Honors Statistics
Curriculum
Grades 10-12
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NEPTUNE TOWNSHIP SCHOOL DISTRICT

HONORS STATISTICS
GRADERS 10-12
CURRICULUM

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The Statistics Honors Curriculum guide was developed for Neptune High School through the efforts of Erin Seneca, Neptune High School mathematics teacher, in cooperation with Tara Stephenson, Department Chairperson, and under the guidance of Cheryl Romano, Supervisor for Curriculum, Instruction and Assessment.

The teacher is to be commended for her dedication in creating this curriculum and formatting it into UbD and her expertise in the area of statistical mathematics. This curriculum guide introduces the students to topics in statistics. It is our hope that this guide will serve as a valuable resource for the staff members who teach this course and that they will feel free to make recommendations for its continued improvement.

The Statistics Honors Curriculum guide was written with related pacing guide in alignment to the the 2016 New Jersey Student Learning Standards for Mathematics.
NEPTUNE TOWNSHIP SCHOOL DISTRICT

DISTRICT MISSION STATEMENT

The primary mission of the Neptune Township School District is to prepare all students for life in the twenty-first century by encouraging them to recognize that learning is a continuing process. It is with high expectations that our schools foster:

• A strong foundation in academic areas, modern technologies, life skills and the arts.

• 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 peoples.

• 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 Core Curriculum Content Standards (NJCCCS), Common Core State Standards (CCSS) and 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 (e.g., 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 is 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

Standards for Mathematical Practice

MP1. Make sense of problems and persevere in solving them.
MP2. Reason abstractly and quantitatively.
MP3. Construct viable arguments and critique the reasoning of others.
MP4. Model with mathematics.
MP5. Use appropriate tools strategically.
MP6. Attend to precision.
MP7. Look for and make use of structure.
MP8. Look for and express regularity in repeated reasoning

Standards for Mathematical Content

Define appropriate quantities for the purpose of descriptive modeling.
Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.
Represent data with plots on the real number line (dot plots, histograms, and box plots).
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.
Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).
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.
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.

<table>
<thead>
<tr>
<th>Essential Questions:</th>
<th>Enduring Understandings:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. What are the various ways we can graphically represent frequency distributions?</td>
<td>1. 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.</td>
</tr>
<tr>
<td>2. What determines whether data is qualitative or quantitative?</td>
<td>2. Qualitative data identify as a category for each case and quantitative data records values and measurements. Sometimes a variable can treated as either qualitative or quantitative depending on what we want to learn from it.</td>
</tr>
<tr>
<td>3. What are the measures of central tendency? How are they determined?</td>
<td>3. Measures of central tendency are the mean median and mode. Determining these values will tell you about the center of the data.</td>
</tr>
<tr>
<td>4. How can measures of variation be determined and interpreted?</td>
<td>4. 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.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Knowledge:</th>
<th>Skills:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students will know...</td>
<td>Students will be able to...</td>
</tr>
<tr>
<td>• A Midpoint is the number in the middle of the class. It is found by adding the</td>
<td>• Calculate classes and midpoints to construct relative frequency charts, cumulative frequency</td>
</tr>
<tr>
<td>upper and lower limits and dividing by two.</td>
<td>charts, and frequency histograms.</td>
</tr>
<tr>
<td>• A relative frequency is the ratio of the number of times an event occurs to</td>
<td>• Determine distribution shapes by creating appropriate distribution charts and identifying outliers.</td>
</tr>
<tr>
<td>the number of occasions on which it might occur in the same period.</td>
<td>• Classify a variable as quantitative or qualitative depending on its’ use.</td>
</tr>
<tr>
<td>• A cumulative frequency distribution is the sum of the class and all classes</td>
<td></td>
</tr>
<tr>
<td>below it in a frequency distribution.</td>
<td></td>
</tr>
</tbody>
</table>
• How to construction a frequency histogram
• Distribution shapes can be 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 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.
• Calculate mean, median, mode and weighted means. Use these values to describe a distributions 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.

