



Bringing Statistics to Life: Census at School

Stephen J. Miller – New Orleans – 10 April 2014

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 NATIONAL COUNCIL OF
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What is Census at School?

- ▶ International classroom project
- ▶ Began in the UK in 2000 to promote statistical literacy in schoolchildren using their own real data
 - ▶ Now also in New Zealand, Australia, Canada, South Africa, Ireland, Japan, Korea, and the United States
 - ▶ Other countries are looking into adopting the program
- ▶ Nearly 20,000 students have participated
- ▶ US Census at School is sponsored by the American Statistical Association with support from the Population Association of America

What is Census at School?

- ▶ Classroom activity for students in grades 4 – 12
- ▶ Focus on statistical problem solving
- ▶ Students complete online survey (*requires data collection*)
- ▶ Analyze their class results
- ▶ Compare their class with random samples of students in the United States and other countries
- ▶ Formulate statistical questions of interest that can be answered using data

How does Census at School work?

- ▶ Students complete a brief online survey (classroom census)
 - ▶ 40 questions total
 - ▶ 13 international questions plus additional U.S. questions
 - ▶ 15-20 minute computer session to complete survey
 - ▶ Some data collection is required
- ▶ Analyze your class results
 - ▶ Use teacher login to gain immediate access to class data
 - ▶ Formulate questions of interest that can be answered with Census at School data, collect/select appropriate data, analyze the data with appropriate graphs and numerical summaries, interpret the results, and make appropriate conclusions in context relating to the original questions

How does Census at School work?

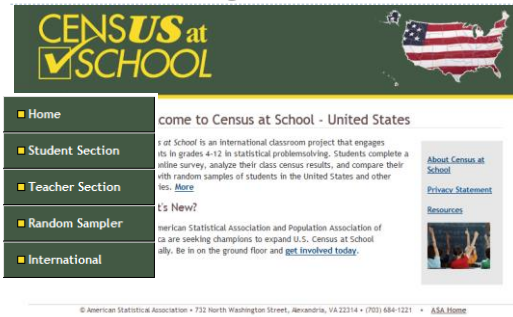
- ▶ Compare your class with samples from the U.S. and other countries
 - ▶ Download a random sample of Census at School data from U.S. students
 - ▶ Download a random sample from participating international students
- ▶ Where to begin?
 - ▶ <http://amstat.org/censusatschool/>

Home Page



The screenshot shows the top portion of the Census at School website. At the top left is the logo "CENSUS at SCHOOL" with a checkmark. To the right is a map of the United States with an American flag. Below the logo is a navigation menu with links: Home, Student Section, Teacher Section, Random Sampler, and International. The main content area is titled "Welcome to Census at School - United States" and contains introductory text about the project, a "What's New?" section, and links to "About Census at School", "Privacy Statement", and "Resources". A small photo of students is visible in the bottom right corner of the main content area.

Home Page



This screenshot shows the full home page layout. The navigation menu on the left is expanded to show the "Student Section" link. The main content area is titled "Welcome to Census at School - United States" and includes a detailed description of the project, a "What's New?" section, and links to "About Census at School", "Privacy Statement", and "Resources". A small photo of students is visible in the bottom right corner of the main content area.

Home Page



This screenshot shows the full home page layout with the navigation menu expanded to show the "Teacher Section" link. The main content area is titled "Welcome to Census at School - United States" and includes a detailed description of the project, a "What's New?" section, and links to "About Census at School", "Privacy Statement", and "Resources". A small photo of students is visible in the bottom right corner of the main content area.



- ▶ Resources
 - ▶ Instructional webinars
 - ▶ Lesson plans from STEW
 - ▶ International Learning Activities
 - ▶ Lesson sharing



- ▶ Teacher Section
 - ▶ Create account
 - ▶ Detailed instructions
 - ▶ Questionnaire
 - ▶ Measurement guide



U.S. Census at School Questionnaire

The first thirteen questions marked with an asterisk are international questions common to the countries participating in the Census at School program.

1. Are you male or female?*
- Male Female
2. How old are you?*
- Age (years) _____
3. Are you right-handed, left-handed or ambidextrous?* (An ambidextrous person is able to use his or her right and left hands equally well.)*
- Right-handed Left-handed Ambidextrous

Questions with an asterisk (*) are common to the US and International questionnaires

(An ambidextrous person is able to use his or her right and left hands equally well.)*

Measurement Guide

U.S. Census at School Measurement Guide

Census at School is an international classroom project with measurements taken in centimeters for some questions and millimeters for others. Please measure using the appropriate metric units indicated in the questions.

