**TOWNSHIP OF UNION PUBLIC SCHOOLS**


# Advanced Placement Statistics
# Adopted June 17, 2015
# Updated December 18, 2018

# Mission Statement

The Township of Union Board of Education believes that every child is entitled to an education designed to meet his or her individual needs in an environment that is conducive to learning. State standards, federal and state mandates, and local goals and objectives, along with community input, must be reviewed and evaluated on a regular basis to ensure that an atmosphere of learning is both encouraged and implemented. Furthermore, any disruption to or interference with a healthy and safe educational environment must be addressed, corrected, or when necessary, removed in order for the district to maintain the appropriate educational setting.

# Philosophy Statement

The Township of Union Public School District, as a societal agency, reflects democratic ideals and concepts through its educational practices. It is the belief of the Board of Education that a primary function of the Township of Union Public School System is to formulate a learning climate conducive to the needs of all students in general, providing therein for individual differences. The school operates as a partner with the home and community.

# Course Description

This course will include the following content areas:

1. Interpreting Categorical and Quantitative Data

   Exploratory analysis of data makes use of graphical and numerical techniques to study patterns and departures from patterns. In examining distributions of one and two categorical and quantitative data, students should be able to detect important characteristics, such as shape, location, variability, and unusual values. From careful observations of patterns in data, students can generate conjectures about relationships among variables.

2. Gathering Data, Making Inferences, and Justifying Conclusions

   Both the type of analysis that is appropriate and the nature of conclusions that can be drawn from that analysis depend in a critical way on how the data was collected. Emphasis will be placed on sampling methods to include: simple random, stratified, systematic, and cluster sampling. Data must be collected according to a well-developed plan if valid information is to be obtained. Experiments must be designed with respect to blocking, blinding, the placebo effect, and methods of randomization.

   Making inferences from data can be thought of as the process of selecting a reasonable model and generalizing sample data to draw justifiable conclusions about the entire population.

3. Conditional Probability, Rules of Probability and Making Decisions based on Probability

   Recognize independence, the role it plays in calculating conditional probabilities and use them to interpret data. The rules of probability allow for the calculation of the probability of compound events in a uniform probability model. Calculate expected value and use it to solve problems and evaluate the outcomes of decisions.

# Recommended Textbooks

**Student Text:**

***Stats***: Modeling the World AP* Edition (Bock Velleman DeVeaux) - Pearson

AP* Test Prep Series Workbook: 7 Main Topic Reviews and 4 Full Length Exams

**Recommended Student Calculator:**
TI 84 Plus Silver Edition Color

**Additional Teacher Materials:**
***Amsco's AP* Statistics***: Preparing for the Advanced Placement Exam Second Edition (Bohan)

# Course Proficiencies

**EACH STUDENT WILL BE ABLE TO:**

- 1. Read and understand terminology in published statistical reports and journals
- 2. Create and interpret graphs from data and calculate descriptive statistics
- 3. Calculate and interpret correlation between two variables
- 4. Determine the influence of one variable on another by using regression methods
- 5. Identify the characteristics of and the differences between observational studies and experiments
- 6. Know the different ways of selecting samples from a population
- 7. Know how to design a valid statistical study and be aware of the biases that may exist
- 8. Calculate the probabilities of real world phenomena
- 9. Students will understand and use sampling distributions
- 10. Calculate and interpret confidence intervals in real world situations
- 11. Perform significance tests and draw valid conclusions from their findings
- 12. Perform and interpret chi-squared tests on categorical data
- 13. Perform non-parametric tests when other significance tests are deemed invalid
- 14. Select and perform the best statistical analysis possible for a specific real world situation

# Curriculum Units

Unit 1: **Interpreting Categorical and Quantitative Data**

Unit 2: **Conditional Probability, Rules of Probability, and Making Decisions based on Probability**