In this unit plan, the following 21st Century Life and Careers skills are addressed:

<table>
<thead>
<tr>
<th>21st Century Themes</th>
<th>Indicate whether these skills are:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check ALL that apply –</td>
<td>E – encouraged</td>
</tr>
<tr>
<td>Personal Financial Literacy</td>
<td>T – taught</td>
</tr>
<tr>
<td>Income and Careers</td>
<td>A – assessed</td>
</tr>
<tr>
<td>Money Management</td>
<td>CRP1. Act as a responsible and contributing citizen and employee.</td>
</tr>
<tr>
<td></td>
<td>CRP2. Apply appropriate academic and technical skills.</td>
</tr>
<tr>
<td></td>
<td>CRP3. Attend to personal health and</td>
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</tbody>
</table>
Credit and Debt Management | E | CRP4. Communicate clearly and effectively and with reason.
Planning, Saving, and Investing |  | CRP5. Consider the environmental, social and economic impacts of decisions.
Becoming a Critical Consumer |  | CRP6. Demonstrate creativity and innovation.
Insuring and Protecting | E | CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.

9.2 Career Awareness, Exploration, and Preparation

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

**Student Resources**

**Primary Source Readings**

**Secondary Source Readings**

**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)
### Stage 2 – Assessment Evidence

<table>
<thead>
<tr>
<th>Performance Task(s):</th>
<th>Other Evidence:</th>
</tr>
</thead>
<tbody>
<tr>
<td>M&amp;M’s Data Collection</td>
<td>Do Now/Anticipatory assignments</td>
</tr>
<tr>
<td>• Students will collect data from mini bags of milk chocolate M&amp;M’s. This data will be used later in the next M&amp;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.</td>
<td>Class Notes</td>
</tr>
<tr>
<td>The Great M&amp;M’s Experiment</td>
<td>Teacher Observations</td>
</tr>
<tr>
<td>• Students will determine the percentage of orange M&amp;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.</td>
<td>Participation in class discussions</td>
</tr>
<tr>
<td></td>
<td>Peer/Self Assessments.</td>
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<td></td>
<td>Guided practice individually, in pairs and in group</td>
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<td>Classroom assignments</td>
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<td>Homework assignments</td>
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<td></td>
<td>Lesson Quizzes</td>
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<td></td>
<td>Closure activities/exit slips</td>
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</table>

### Stage 3 – Learning Plan

<table>
<thead>
<tr>
<th>Instructional Strategies</th>
<th>Descriptions</th>
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<tr>
<td>Suggested Learning Activities</td>
<td>Frequency distribution constructions of collected data</td>
</tr>
<tr>
<td></td>
<td>Interpreting frequency distributions</td>
</tr>
<tr>
<td></td>
<td>Graphing data sets</td>
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<tr>
<td></td>
<td>Interpreting graphically represented data sets</td>
</tr>
<tr>
<td></td>
<td>Working with measures of central tendency</td>
</tr>
<tr>
<td></td>
<td>Using measure of position to represent and interpret data sets</td>
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</tbody>
</table>

<table>
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<tr>
<th>Modifications</th>
<th>Special Education Students: (These are just suggested ideas to modify instruction. All modifications and accommodations should be specific to each individual child’s IEP)</th>
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<td>• Multi-sensory instruction.</td>
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<td>• Differentiated instruction.</td>
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<tr>
<td></td>
<td>• Additional Vocabulary Activities.</td>
</tr>
<tr>
<td></td>
<td>• Provide hands-on manipulatives with format skeletons to groups of students.</td>
</tr>
</tbody>
</table>
• Draw and label diagrams to represent the data for visual learners.
• Provide time for revision of work when students show need.
• Facilitate group discussions to assess understanding among varying ability levels of students.
• Scaffolding content.
• Graphic organizers.

**English Language Learners:**
• Identify key phrases or new vocabulary to pre-teach.
• Additional Vocabulary Activities: to support the ELL students to build mathematical understanding
• Draw and label diagrams to represent the data for visual learners.
• Provide visual cues.
• Provide time for revision of work when students show need.
• Scaffolding content.
• Graphic organizers.
• Encourage students to offer bilingual assistance to each other.