| HEIGHT | |
|--|--|
| 4. How tall are you without your shoes on? Answer to the nearest centimeter. | |
| THOUGHTS ABOUT THE QUESTION | CONSIDERING SOURCES OF VARIATION AND MEASURES |
| The original international question was, "How tall are you? Answer to the nearest centimeter." This was later changed to, "How tall are you without your shoes on? Answer to the nearest centimeter." Why do you think the question was changed? | How can we, as a class, make height measurements to ensure accuracy? |
| When grade 4-12 students' heights are measured in centimeters, what do you think the values will be? The shortest? The tallest? If you plot a graph of students' heights, what shape do you predict the distribution will be? | Consider: |
| | <ul style="list-style-type: none"> One person making all the measurements. Attaching a height chart to the wall using an official height chart or attaching two or more tape measures to the wall. Using a book as the guide, rather than a ruler. The book can be placed with the flat spine against the wall and the student's head can be placed against the top edge of the book. |

Measurement Guide

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| CONSIDERING SOURCES OF VARIATION AND MEASURES | |
|---|--|
| How can we, as a class, make height measurements to ensure accuracy? | |
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Measurement Guide

- One person making all the measurements.
- Attaching a height chart to the wall using an official height chart or attaching two or more tape measures to the wall.
- Using a book as the guide, rather than a ruler. The book can be placed with the flat spine against the wall and then slid down until it touches the person's head. This takes the measure at right angles. With a ruler, there is a tendency to angle the ruler up or down.
- Using a book as the guide, rather than a ruler. The book can be placed with the flat spine against the wall and the student's head can be placed against the top edge of the book.

Measurement Guide

- Measuring height correctly in **centimeters**, not in feet or inches, as is common in the United States. Students likely will not have a sense of their height in centimeters. Keep in mind that a 4 ft tall student is 122 cm and a 6 ft tall student is 183 cm. Make sure the heights measured in centimeters are reasonable values.

The original international question was, "How tall are you? Answer to the nearest centimeter." This was later changed to, "How tall are you without your shoes on? Answer to the nearest centimeter." Why do you think the question was changed?

When grade 4–12 students' heights are measured in centimeters, what do you think the values will be? The shortest? The tallest? If you plot a graph of students' heights, what shape do you predict the distribution will be?

How can we, as a class, make height measurements to ensure accuracy?

- Consider:
- One person making all the measurements.
 - Attaching a height chart to the wall using an official height chart or attaching two or more tape measures to the wall.
 - Using a book as the guide, rather than a ruler. The book can be placed with the flat spine against the wall and above the student's head to measure the height.

Measurement Guide

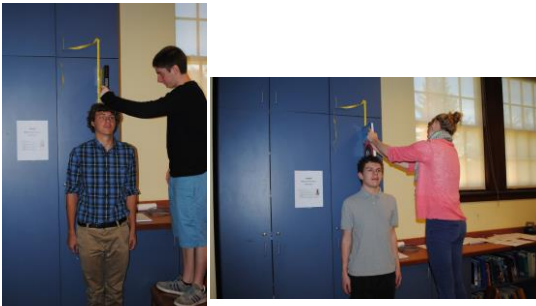
HEIGHT MEASUREMENT STATION

Work in pairs to take one another's height measurements.

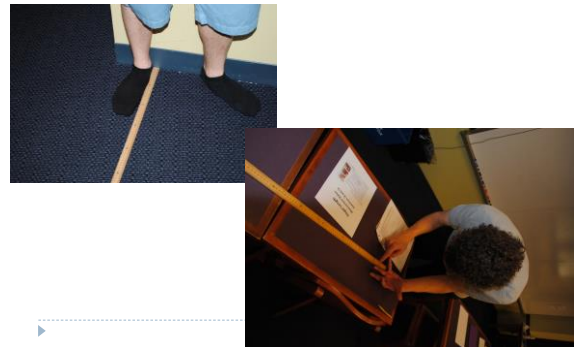
- Take your shoes off. Stand with your back to the wall against the height measurement chart/tape measure.
- Get your partner to take the provided textbook and place it on the wall above your head. Make sure the spine of the book is flat against the wall.
- Your partner will slide the book down until it touches your head.
- Your partner will read the height off the chart to the nearest **centimeter** (not feet or inches). The height is shown by looking at the bottom of the spine of the book.
- Check to make sure your height measured in centimeters is a reasonable value (height measurements in centimeters for students in grades 4–12 will generally be between 120 and 200 cm).
- Record your height measurement in **centimeters** as a number for Question 4.



Measurement Guide



Measurement Guide



Reaction Time

Test Your Reaction Time!

- Click on "start."
- As soon as the square background color changes, hit "stop!"
- Record your reaction time in seconds as a decimal (e.g., 0.594).

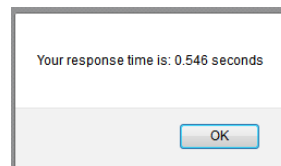


start stop

Reaction Time

Test Your Reaction Time!