Unit 3: **Gathering Data, Making Inferences, and Justifying Conclusions**

# Pacing Guide AP Statistics
## Semester I

## Unit 1

| **Interpreting Categorical and Quantitative Data** | **Chapters** | **# of days** |
|---|---|---|
| Introduction to Statistics and How to Learn from Data | 1 | 8 |
| Exploring Data with Graphs and Descriptive Numerical Summaries | 2-6 | 16 |
| Association: Contingency, Correlation, and Regression | 7-10 | 14 |

## Unit 2

| **Conditional Probability, Rules of Probability, and Making Decisions based on Probability** | | |
|---|---|---|
| Experiments and Sampling Methods | 11-13 | 14 |
| Probability in Our Daily Lives | 14 | 16 |
| Discrete and Continuous Probability Distributions | 15-17 | 12 |

# Pacing Guide – AP Statistics
## Semester II

## Unit 3

| **Gathering Data, Making Inferences and Justifying Conclusions** | **Sections** | **# of days** |
|---|---|---|
| Sampling Distributions | 18 | 8 |
| Statistical Inference: Confidence Intervals | 19,21 | 10 |
| Statistical Inference: Significance Tests About Hypotheses | 20,21-23 | 18 |
| Analyzing the Association Between Categorical Variables: Chi-Square Tests | 26 | 6 |
| Analyzing Association Between Quantitative Variables: Inference for Regression Analysis | 27 | 6 |
| A.P Exam Review | Cumulative, Review WB | 12 |
| Multiple Regression | 29 | 5 |
| Nonparametric Statistics | Supplementary | 10 |
| Researching Statistics | Supplementary | 5 |

# Unit 1: Interpreting Categorical and Quantitative Data

| Essential Questions | NJSLS/Instructional Outcomes | Activities | Assessments |
|---|---|---|---|
| 1. How can we construct and interpret graphical displays of distributions of univariate data? (stemplot, histogram, cumulative frequency plot)<br><br>2. How can we summarizing distributions of univariate data?<br><br>3. How can we compare distributions of univariate data (back-to-back stem plots and parallel boxplots)?<br><br>4. How can we explore bivariate data?<br><br>5. How can we explore categorical data? | 1. Identify center, spread, clusters, outliers and other unusual features of univariate data by reading graphical representations. **S-ID2**<br><br>2. Calculate center, spread and position of univariate data **S-ID3**<br><br>3. Compare and contrast features of different univariate distributions. **S-ID3**<br><br>4. Analyze patterns in scatterplots, recognize correlation and linearity. Find least-squares regression line and verify its validity by checking residual plots, outliers, and influential points**. S-ID6**<br><br>5. Construct and interpret representations of categorical data. **S-ID5** | 1. Instructor and student use of interactive computer software applet to demonstrate resistance of mean and median by outliers in a data set.<br><br>2. Use of correlation by eye computer applet designed to aid students in recognizing strength of correlation.<br><br>3. Use Microsoft Excel computer program to complete least squares regression project (See Appendix A) (**Interdisciplinary Connection**)<br><br>4. Organize univariate data into logical graphical representations using the graphing calculator that can be used to make conclusions about univariate distributions.<br><br>5. Enter data into graphing calculator and run one variable statistics to find the mean, median, mode, range, standard deviation, percentiles, and z-scores for univariate data.<br><br>6. Estimate population percentages using normal distribution. Use calculators, spreadsheets, and tables to estimate areas under the normal curve<br><br>7. Check the validity of least-squares regression by analyzing patterns in residual plots<br><br>8. Fit a function to the data, use linear, quadratic and exponential functions fitted to data to solve problems in the context of the data (**Interdisciplinary Connection**). | Use given data of test grades from the previous statistics test to answer questions 1-3<br><br>58, 89, 67, 99, 74, 91, 84, 86, 70, 73, 97, 61, 52, 88, 55, 12, 78, 60<br><br>1. Calculate mean, median, mode, range, and standard deviation of data.<br><br>2. Construct a stem leaf plot of the data.<br><br>3. Describe the distribution of the data. Calculate boundaries for and make mention of any outliers. |

| | | | |
|---|---|---|---|
| | | 9. Construct and interpret frequency tables, bar charts, and other representations of categorical data. | |