**Students at Risk of Failure:**
• Reteach to Build Understanding: for struggling learners to revisit and practice the lesson concept or skill modeling.
• Provide time for revision of work when students show need.
• Scaffolding content.
• Graphic organizers.
• Mnemonics.

**Gifted Students:**
• Enrichment Activities: to challenge the advanced-proficient student.
• Provide extension assignments and activities.
• Projects in multiple tasks.
• Grouping.
• *Honors-level courses should feature activities and assessments that challenge students beyond the general education class requirements.*
**Unit Plan Title**  
Exploring Relations Between Variables

**Suggested Time Frame**  
11 days

**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**

**Standards for Mathematical Practice**

MP1. Make sense of problems and persevere in solving them.
MP2. Reason abstractly and quantitatively.
MP3. Construct viable arguments and critique the reasoning of others.
MP4. Model with mathematics.
MP5. Use appropriate tools strategically.
MP6. Attend to precision.
MP7. Look for and make use of structure.
MP8. Look for and express regularity in repeated reasoning

**Standards for Mathematical Content**

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.

**Essential Questions:**

**Enduring Understandings:**
1. The level of correlation between two pairs of ordered data can be evaluated.
1. When looking at data collected between two variables, how can we judge their correlations?
2. How are correlation and causation related to each other?
3. If two variables are correlated, how can we predict one variable’s value given the value of the other variable?

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 and 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.

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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<tr>
<td><strong>9.1 Personal Financial Literacy</strong></td>
<td>E – encouraged</td>
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<td>Credit and Debt Management</td>
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**Career Ready Practices**
- CRP1. Act as a responsible and contributing citizen and employee.
- CRP2. Apply appropriate academic and technical skills.
- CRP3. Attend to personal health and financial well-being.
- CRP4. Communicate clearly and effectively and with reason.
| Planning, Saving, and Investing | E | CRP5. Consider the environmental, social and economic impacts of decisions. |
| X Becoming a Critical Consumer | E | CRP6. Demonstrate creativity and innovation. |
| Insuring and Protecting | ETA | CRP8. Utilize critical thinking to make sense of problems and persevere in solving them. |
| **9.2 Career Awareness, Exploration, and Preparation** | | CRP9. Model integrity, ethical leadership and effective management. |
| X Career Awareness | E | CRP10. Plan education and career paths aligned to personal goals. |
| X Career Exploration | ETA | CRP11. Use technology to enhance productivity. |
| X Career Preparation | ET | CRP12. Work productively in teams while using cultural global competence. |

### 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/)
### Stage 2 – Assessment Evidence

**Performance Task(s):**

- **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.

- **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.

**Other Evidence:**

- Do Now/Anticipatory assignments
- Class Notes
- Teacher Observations
- Participation in class discussions
- Peer/Self Assessments.
- Guided practice individually, in pairs and in group
- Classroom assignments
- Homework assignments
- Lesson Quizzes
- Closure activities/exit slips

### Stage 3 – Learning Plan

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<tr>
<th><strong>Instructional Strategies</strong></th>
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</tr>
</thead>
</table>
| **Suggested Learning Activities** | • 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. |

**Modifications**

- Special Education Students: *(These are just suggested ideas to modify instruction. All modifications and accommodations should be specific to each individual child’s IEP)*
  - Multi-sensory instruction.
  - Differentiated instruction.
  - Additional Vocabulary Activities.
  - Provide hands-on manipulatives with format skeletons to groups of students.
  - Draw and label diagrams to represent the data for visual learners.
  - Provide time for revision of work when students show need.
- Facilitate group discussions to assess understanding among varying ability levels of students.
- Scaffolding content.
- Graphic organizers.

**English Language Learners:**
- Identify key phrases or new vocabulary to pre-teach.
- Additional Vocabulary Activities: to support the ELL students to build mathematical understanding.
- Draw and label diagrams to represent the data for visual learners.
- Provide visual cues.
- Provide time for revision of work when students show need.
- Scaffolding content.
- Graphic organizers.
- Encourage students to offer bilingual assistance to each other.

