups are equal.
- Find critical values in a normal distribution.
- Find critical values in a $t$-distribution.
- Perform a two sample $z$-test for the difference between two means using large independent samples.
- Perform a $t$-test for the difference between two population means using small independent samples.
- Interpret the result of a test of a hypothesis about a population mean.
- Write a claim for a hypothesis and use a $z$-test to test means.
- Find and use P-values to test a mean.
- Use a $t$-test to test a population mean.
## Integrated Social and Emotional Learning Competencies

*The following social and emotional competencies are integrated in this curriculum document:*

### Self-Awareness
- [ ] Recognize one’s own feelings and thoughts
- [ ] Recognize the impact of one’s feelings and thoughts on one’s own behavior
- ☒ Recognize one’s personal traits, strengths and limitations
- ☒ Recognize the importance of self-confidence in handling daily tasks and challenges

### Self-Management
- [ ] Understand and practice strategies for managing one’s own emotions, thoughts and behaviors
- ☒ Recognize the skills needed to establish and achieve personal and educational goals
- [ ] Identify and apply ways to persevere or overcome barriers through alternative methods to achieve one’s goals

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### Career Ready Practices

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| CRP2. | Apply appropriate academic and technical skills. |
| CRP3. | Attend to personal health and financial well-being. |
| 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. |
| CRP9. | Model integrity, ethical leadership and effective management. |
| CRP10. | Plan education and career paths aligned to personal goals. |
| CRP11. | Use technology to enhance productivity. |
| CRP12. | Work productively in teams while using cultural global competence. |

### Career Awareness, Exploration, and Preparation

Interdisciplinary Connections

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<td><strong>JellyBlubber Lab</strong></td>
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<tr>
<td>▷ Students will gather data by taking an SRS of JellyBlubbers in order to estimate the true mean length of the colony by creating a confidence interval for the mean.</td>
<td>• Formative Assessments</td>
</tr>
<tr>
<td>▷ Students will then chart the intervals on a class graph to illustrate the meaning of 95% confidence.</td>
<td>• Exit Slips</td>
</tr>
<tr>
<td><strong>Timing Your Reaction Lab</strong></td>
<td>• Self-Assessment</td>
</tr>
<tr>
<td>▷ Students will gather data using a Reaction Timer for their dominant and non-dominant hands and analyze the data using 2-sample inference methods for independent samples (males vs. females) and dependent samples (dominant vs. non-dominant).</td>
<td>• Informal Observations</td>
</tr>
<tr>
<td><strong>Moneyball Project</strong></td>
<td>• <em>LinkIt!</em> Statistics Midterm 2019</td>
</tr>
<tr>
<td>▷ The movie <em>Moneyball</em> tells the story of how Oakland Athletics general manager Billy Beane used the power of statistics to gain an advantage in assembling and managing his baseball team.</td>
<td>• Summative Assessments: Quizzes, Unit Tests, Final Assessment</td>
</tr>
<tr>
<td>▷ In this project students will watch the movie, answer questions related to the movie and then determine if sabermetrics can make a difference on a team that is currently losing by trading out 2 players by using sabermetrics and summarizing their findings using their calculations.</td>
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## Stage 3 – Learning Plan

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<tr>
<td>▷ Confidence intervals for one and two means (with t)</td>
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</tr>
<tr>
<td>▷ Hypothesis testing for one and two means (with t)</td>
<td></td>
</tr>
<tr>
<td>▷ Confidence intervals and hypothesis testing for matched pairs means (with t)</td>
<td></td>
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</table>
Accommodations and Modifications

Below please find a list of suggestions for accommodations and modifications to meet the diverse needs of our students. Teachers should consider this a resource and understand that they are not limited to the recommendations included below.

An accommodation changes HOW a student learns; the change needed does not alter the grade-level standard. A modification changes WHAT a student learns; the change alters the grade-level expectation.

Special Education and 504 Plans

All modifications and accommodations must be specific to each individual child’s IEP (Individualized Educational Plan) or 504 Plan.

- Pre-teach or preview vocabulary
- Repeat or reword directions
- Have students repeat directions
- Use of small group instruction
- Pair visual prompts with verbal presentations
- Ask students to restate information, directions, and assignments
- Repetition and time for additional practice
- Model skills/techniques to be mastered
- Extended time to complete task/assignment/work
- Provide a copy of class notes
- Strategic seating (with a purpose - eg. less distraction)
- Flexible seating
- Repetition and additional practice
- Use of manipulatives
- Use of assistive technology (as appropriate)
- Assign a peer buddy
- Emphasize key words or critical information by highlighting
- Use of graphic organizers
- Scaffold with prompts for sentence starters
- Check for understanding with more frequency
- Provide oral reminders and check student work during independent practice
- Chunk the assignment - broken up into smaller units, work submitted in phases
- Encourage student to proofread assignments and tests
- Provide regular home/school communication
- Teacher checks student planner
- Provide student with clear expectations in writing and grading criteria for assignments (rubrics)

Testing Accommodations:

Students should receive all testing accommodations for Benchmark assessments that they receive for State testing.
• Setting: Alternate setting for assessments, small groups, screens to block distractions
• Presentation: large print, test readers, use of audio, fewer questions on each page
• Response: answer verbally, use large block answer sheet, speech-to-text dictation, accept short answers
• Allow for retakes
• Provide study guides
• Use of reference aids such as glossary, multiplication tables, calculator
• Choice of test format (multiple-choice, essay, true-false)
• Alternate ways to evaluate (projects or oral presentations instead of written tests)
• Open-book or open-note tests

**English Language Learners:**
*All modifications and accommodations should be specific to each individual child’s LEP level as determined by the WIDA screening or ACCESS, utilizing the WIDA Can Do Descriptors.*

• Pre-teach or preview vocabulary
• Repeat or reword directions
• Have students repeat directions
• Use of small group instruction
• Scaffold language based on their Can Do Descriptors
• Alter materials and requirements according to Can Do Descriptors
• Adjust number of paragraphs or length of writing according to their Can Do Descriptor
• TPR (Total Physical Response-Sheltered Instruction strategy) Demonstrate concepts through multi-sensory forms such as with body language, intonation
• Pair visual prompts with verbal presentations
• Repetition and additional practice
• Model skills and techniques to be mastered
• Native Language translation (peer, assistive technology, bilingual dictionary)
• Emphasize key words or critical information by highlighting
• Use of graphic organizers
• Scaffold with prompts for sentence starters
• Check for understanding with more frequency
• Use of self-assessment rubrics
• Increase one-on-one conferencing; frequent check ins
• Use study guide to organize materials
• Make vocabulary words available in a student created vocabulary notebook, vocabulary bank, Word Wall, or vocabulary ring
• Extended time
• Select text complexity and tiered vocabulary according to Can Do Descriptors
• Projects completed individually or with partners
• Use online dictionary that includes images for words: [http://visual.merriamwebster.com/](http://visual.merriamwebster.com/).
**Students at Risk of Failure:**

- Use of self-assessment rubrics for check-in
- Pair visual prompts with verbal presentations
- Ask students to restate information and/or directions
- Opportunity for repetition and additional practice
- Model skills/techniques to be mastered
- Extended time
- Provide copy of class notes
- Strategic seating with a purpose
- Provide students opportunity to make corrections and/or explain their answers
- Support organizational skills
- Check daily planner
- Encourage student to proofread work
- Assign a peer buddy
- Build on students’ strengths based on Multiple Intelligences: Linguistic (verbal); Logical (reasoning); Musical/Rhythmic; Intrapersonal Intelligence (understanding of self); Visual Spatial Intelligence; Interpersonal Intelligence (the ability to interact with others effectively); Kinesthetic (bodily); Naturalist Intelligence; and Learning Styles: Visual; Auditory; Tactile; Kinesthetic; Verbal

**High Achieving:**

**Extension Activities**

- Allow for student choice from a menu of differentiated outcomes; choices grouped by complexity of thinking skills; variety of options enable students to work in the mode that most interests them
- Allow students to pursue independent projects based on their individual interests
- Provide enrichment activities that include more complex material
- Allow opportunities for peer collaboration and team-teaching
- Set individual goals
- Conduct research and provide presentation of appropriate topics
- Provide students opportunity to design surveys to generate and analyze data to be used in discussion
- Allow students to move through the assignment at their own pace (as appropriate)

**Strategies to Differentiate to Meet the Needs of a Diverse Learning Population**

- Vocabulary Sorts—students engage with the vocabulary word by sorting into groups of similar/different rather than memorizing definitions
- Provide “Realia” (real life objects to relate to the five senses) and ask questions relating to the senses
- Role Play—students create or participate in role playing situations or Reader’s Theater
- Moving Circle—an inside and outside circle partner and discuss, circles moves to new partner (Refer to Kagan Differentiated Strategies)
- Brainstorm Carousel-Large Post Its around the room, group moves in a carousel to music. Group discusses topic and responses on paper. Groups rotate twice to see comments of others. (Refer to Kagan Differentiated Strategies)
- Gallery Walk-Objects, books, or student work is displayed. Students examine artifacts and rotate.
- Chunking-chunk reading, tests, questions, homework, etc to focus on particular elements.
- Think Pair Share Write
- Think Talk Write
- Think Pair Share
- Note-taking -can be done through words, pictures, phrases, and sentences depending on level
- KWL (Know, Want to Know, Learned)/KWHL (Know, What to Know, How Will I Learn, learned)/KWLS (Know, Want to Know, Learned, Still Want to Know)/KWLQ (Know, What to Know, Learned, Questions I Still Have) Charts
- Circle Map strategy- place the main topic in a small circle and add student ideas in a bigger circle around the topic. Students may use their native language with peers to brainstorm.
- Flexible grouping -as a whole class, a small group, or with a partner, temporary groups are created: [http://www.teachhub.com/flexible-grouping-differentiated-instruction-strategy](http://www.teachhub.com/flexible-grouping-differentiated-instruction-strategy).
- Jigsaw Activities -cooperative learning in a group, each group member is responsible for becoming an "expert" on one section of the assigned material and then "teaching" it to the other members of the team: [http://www.adlit.org/strategies/22371/](http://www.adlit.org/strategies/22371/).
<table>
<thead>
<tr>
<th>Day</th>
<th>Unit</th>
<th>Topic</th>
<th>Chapter</th>
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