***Suggested Differentiation for Unit 1***

- **Tier 1 Learners:**
  - Have guided notes filled out at different levels according to ability.
  - Give assignments that contain tasks of varying difficulty. Each task should focus on essential learning that all students should master, but the tasks will vary in difficulty.
  - Group students by similar interest when working on application problems.
  - Use mini lessons to reteach to those having difficulty.
  - Group students so that each group contains all level learners. The tier 3 learners can serve as peer helpers.
  - Assign a basic homework assignment. Require students to spend a set amount of time to work (showing effort) on the assignment rather than completing the entire assignment.
  - Allow students to choose a method for completing a project: video, PowerPoint, paper, or presentation.
- **Tier 2 Learners:**
  - Utilize foldables creating tangible products to help students digest information while incorporating several of the multiple intelligences.
- **Tier 3 Learners:**
  - Have problems posted around the room. Have students loop to specific questions based on difficulty.

**Curriculum Development Resources**

- Course textbooks
- Graphing calculator
- Kuta software
- Quia software
- Laptop with Microsoft

## Unit 2: Conditional Probability, Rules of Probability, and Making Decisions based on Probability

| Essential Questions | NJSLS/Instructional Outcomes | Activities | Assessments |
|---|---|---|---|
| 1. How can we use the Law of Large Numbers to understand probability?<br>2. How can we use the Addition rule, multiplication rule, conditional probability, and independence to find the probability of an event occurring?<br>3. How can we combine independent random variables<br>4. How can we use the normal distribution to understand probability?<br>5. How does the Central limit Theorem play a role in Sampling distributions?<br>6. What are the types of sampling distributions? | 1. Interpret probability including long-run relative frequency interpretation. **S-CP2**<br>2. Find probabilities based on distributions of discrete random variables. **S-MD2**<br>3. Simulate the random behavior of events based on probability distributions. **S-MD1**<br>4. Calculate expected value and standard deviation of a random variable and linear transformations of a random variable. **S-ID6**<br>5. Differentiate between independent and dependent events.**S-CP2**<br>6. Identify properties of a normal distribution and use normal distribution tables **S-MD3** | 1. Calculate probability based on both independent and dependent events<br><br>2. Find probability based on binomial and geometric random variables. Use graphing calculator functions binompdf and binomcdf to calculate binomial probabilities.<br><br>3. Find the mean and standard deviation for sums and differences of independent random variables.<br><br>4. Find probabilities based on normally distributed random variables.<br><br>5. Use sampling distributions reach conclusions about sample data. **(Interdisciplinary Connection)** | 1. A set of 2000 measurements has a symmetric, mound-shaped distribution. The mean Is 5.3 and the standard deviation is 0.7. Determine an interval that contains approximately 1360 data values.<br>2. In a group of 100 scouts who took the physical exam for summer camp, 20% had type A blood. Six percent had both blond hair and type A blood. Find the probability that one scout selected at random will have blond hair, given that the blood test reveals type A.<br>3. Rogers High will play Memorial High in baseball six times during the upcoming season. Assume the teams are of equal ability; that is, p = .5. Within the context of a binomial experiment, what is the probability that:<br>Rogers will win 4 games and lose 2<br>Rogers will win *at least* 4 games? |

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|---|---|---|---|
| | 7. Reach conclusions about data using the following sampling distributions:<br>a. Sampling distribution of a sample proportion<br>b. Sampling distribution of a sample mean<br>c. Students use computer applet for Central Limit Theorem to draw different sample sizes from a population and draw conclusions of the sampling distribution.<br>d. Difference between two independent sample proportions<br>e. Difference between two independent sample means<br>f. Simulate sample distributions<br>g. t-distribution<br>h. chi-square distribution<br>**S-MD-7** | | |