- Click on "start."
- As soon as the square background color changes, hit "stop!"
- Record your reaction time in seconds as a decimal (e.g., 0.594).

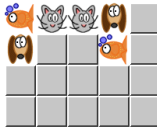


start stop

Memory Test

Test your memory. How quickly can you uncover all the pairs of pictures?

1. Click on "Start."
2. Click on the squares to uncover their pictures (only pairs will remain uncovered).
3. Click until you have uncovered all the pairs.
4. Record your time in seconds as a number.



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Rating Slider

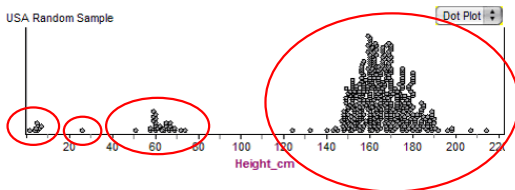
How important are the following issues to you?

Use the sliders to mark the level of importance. Record your ratings for each issue on the scale from 0 (not important) to 1000 (very important).

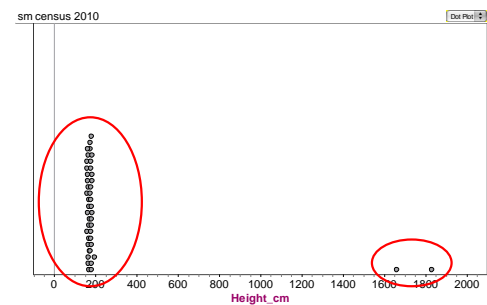
| | Not important | Very important |
|---|---------------|----------------|
| Reducing pollution | 428 | |
| Recycling | 829 | |
| Conserving water | 963 | |
| Conserving energy (electricity, gas, oil for heating, lighting, car travel) | 636 | |
| Owning a computer | 225 | |
| Access to the Internet | 70 | |

Data Review ("cleaning")

- ▶ Important to review the data carefully before analysis
 - ▶ Look for unusual values that don't make sense
 - ▶ More than 24 hours in a day
 - ▶ Heights of 6 cm



Data Review ("cleaning")



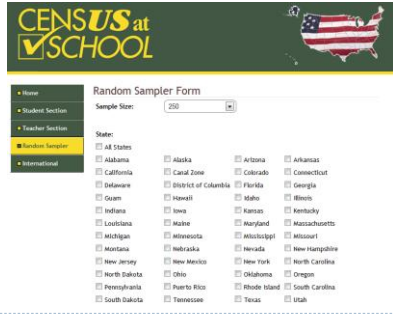
Data Review ("cleaning")

- ▶ Recent Development!!!
 - ▶ Soon (not sure when) the US site will have the raw (original) data.
 - ▶ The International site will have "cleaned" data.
 - ▶ Gives the teacher the opportunity to include data cleaning in the project or not.

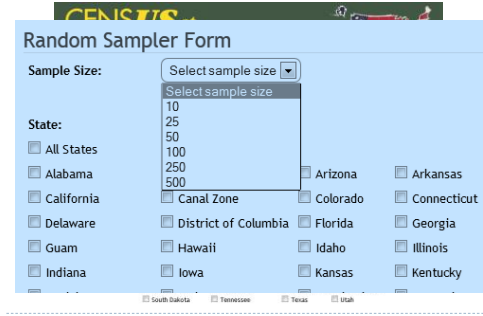
Random Sampler

- ▶ Statistics can be used to gain information about a population by examining a **random sample** of the population
- ▶ Generalizations about a population from a sample are valid only if the sample is representative of that population
- ▶ Random sampling tends to produce representative samples and support valid inferences

Random Sampler



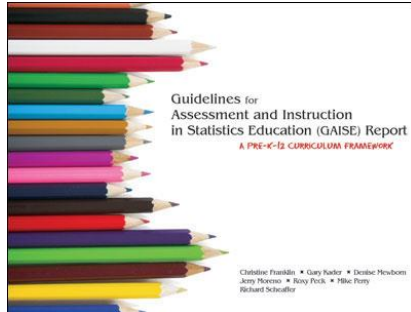
Random Sampler



Random Sampler

Random Sampler

Statistical Problem Solving



<http://amstat.org/education/gaise/>

Statistical Problem Solving

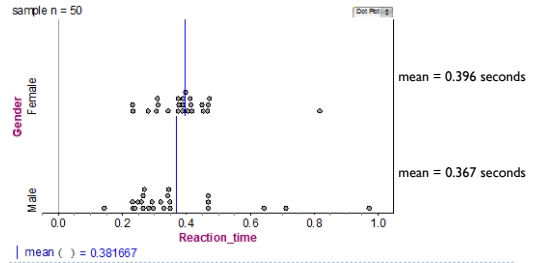
1. Formulate Questions
 - ▶ Clarify the problem at hand
 - ▶ Formulate one (or more) questions that can be answered with data
2. Collect Data
 - ▶ Design a plan to collect appropriate data
 - ▶ Employ the plan to collect the data
3. Analyze Data
 - ▶ Select appropriate graphical and numerical methods
 - ▶ Use the methods to analyze the data
4. Interpret Results
 - ▶ Interpret the analyses (in context)
 - ▶ Relate interpretation to the original question

Statistical Questions

- ▶ Do male students have faster reaction times than female students?
- ▶ How long a commute to school do students have? Is there a relationship between mode of transportation and length of commute?
- ▶ Is there a relationship between height and arm span? If so, what type of relationship is it? Is it the same relationship for male and female students?

