

Teaching the Common Core State Standards (www.corestandards.org) with Census at School
www.amstat.org/censusatschool

<p>Grade 4 – Measurement and Data (4.MD)</p> <ul style="list-style-type: none"> • Solve problems involving measurement and conversion of measurements from a larger unit to a smaller unit. • Represent and interpret data. 	<p>The U.S. Census at School questionnaire includes measurement questions (measuring height, arms pan, and foot length in centimeters, finger length in millimeters, etc.) and opportunities to represent and interpret real student data.</p>
<p>Grade 5 – Measurement and Data (5.MD)</p> <ul style="list-style-type: none"> • Convert like measurement units within a given measurement system. • Represent and interpret data. 	<p>Because Census at School is an international program, measurements are provided in metric units. A measurement guide is provided online, which can help facilitate unit conversion and classroom discussion.</p>
<p>Grade 6 – Statistics and Probability (6.SP)</p> <p>Develop understanding of statistical variability.</p> <ol style="list-style-type: none"> 1. Recognize a statistical question as one that anticipates variability in the data related to the question and accounts for it in the answers. <i>For example, “How old am I?” is not a statistical question, but “How old are the students in my school?” is a statistical question because one anticipates variability in students’ ages.</i> 2. Understand that a set of data collected to answer a statistical question has a distribution which can be described by its center, spread, and overall shape. 3. Recognize that a measure of center for a numerical data set summarizes all of its values with a single number, while a measure of variation describes how its values vary with a single number. <p>Summarize and describe distributions.</p> <ol style="list-style-type: none"> 4. Display numerical data in plots on a number line, including dot plots, histograms, and box plots. 5. Summarize numerical data sets in relation to their context, such as by: <ol style="list-style-type: none"> a. Reporting the number of observations. b. Describing the nature of the attribute under investigation, including how it was measured and its units of measurement. c. Giving quantitative measures of center (median and/or mean) and variability (interquartile range and/or mean absolute deviation), as well as describing any overall pattern and any striking deviations from the overall pattern with reference to the context in which the data were gathered. d. Relating the choice of measures of center and variability to the shape of the data distribution and the context in which the data were gathered. 	<p>Census at School provides opportunities for students to participate in the statistical problem-solving and investigation process:</p> <p>Formulate statistical questions of interest that can be answered with the Census at School data.</p> <p>Collect/select appropriate Census at School data and write down the variable names and type for this investigation.</p> <p>Analyze the data. Include appropriate graphs and numerical summaries for the corresponding variables.</p> <p>Interpret the results and make appropriate conclusions in context. Be sure to justify your results using your graphs and numerical summaries and relate your interpretation to the original question.</p> <p>All of the 6.SP standards can be taught in context of statistical problem solving using real student data with Census at School. There are examples of formulating statistical questions that can be answered with Census at School data, appropriate graphs, and measures of center and spread and their relationship to distribution shape in the PowerPoint “Teaching Data Analysis as an Investigative Process with Census at School” available online at http://www.amstat.org/censusatschool/resources.cfm.</p>
<p>Grade 7 – Statistics and Probability (7.SP)</p> <p>Use random sampling to draw inferences about a population.</p> <ol style="list-style-type: none"> 1. Understand that statistics can be used to gain information about a population by examining a sample of the population; generalizations about a population from a sample are valid only if the sample is representative of that population. Understand that 	<p>In addition to analyzing the class census data, students can compare their class with random samples from participating students in the United States through the U.S. random sampler and other participating countries through the international random sampler. The U.S. Census at School Random Sampler provides a random sample of responses from students participating in the U.S. Census at School program. Class</p>

random sampling tends to produce representative samples and support valid inferences.

2. Use data from a random sample to draw inferences about a population with an unknown characteristic of interest. Generate multiple samples (or simulated samples) of the same size to gauge the variation in estimates or predictions. *For example, estimate the mean word length in a book by randomly sampling words from the book; predict the winner of a school election based on randomly sampled survey data. Gauge how far off the estimate or prediction might be.*

Draw informal comparative inferences about two populations.