***Suggested Differentiation for Unit 2***

- **Tier 1 Learners:**
  - Have guided notes filled out at different levels according to ability.
  - Give assignments that contain tasks of varying difficulty. Each task should focus on essential learning that all students should master, but the tasks will vary in difficulty.
  - Group students by similar interest when working on application problems.
  - Use mini lessons to reteach to those having difficulty.
  - Group students so that each group contains all level learners. The tier 3 learners can serve as peer helpers.
  - Assign a basic homework assignment. Require students to spend a set amount of time to work (showing effort) on the assignment rather than completing the entire assignment.
  - Allow students to choose a method for completing a project: video, PowerPoint, paper, or presentation.
- **Tier 2 Learners:**
  - Utilize foldables creating tangible products to help students digest information while incorporating several of the multiple intelligences.
- **Tier 3 Learners:**
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**Curriculum Development Resources**

- Course textbook
- Graphing calculator
- Kuta software
- Quia software
- Laptop with Microsoft

# Unit 3: Gathering Data, Making Inferences, and Justifying Conclusions

| Essential Questions | NJSLS/Instructional Outcomes | Activities | Assessments |
|---|---|---|---|
| 1. What are the methods of data collection?<br><br>2. How can we conduct random sampling using stratified, cluster, systematic, and simple random sampling?<br><br>3. How can we plan and conduct surveys to avoid bias?<br><br>4. How can we plan and conduct experiments?<br><br>5. When is it appropriate to use each of the following experimental techniques will be discussed: blocking, randomization, blinding, double blinding, replication, and the placebo effect? | 1. Understand methods of data collection. **S-IC3**<br>2. Identify characteristics of a well-designed, well-conducted survey. **S-IC3**<br>3. Randomly select from a population in order to have a sample from which valid conclusions can be drawn.**S-IC4**<br>4. Identify different sampling methods and sources of bias. **S-IC4**<br>5. Identify characteristics of a well designed, well conducted experiment.**S-IC4**<br>6. Estimation<br>a. Calculate and interpret confidence intervals for the following:<br>i. a proportion<br>ii. difference between two proportions<br>iii. a mean<br>iv. difference between two means (unpaired and paired)<br>v. slope of a least squares regression line<br>vi. prediction interval for predicted value | 1. Discussion of different types of bias including sampling bias, response bias, nonresponse bias, observer bias.<br>2. Plan a well-designed survey.<br>3. Draw an appropriate sample from the population.<br>4. Identify possible sources of bias.<br>5. Analyze sample data appropriately.<br>6. Complete Sample Survey Project (Project description in Appendix B) **(Interdisciplinary Connection)**<br>7. Make conclusions about a population based on confidence intervals.<br>8. Use graphing calculator to create any confidence interval from data or from summary statistics. | 1. Gathering Data Sample Problems<br>i. A survey is to be conducted in your high school. There is to be a total of 40 students in the sample. Describe how you would choose the participants if:<br>ii. There are to be the same number of freshman, sophomores, juniors, and seniors in the sample.<br>iii. There are to be the same number of males and females in the sample.<br>iv. There are no restrictions on the choice of the participants.<br>v. Identify the source of the bias and specify the direction of the bias. |

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| 6. How can we generalize results and types of conclusions that can be drawn from observational studies, experiments, and surveys?<br><br>7. What is the relationship between point estimators and confidence intervals?<br><br>8. How can we conduct Tests of Significance?<br>a. null and alternative hypotheses<br>b. p-values<br>c. concept and calculation of power | **S-MD5**<br>7. Tests of significance<br>a. Perform and interpret tests of significance for the following:<br>i. a proportion<br>ii. difference between two proportions<br>iii. a mean<br>iv. difference between two means (unpaired and paired)<br>v. slope of a least squares regression line<br>vi. chi-square tests for goodness of fit and independence<br>**S-MD5** | 9. Make conclusions about a population based on tests of significance.<br>a. Set up correct null and alternative hypotheses based on the context of the problem.<br>b. Verify assumptions for the test chosen are satisfied<br>c. Use graphing calculator to calculate test statistic and P-value of the significance test.<br>d. Draw conclusions of the test based on the test statistic and P-value in the context of the problem.<br><br>10. Find, read and summarize scholarly research journal articles in the student's intended area of college study.<br>11. Complete Final Project (Project description in Appendix C)<br>**(Interdisciplinary Connection)** | 2. A flour company wants to know what fraction of Minneapolis households bake tier own bread. An SRS of 500 residential addresses is drawn and interviewers are sent to these addresses. The interviewers are employed during regular working hours on weekdays and they interview only during those hours.<br><br>3. Inference and Justifying Conclusions Problems<br>i. A random sample of 64 students were asked to rate the school cafeteria food on a scale from 1 to 30. The sample mean was 22 and the standard deviation was 2.5. Determine the limits of a:<br>68% confidence interval<br>80% confidence interval<br>95% confidence interval |