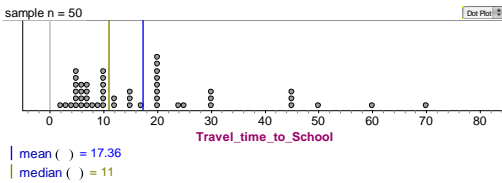
Statistical Questions

- ▶ Do male students have faster reaction times than female students?



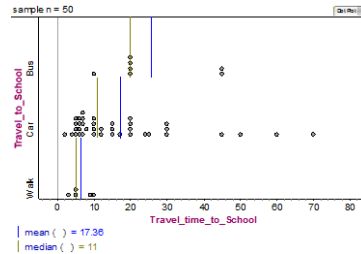
Statistical Investigation – Example

- ▶ How long a commute to school do students have?



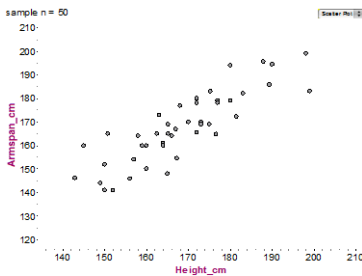
Statistical Questions

- ▶ Is there a relationship between mode of transportation and length of commute?



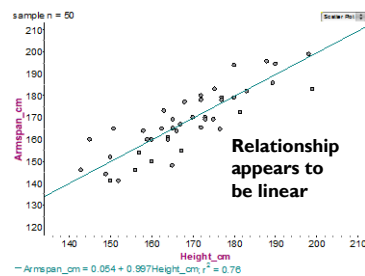
Statistical Questions

- ▶ Is there a relationship between height and arm span?



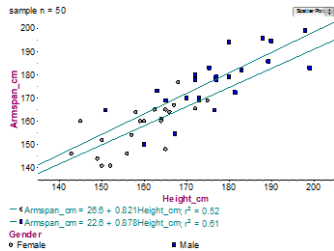
Statistical Questions

- ▶ If so, what type of relationship is it?



Statistical Questions

- ▶ Is the relationship the same for male and female students?



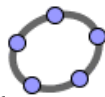
In-Class Activities

- ▶ Available from STEW (Statistics Education Web) at <http://amstat.org/education/stew/>
 - ▶ *Scatter It! (Using Census Results to Help Predict Melissa's Height)*
 - ▶ Explore the relationship between age and height in order to help a hypothetical student predict her height in two years
 - ▶ *You and Michael*
 - ▶ Marcus Vitruvius proposed that a person's height and arm span are approximately equal. Students will collect height and arm span data to assess whether or not this relationship is reasonable.

Statistical Software

▶ GeoGebra

- ▶ <http://www.geogebra.org/>
- ▶ Free for teachers and students
- ▶ Easy to use interface
- ▶ Online resources and help available



▶ Core Math Tools

- ▶ From NCTM and Core-Plus Mathematics Project
- ▶ <http://www.nctm.org>
- ▶ Free for teachers and students
- ▶ Easy to use
- ▶ More than data analysis



Statistical Software

- ▶ Microsoft **Excel** or other spreadsheets
- ▶ Minitab (www.minitab.com)
- ▶ JMP (www.jmp.com)
- ▶ Fathom (www.keycurriculum.com)
- ▶ R (www.r-project.org)
- ▶ StatCrunch (www.statcrunch.com)

Resources

- ▶ Census at School Resources page
 - ▶ <http://amstat.org/censusatschool/resources.cfm>
 - ▶ Instructional webinars, activities, PowerPoint presentations
- ▶ Guidelines for Assessment and Instruction in Statistics Education (GAISE) Report
 - ▶ <http://amstat.org/education/gaise/>
- ▶ Statistics Education Web (STEW)
 - ▶ <http://amstat.org/education/stew/index.cfm>
 - ▶ Online journal of K-12 statistics lesson plans
- ▶ American Statistical Association K-12 Statistics Education Webinars
 - ▶ <http://amstat.org/education/webinars/index.cfm>

Questions?

- ▶ Open session for questions and discussion
- ▶ Feel free to contact me directly:
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