3. Informally assess the degree of visual overlap of two numerical data distributions with similar variabilities, measuring the difference between the centers by expressing it as a multiple of a measure of variability. *For example, the mean height of players on the basketball team is 10 cm greater than the mean height of players on the soccer team, about twice the variability (mean absolute deviation) on either team; on a dot plot, the separation between the two distributions of heights is noticeable.*

4. Use measures of center and measures of variability for numerical data from random samples to draw informal comparative inferences about two populations. *For example, decide whether the words in a chapter of a seventh-grade science book are generally longer than the words in a chapter of a fourth-grade science book.*

Note: Grade 7 also includes probability standards

participation and student responses are voluntary and do not represent a random sample of students in individual states or the United States. This can provide an interesting classroom discussion regarding the population of interest and the population to which to draw inferences (only students participating in U.S. Census at School). Multiple samples can be selected of the same size to gauge variation.

The class Census at School data, random samples from U.S. Census at School responses, and random samples from participating international students all provide different populations to draw informal comparative inferences. Additionally, each dataset provides a large variety of categorical and quantitative variables/responses, including variables that can be used to compare potential different populations, such as gender, grade, geographic region, etc.

Students can then compare distributions and measures of centers and spread to draw informal comparative inferences about two (or more) populations.

Grade 8 – Statistics and Probability (8.SP)

Investigate patterns of association in bivariate data.

1. Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association.

2. Know that straight lines are widely used to model relationships between two quantitative variables. For scatter plots that suggest a linear association, informally fit a straight line, and informally assess the model fit by judging the closeness of the data points to the line.

3. Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept. *For example, in a linear model for a biology experiment, interpret a slope of 1.5 cm/hr as meaning that an additional hour of sunlight each day is associated with an additional 1.5 cm in mature plant height.*

4. Understand that patterns of association can also be seen in bivariate categorical data by displaying frequencies and relative frequencies in a two-way table. Construct and interpret a two-way table summarizing data on two categorical variables collected from the same subjects. Use relative frequencies calculated for rows or columns to describe possible association between the two variables. *For example, collect data from students in your class on whether or not they have a curfew on school nights and whether or not they have assigned chores at home. Is there evidence that those who have a curfew also tend to have chores?*

All of the 8.SP standards can be taught in context of statistical problem solving using real student data with Census at School. Census at School provides a variety of quantitative and categorical responses that can be used to investigate patterns of associate in bivariate measurement data and bivariate categorical data.

There are examples of investigating patterns of association in bivariate measurement data, modeling the relationships that suggest linear association with a line, informally assessing the model fit, solving problems in context of the data, interpreting slope and intercept, and investigating patterns of association in bivariate data with a two-way table and relative frequencies in the PowerPoint “Teaching Data Analysis as an Investigative Process with Census at School” available online at <http://www.amstat.org/censusatschool/resources.cfm>.

High School – Statistics and Probability

Interpreting Categorical & Quantitative Data (S-ID)

Summarize, represent, and interpret data on a single count or measurement variable

1. Represent data with plots on the real number line (dot plots, histograms, and box plots).
2. Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.
3. Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).
4. Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate areas under the normal curve.

Summarize, represent, and interpret data on two categorical and quantitative variables

5. Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data.
6. Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.
 - a. Fit a function to the data; use functions fitted to data to solve problems in the context of the data. Use given functions or choose a function suggested by the context. Emphasize linear, quadratic, and exponential models.
 - b. Informally assess the fit of a function by plotting and analyzing residuals.
 - c. Fit a linear function for a scatter plot that suggests a linear association.

Interpret linear models

7. Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.
8. Compute (using technology) and interpret the correlation coefficient of a linear fit.
9. Distinguish between correlation and causation.

Making Inferences & Justifying Conclusions (S-IC)

Understand and evaluate random processes underlying statistical experiments

1. Understand statistics as a process for making inferences about population parameters based on a random sample from that population.
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?*

Make inferences and justify conclusions from sample surveys, experiments, and observational studies

3. Recognize the purposes of and differences among sample

The high school statistics standards can be taught in context of statistical problem solving using real student data with Census at School. Census at School provides a variety of categorical and quantitative responses that can be used to summarize, represent, or interpret data for a single variable or two categorical and quantitative variables.

There are examples of summarizing, representing, and interpreting data for a single count or measurement variable, data on two categorical and quantitative variables, and interpreting linear models, making inferences, and justifying conclusions in the PowerPoint “Teaching Data Analysis as an Investigative Process with Census at School” available online at <http://www.amstat.org/censusatschool/resources.cfm>.

- surveys, experiments, and observational studies; explain how randomization relates to each.
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.
 5. Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.
 6. Evaluate reports based on data.

Note: There are also high school probability standards, where many of these can be motivated and analyzed based on real student data in Census at School