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| | | | 4. Suppose your world history teacher had given a particular exam for several years and has determined that the scores are normally distributed and that the population mean score on the exam is 84 and the population standard deviation is 6. Her present class of 36 students obtains a mean score of 86. Should she retain the hypothesis that the class is representative of the population as defined by previous classes? Test at the 0.05 level with a two-tailed test to see if the null hypothesis is valid. |

***Suggested Differentiation for Unit 3***

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  - Have guided notes filled out at different levels according to ability.
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  - Group students by similar interest when working on application problems.
  - Use mini lessons to reteach to those having difficulty.
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  - Assign a basic homework assignment. Require students to spend a set amount of time to work (showing effort) on the assignment rather than completing the entire assignment.
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**Additional Suggested Modifications for Units**

Below is an additional list of modifications and accommodations opportunities. This includes, but is not limited to,:

1. English Language Learners.
    a. Read written instructions.
    b. Model and provide examples
    c. Extended time on assessments when needed.
    d. Establish a non-verbal cue to redirect student when not on task.
    e. Students may use a bilingual dictionary.

**English Language Development Standard 3: Language of Mathematics:** English language learners communicate information, ideas and concepts necessary for academic success in the content area of mathematics.

2. Special Education/504 Students.
    a. Extended time on assessments when needed.
    b. Preferred seating to be determined by student and teacher.
    c. Provide modified assessments when necessary.
    d. Student may complete assessments in alternate setting when requested.
    e. Establish a non-verbal cue to redirect student when not on task.
    f. Maintain strong teacher / parent communication.
    g. Conversion chart

**New Jersey Student Learning Standards - Technology**

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.

A. Technology Operations and Concepts: Students demonstrate a sound understanding of technology concepts, systems and operations

B. Creativity and Innovation: Students demonstrate creative thinking, construct knowledge and develop innovative products and process using technology.

C. Communication and Collaboration: Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning.

E: Research and Information Fluency: Students apply digital tools to gather, evaluate, and use information.

F: Critical thinking, problem solving, and decision making: Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.

Students will be instructed on how to use TI-84 Plus graphing calculators, ND Microsoft Excel to generate graphs, compute statistics, and analyze data. Such technology will be required on homework, projects, and other assessments.

*See Activities/Appendix for further Technology Integration.

**Career Readiness Practices**

- CRP1. Act as a responsible and contributing citizen and employee.
- CRP2. Apply appropriate academic and technical skills.
- CRP4. Communicate clearly and effectively and with reason.
- CRP6. Demonstrate creativity and innovation.
- CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.
- CRP11. Use technology to enhance productivity.

**NJSLS 9.2 - Career Awareness, Exploration, and Preparation**

9.2.8.B.3 Evaluate communication, collaboration, and leadership skills that can be developed through school, home, work, and extracurricular activities for use in a career.

# Appendix A: A.P. Baseball Statistics Project

**Objective:** To describe the association between quantitative variables and to predict values of the response variable based on the values of the explanatory variable. In baseball terms, we will find which variable is most correlated with winning and predict the number of wins based on this variable. All starred steps must be done on the computer using EXCEL.