**Students at Risk of Failure:**
- Reteach to Build Understanding: for struggling learners to revisit and practice the lesson concept or skill modeling.
- Provide time for revision of work when students show need.
- Scaffolding content.
- Graphic organizers.
- Mneumonics.

**Gifted Students:**
- Enrichment Activities: to challenge the advanced-proficient student.
- Provide extension assignments and activities.
- Projects in multiple tasks.
- Grouping.
- *Honors-level courses should feature activities and assessments that challenge students beyond the general education class requirements.*
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

Standards for Mathematical Practice

MP1. Make sense of problems and persevere in solving them.
MP2. Reason abstractly and quantitatively.
MP3. Construct viable arguments and critique the reasoning of others.
MP4. Model with mathematics.
MP5. Use appropriate tools strategically.
MP6. Attend to precision.
MP7. Look for and make use of structure.
MP8. Look for and express regularity in repeated reasoning

Standards for Mathematical Content

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.

Essential Questions:

1. How do you plan and conduct a survey or experiment to collect data?
2. How do we obtain data? Why is it important?

Enduring Understandings:

1. 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.
2. 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...

Skills:

Students will be able to...
- 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.
- 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.

| In this unit plan, the following 21st Century Life and Careers skills are addressed: |
| Check ALL that apply – 21st Century Themes | Indicate whether these skills are: |
| | \- E – encouraged  
| | \- T – taught  
| | \- A – assessed |
| Career Ready Practices |
| 9.1 Personal Financial Literacy | CRP1. Act as a responsible and contributing citizen and employee. |
| Income and Careers | CRP2. Apply appropriate academic and technical skills. |
| Money Management | CRP3. Attend to personal health and financial well-being. |
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Student Resources

Primary Source Readings

Secondary Source Readings

Supporting Text pages
American Statistical Association Journals - AmStat - Journals

Teacher Resources

Texts:

Supplemental Workbooks:

Websites:
www.khanacademy.com
www.apstatsmonkey.com
www.mathxl.com
www.statsci.org
www.amstat.org
https://www.learner.org/courses/againstallodds/

Worksheets:
Teacher created worksheets

Videos:
www.khanacademy.com
Teacher created videos

Stage 2 – Assessment Evidence

Performance Task(s):
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.

Other Evidence:
Do Now/Anticipatory assignments
Class Notes
Teacher Observations
Participation in class discussions
Peer/Self Assessments.
Guided practice individually, in pairs and in group
Classroom assignments
Homework assignments
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- Encourage students to offer bilingual assistance to each other.

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- Enrichment Activities: to challenge the advanced-proficient student.
- Provide extension assignments and activities.
- Projects in multiple tasks.
- Grouping.
- *Honors-level courses should feature activities and assessments that challenge students beyond the general education class requirements.*
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

Standards for Mathematical Practice

MP1. Make sense of problems and persevere in solving them.
MP2. Reason abstractly and quantitatively.
MP3. Construct viable arguments and critique the reasoning of others.
MP4. Model with mathematics.
MP5. Use appropriate tools strategically.
MP6. Attend to precision.
MP7. Look for and make use of structure.
MP8. Look for and express regularity in repeated reasoning

Standards for Mathematical Content

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 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, $P(A \cup B) = P(A) + P(B) - P(A \cap B)$, and interpret the answer in terms of the model.

**S-CP.B.8.** (+) Apply the general Multiplication Rule in a uniform probability model, $P(A \cap B) = P(A)P(B|A) = P(B)P(A|B)$, 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).

<table>
<thead>
<tr>
<th>Essential Questions:</th>
<th>Enduring Understandings:</th>
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<td>1. What is conditional probability?</td>
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18
2. How can one determine if two events will occur in sequence?  
3. How can one determine if two events are mutually exclusive?  
4. How do you determine if a distribution is a probability distribution?

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<td><strong>Students will be able to...</strong></td>
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- 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.  
- Understand the Law of Large Numbers  
- Understand the difference between independent and dependent events  
- Conditional probability is the probability of an event \(A\), given that another \(B\) has already occurred.  
- Understand the multiplication rule  
- Understand the Fundamental Counting Principle  
- Appropriate conditions for using a geometric, binomial, or normal model.  
- 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.