**Requirements**

☆1. Collect the following baseball data from the _____ baseball season:

Hitting Stats: *Team, Runs, HR, SB, SLG, AVG*

Pitching Stats: *Wins, R, SO*

**Directions** (Warning: This will take a while to do and can be frustrating. Good luck!)

a. Go to www.mlb.com and drag the mouse over the "Stats" tab. Then click on "Historical".

b. Near the bottom left of the page, click on the gray box that says "Historical Team Stats".

c. Using the options on the left, go to the hitting stats for the given season.

d. Sort the data by team by clicking on the heading "Team".

e. Copy and paste the hitting stats into EXCEL.

f. Clean up the data and delete all unnecessary columns. (Be careful)

g. Now repeat steps c-f for the pitching stats.

h. Print out the data all on one page in landscape format.

☆2. Use EXCEL to construct 7 scatterplots that plots each quantitative variable as the x variable against *Wins* as the y variable. Add the regression equation (trend line) and $r^2$ value by right clicking on a point on the scatterplot and clicking "add trendline"; then on the options tab add the equation and $r^2$ value. Print them out all on the same page. On a separate page, discuss any associations visible in each scatterplot (linear or nonlinear, positive or negative).

3. If any of the scatterplots appear to be curved, attempt a transformation to make the scatterplot linear. Show the new transformed scatterplot and use it instead of the original curved one.

☆4. Calculate and interpret the correlation for each of these seven variables with *Wins*. Comment on the validity of the correlation.

5. Interpret $r^2$ for each of the seven variables with *Wins*.

6. Are there any influential points in any of your scatterplots? If so, identify them by *Team* name.

7. Based on the results of steps #2-6, identify which of the seven variables seems to be the best predictor of *Wins*? Why?

8. Use the regression line of the variable you selected in step #7 to predict the number of *Wins* the New York Mets ***should*** have had, based on this variable.

9. Calculate and interpret the residual for the New York Mets based on the same regression line.

☆10. Use EXCEL to construct a residual plot for the same regression you chose in step #7. Does this residual plot verify that the least squares regression line fits the data well? Explain. (Show the predicted values, residuals and residual plot all on the same page.)

☆ Add another variable defined by ($Runs^2 - R^2$). Construct the scatterplot and calculate the correlation between this variable and *Wins*. This is one of the better-known

# Appendix B: AP Statistics Sample Survey Group Project
## Due: 12/13/10

**Objective:** Design and implement an observational study to answer your topic question.

**Requirements**

Each student must hand in their own individual project.
Topic questions must be approved by the teacher.
Steps 2-7 should be the same for every member in your group.
Steps 8-12 should be different for every member.

On your title page, write your name and topic question. Also list your group members.
Please number the requirements in your final report.

**Group Project Requirements**

1. Each person in your group must decide on an individual topic question with a common group theme.
2. Combine all the topic questions from your group into one survey. Think carefully about the wording of these questions. Include this survey in your individual report.
3. What is the population for your study?
4. What sampling method will your group use to gather your data? What will the sample size be? Explain why your group chose that sampling method over the others.
5. Explain exactly how the subjects for your sample will be chosen. Will the sample be representative of the population? Be as specific as possible.
6. Collect the sample based on the survey your group prepared and sampling method your group selected. (This step does not need to be included in the final written report.)
7. Discuss any problems that your group ran into with the sampling process. Are there any biases that may occur as a result of the sample your group collected? Explain. (It's OK to mention problems or biases that you find. In practice, almost no sample is without its share of problems. Just mention the issues your group ran into and how your group dealt with them.)

**The group aspect of the project is complete. The rest of the project will be individual, using the data for your individual topic question only.**

**Individual Project Requirements**

8. Display the data collected on your *individual* topic question from the survey.
9. Construct a table to display the data.
10. Make an appropriate graph based on your data.
11. If the data is categorical, calculate the relative frequency of each category.
    If the data is quantitative, calculate the mean, median, mode, standard deviation.
12. Summarize the conclusions that you found based on the graphs and calculations. Explain the results of the sample.

Results Presentation

Students must present their findings to the class in a clear and concise manner with emphasis on the use of proper statistical vocabulary and terminology.

# Appendix C: AP Statistics Final Project

**Overview**
Each student will prepare a poster.
The project will include an analysis of data from an existing dataset or a dataset generated by the student. The end product is a poster (on 22 by 28 inch poster board) that will be presented to a group of fellow students at a poster session scheduled for **Monday, June 14 through Wednesday, June 16**. During the poster presentations you will also be responsible for reviewing the poster presentations of others in your class. Posters will be graded after the presentations are completed.

**Proposal**
A proposal for the project will be required. The proposal must be a single page that gives a brief statement of your topic, the issue or question you are addressing, the source of the data (be specific), how the data was (or will be) collected, the sample size, and the graphical and statistical analysis techniques that will be used.
The proposal will be due by **Friday, May 14**.

**Poster Presentation Reviews**
At the completion of each poster presentation, the other members of the class will independently review the poster and presentation by completing the attached review form (a blank review form is provided).

**Analysis of Data**
The project will consist of 1) locating or collecting data in your field of interest that will require both graphical displays and statistical analyses, 2) preparing a poster that presents the aforementioned graphical display(s) and results of statistical tests, 3) verbally presenting the poster to fellow students at a poster presentation session, and 4) reviewing the poster presentations of other class members.

**Step 1 – Selection of the Dataset or Design of the Study**

Identify a field of potential interest, such as medicine, biology, economics, sports, etc. The internet has a vast source of datasets on almost any subject. Just search for your favorite topic using an internet search engine. Be sure to select a dataset that has a clear description of its context (e.g. background, study design, specification of variables, etc.). Sports are a good source for datasets (e.g. try www.baseball-reference.com). If you have already collected your own dataset or plan on collecting your own data, you will need to be concerned about aspects of study design. What are the primary study objectives? What are the primary variables? How was the sample size determined? How were the individuals selected? How are you avoiding bias? What statistical techniques will be used? If you plan on collecting data from other individuals (e.g. surveying your fellow students), please see the instructor to discuss issues of consent and confidentiality before you start.

**Step 2 – Conduct your Study and Analyze your Data**

The best approach to data analysis is to have a clear plan that focuses on your primary objectives.
Your plan should include methods for understanding your data [graphs and tables] and the analysis [the analysis method(s), key graph(s) and table(s) reporting the analysis results].

**Step 3 – Preparation of your Poster**

The presentation should fit onto a 22 by 28 inch poster board, use a font size of 28 or higher throughout (for readability), and should consist of the following elements:

1) A brief descriptive title of the research topic.
2) If you used data collected by someone else, you should give a complete formal statement of the reference for the data.
   If you generated the dataset yourself, you should give a single sentence summary description of the dataset accompanied by the statement "collected and analyzed by (your name)". If someone else assisted you in the collection of the data, then their name should also be given.
3) An abstract giving the following:
   a. Background (10-40 words)
   b. Methods (10-40 words)
   c. Results (20-100 words)
   d. Conclusions (10-40 words)
4) A statement of your study design, indicating the specific source of the data, the sample size, and how the data was collected (50-100 words).
5) A table describing the key characteristics of your dataset (e.g. if you are reporting a clinical analysis, this would be a table giving summary statistics on the age, race, sex and disease characteristics of the patients in the study).

6) A graphical display(s) useful for understanding the results of your study. The most common type of graphical display is the histogram or bar chart.
7) A paragraph describing the concept/conclusions of the graphical display(s) (50-100 words).
8) The results of the main statistical tests you conducted. In general, the most common types of statistical analyses are t-tests, chi-square tests, and regression. Include all parts of the significance test or confidence interval.
9) A paragraph describing the concept/conclusions of the statistical test results (50-100 words).
10) A single paragraph describing the strengths (20-100 words) and weaknesses (20-100 words) of the graphical display(s) and statistical test results (e.g. weaknesses may involve a small number of subjects, suboptimal study design, unmet assumptions, or variables that you would have liked to control for, but were not available in your data).

**Important notes**

1. Focus on presenting only 1-2 analysis points clearly. Don't try to present lots of complex material. One of the goals of this project is for you to develop the skill to be able to present the results of an analysis in a clear, succinct manner that will maximize the likelihood that it will convince others of your main conclusions. Do not fill up your poster with unnecessarily complex detailed graphs, analyses and text.