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<th>In this unit plan, the following 21st Century Life and Careers skills are addressed:</th>
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<td><strong>Career Ready Practices</strong></td>
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Teacher Resources

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Supplemental Workbooks:

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www.statsci.org
www.amstat.org
https://www.learner.org/courses/againstallodds/

Worksheets:
Teacher created worksheets

Videos:
www.khanacademy.com
Teacher created videos

Stage 2 – Assessment Evidence

Performance Task(s):
*Casino Lab*
- The purpose of this lab is to allow students to explore the rules of probability in the setting of real-life games. Students will simulate playing several casino type and other popular games of chance. Their task is to collect information/data about each game and answer the corresponding questions.

Other Evidence:
Do Now/Anticipatory assignments
Class Notes
Teacher Observations
Participation in class discussions
Peer/Self Assessments.
Guided practice individually, in pairs and in group
Classroom assignments
Homework assignments
Lesson Quizzes
Closure activities/exit slips

Stage 3 – Learning Plan
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| Suggested Learning Activities                   | • Basic probability principles including complement, independence and mutually exclusive  
• Simulating probability scenarios  
• Addition, multiplication and conditional probability rules  
Videos: 21, *Moneyball*                                                                 |
| Modifications                                    | **Special Education Students:** *(These are just suggested ideas to modify instruction. All modifications and accommodations should be specific to each individual child’s IEP)*  
• Multi-sensory instruction.  
• Differentiated instruction.  
• Additional Vocabulary Activities.  
• Provide hands-on manipulatives with format skeletons to groups of students.  
• Draw and label diagrams to represent the data for visual learners.  
• Provide time for revision of work when students show need.  
• Facilitate group discussions to assess understanding among varying ability levels of students.  
• Scaffolding content.  
• Graphic organizers.  

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• Identify key phrases or new vocabulary to pre-teach.  
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• Encourage students to offer bilingual assistance to each other.  

**Students at Risk of Failure:**  
• Reteach to Build Understanding: for struggling learners to revisit and practice the lesson concept or skill modeling.  
• Provide time for revision of work when students show need.  
• Scaffolding content.  
• Graphic organizers.  
• Mnemonics.  

**Gifted Students:**  
• Enrichment Activities: to challenge the advanced-proficient student.  
• Provide extension assignments and activities. |
- Projects in multiple tasks.
- Grouping.
- *Honors-level courses should feature activities and assessments that challenge students beyond the general education class requirements.*
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

Standards for Mathematical Practice

MP1. Make sense of problems and persevere in solving them.
MP2. Reason abstractly and quantitatively.
MP3. Construct viable arguments and critique the reasoning of others.
MP4. Model with mathematics.
MP5. Use appropriate tools strategically.
MP6. Attend to precision.
MP7. Look for and make use of structure.
MP8. Look for and express regularity in repeated reasoning

Standards for Mathematical Content

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.
### Essential Questions:
1. What is a confidence interval and how do we interpret it?
2. What happens when we increase the level of confidence or sample size?
3. How can we identify types of errors and their significance?
4. How can the statistical method of hypothesis testing prove or disprove a given hypothesis statement?

### Enduring Understandings:
1. Confidence intervals are a balance between the precision and the certainty of a statement about a model perimeter.
2. The margin of error of a confidence interval for a proportion changes with the sample size and the level of confidence.
3. Students will be able to interpret p-values, Type I and Type II errors in context.
4. 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.
- Understand 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 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.
- Use a t-test to test a population proportion.