2. Word limits and font sizes have been designed for this poster project to encourage the development of an effective poster. Please follow them.

3. If your current text and material doesn't fit onto the poster, your first thought should be to condense your text to just the essential elements. The skill of condensing text to fit within the word limits of professional journals is a skill nearly all will eventually need in their career. It is recommended that the student write at least twice as much text as needed for the poster and then condense it down to reach the word limits.

Text initially written to a target word limit often looks disjoint and sloppy. Also, please do not have any material hang over the edges of the poster.

4. Discussing strengths and weaknesses. Referring to the poster paragraph describing the strengths and weaknesses of the graphical display(s) and statistical test results (section 10), please carefully note the following points. Study weaknesses (e.g. suboptimal study design) should be identified using specific comments (rather than general comments) and a statement should be included that indicates how the problem could be solved in a practical manner. For example, a true experiment may not be possible, but it might be feasible to identify suitable individuals that could be used as controls. If there is a problem with a lack of testing of assumptions, the specific unreasonable assumptions should be identified, the method of testing or assessing the assumption should be identified, and a statement added giving your balanced judgment regarding the extent of potential impact the violation of this assumption would have on study results. If you can't show causality, describe why not? What causal relationship would you like to demonstrate if you could?

**Poster Project Review Comments**

Name of student who prepared the poster _____

**Please use the following rating scale for the 5 questions below**
(5 – Outstanding, one of the best in the class; 4 - Very good, clear and well-done; 3 –Good, about average for the class; 2 – Fair, but could be improved; 1 – Some weaknesses, needs to be improved)

_____ Abstract
_____ Graphical display(s) and descriptive paragraph of the concept/conclusions
_____ Statistical tests (tables) and descriptive paragraph of the concept/conclusions
_____ Description of the strengths and weaknesses of the graphical display(s) and statistical test results
_____ Verbal presentation

Please give at least 20 words describing the strength of the poster and/or presentation.
_____
_____
_____

Please give at least 20 words of constructive criticism regarding the poster and/or presentation.
_____
_____
_____
_____

_____ Name of student who prepared this review

## Appendix D: New Jersey Student Learning Standards Statistics

Common Core State Standards S-ID, S-IC, S-CP and S-MD are used throughout curriculum. Students will develop their mathematical skills as well as their problem solving strategies and their ability to interpret information and data. They will become efficient and creative problem solvers and will acquire an understanding of mathematical concepts. Students will be able to solve problems numerically, graphically, and analytically. They will use technology to reinforce concepts and also as an efficient problem solving tool.

# Appendix E: New Jersey Scoring Rubric

**Scoring Guide for Mathematics Open-Ended (OE) Questions**
**(Generic Rubric)**

**3-Point Response**

The response shows complete understanding of the problem's essential mathematical concepts. The student executes procedures completely and gives relevant responses to all parts of the task. The response contains few minor errors, if any. The response contains a clear, effective explanation detailing how the problem was solved so that the reader does not need to infer how and why decisions were made.

**2-Point Response**

The response shows nearly complete understanding of the problem's essential mathematical concepts. The student executes nearly all procedures and gives relevant responses to most parts of the task. The response may have minor errors. The explanation detailing how the problem was solved may not be clear, causing the reader to make some inferences.

**1-Point Response**

The response shows limited understanding of the problem's essential mathematical concepts. The response and procedures may be incomplete and/or may contain major errors. An incomplete explanation of how the problem was solved may contribute to questions as to how and why decisions were made.

**0-Point Response**

The response shows insufficient understanding of the problem's essential mathematical concepts. The procedures, if any, contain major errors. There may be no explanation of the solution, or the reader may not be able to understand the explanation. The reader may not be able to understand how and why decisions were made.

The generic rubric above is used as a guide to develop specific scoring guides or rubrics for each of the open-ended (OE) questions that appear on the New Jersey fourth-grade (ESPA), eighth-grade (GEPA), and eleventh-grade (HSPA) proficiency assessments in Mathematics. The generic rubric helps ensure that students are scored in the same way for the same demonstration of knowledge and skills regardless of the test question.