### In this unit plan, the following 21st Century Life and Careers skills are addressed:

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**Career Ready Practices**
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[www.khanacademy.com](http://www.khanacademy.com)  
[www.apstatsmonkey.com](http://www.apstatsmonkey.com)  
[www.mathx1.com](http://www.mathx1.com)
Worksheets:
Teacher created worksheets

Videos:
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Teacher created videos

Stage 2 – Assessment Evidence

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<td><strong>Taste the Difference</strong></td>
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<tr>
<td>• To model a taste test to the binomial distribution and perform a hypothesis test for proportions. The student is to gather data and use the binomial probability density function and model the binomial distribution with the standard normal distribution. The TI-83 calculator (or equal), the binomialpdf, and binomialcdf functions will be used.</td>
<td>Class Notes</td>
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<td><strong>Confidence Interval Project</strong></td>
<td>Teacher Observations</td>
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<td>• Students will choose one of 5 topics to research sample data and provide a presentation of their findings using confidence intervals.</td>
<td>Participation in class discussions</td>
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<td>Applications of Normal Distributions Presentation</td>
</tr>
<tr>
<td></td>
<td>Confidence intervals for one and two proportions</td>
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- Projects in multiple tasks.  
- Grouping.  
- *Honors-level courses should feature activities and assessments that challenge students beyond the general education class requirements.*
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**  
**Standards for Mathematical Practice**  
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**Essential Questions:**  
**Enduring Understandings:**
1. How do you interpret a decision based on the results of a significance test?
2. How can a model be used to draw conclusion from data?
3. How confident can we be that the model is appropriate?
4. What does it mean to make an inference?

1. Statistical significance does not measure the importance or magnitude of an effect. Recognize when others misinterpret statistical significance as proof of practical importance.
2. There are important assumptions and conditions we must check before using any statistical inference procedure.
3. 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.
4. Inference is a tool for validating a claim about a population parameter.

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.
- We do not “accept” the null hypothesis, we fail to reject it.
- The difference between a null hypothesis and an alternative hypothesis.
- Understand type I and type II errors, interpreting levels of significance
- Know 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.
In this unit plan, the following 21st Century Life and Careers skills are addressed:

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<thead>
<tr>
<th>21st Century Themes</th>
<th>Indicate whether these skills are:</th>
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<td>E – encouraged</td>
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<td>A – assessed</td>
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**Career Ready Practices**

| CRP1 | Act as a responsible and contributing citizen and employee. |
| 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. |

**Student Resources**

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

**Teacher Resources**

**Texts:**
Supplemental Workbooks:

Websites:
www.khanacademy.com
www.apstatsmonkey.com
www.mathxl.com
www.statsci.org
www.amstat.org
https://www.learner.org/courses/againstallodds/

Worksheets:
Teacher created worksheets

Videos:
www.khanacademy.com
Teacher created videos

Stage 2 – Assessment Evidence

Performance Task(s):
JellyBlubber Lab
- 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. Students will then chart the intervals on a class graph to illustrate the meaning of 95% confidence.

Timing Your Reaction Lab
- 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)

Moneyball Project
- The movie Moneyball 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. 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.

Stage 3 – Learning Plan

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<td>• Hypothesis testing for one and two means (with t)</td>
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<td>• Additional Vocabulary Activities.</td>
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<td>• Provide hands-on manipulatives with format skeletons to groups of students.</td>
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<td>• Draw and label diagrams to represent the data for visual learners.</td>
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<td>• Provide time for revision of work when students show need.</td>
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<td>• Facilitate group discussions to assess understanding among varying ability levels of students.</td>
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<td>• Scaffolding content.</td>
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<td>• Graphic organizers.</td>
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**English Language Learners:**

- Identify key phrases or new vocabulary to pre-teach.
- Additional Vocabulary Activities: to support the ELL students to build mathematical understanding.
- Draw and label diagrams to represent the data for visual learners.
- Provide visual cues.
- Provide time for revision of work when students show need.
- Scaffolding content.
- Graphic organizers.
- Encourage students to offer bilingual assistance to each other.

**Students at Risk of Failure:**

- Reteach to Build Understanding: for struggling learners to revisit and practice the lesson concept or skill modeling.
- Provide time for revision of work when students show need.
- Scaffolding content.
- Graphic organizers.
- Mneumonics.

**Gifted Students:**

- Enrichment Activities: to challenge the advanced-proficient student.
| • Provide extension assignments and activities.  
• Projects in multiple tasks.  
• Grouping.  
• **Honors-level courses should feature activities and assessments that challenge students beyond the general education class requirements.** |
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