GEO STAC
Teaching Guide

Lesson Developer: L. Longo, Mapleton High School
Subject Area: Mathematics: Algebra II/Statistics
Grade Level: High School

Lesson Description: Students will complete this activity in conjunction with an introductory statistics lesson about the importance of samples. Students will use the Oregon Reference Map and use the data to find basic statistics about samples with the help of spreadsheet software. The student's first sample will be cities with populations over 50000. The students' second sample will be cities with a population of less than 145. The students' third and final sample will include all of the cities located in Lane County. For each sample, student will provide a geographic description and calculate the average for the median ages, create an average break-down of ethnic diversity, and average the average family size. Finally, the students will describe the differences in the samples and what role they played in their outcomes. They will describe the sample and potential biases when compared to Oregon at large.

Recommended Time to Teach: 60-75 minutes

Education Standards:

> Common Core Standard English Language Arts Standards: English language Arts Standards ».History / Social Studies » Grade 12
>
> > CCSS.ELA-Literacy.RH.11-12.7: Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, as well as in words) in order to address a question or solve a problem**.**
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> Common Core Standard English Language Arts Standards: English Language Arts Standards » Science & Technical Subjects » Grade 11-12
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> > CCSS.ELA-Literacy.RST.11-12.3: Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.
>
> Common Core Standards Math Mathematics » High School: Statistics & Probability » Using Probability to Make Decisions
> > CCSS.Math.Content.HSS-MD.B.6 (+) Use probabilities to make fair decisions.

CCSS.Math.Content.HSS-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).

<u>ITSE National Technology</u>:
    3. Research and Information Fluency
        a. Plan strategies to guide inquiry
        b..Locate, organize, analyze, evaluate, synthesize, and ethically use information from a variety of sources and media
        c. Evaluate and select information sources and digital tools based on the appropriateness to specific tasks
        d. Process data and report results
    4. Critical Thinking, Problem Solving, and Decision Making
        c. Collect and analyze data to identify solutions and/or make informed decisions
    5. Digital Citizenship
        b. Exhibit a positive attitude toward using technology that supports collaboration, learning, and productivity
    6. Technology Operations and Concepts
        a. Understand and use technology systems
        b. Select and use applications effectively and productively

<u>National Geography Standards</u>
    1) How to use maps and other geographic representations, geospatial technologies, and spatial thinking to understand and communicate information
    2) How to analyze the spatial organization of people, places, and environments on Earth's surface
    3) How to apply geography to interpret the present and plan for the future

Discipline: Mathematics
1) Data Analysis : Develop and evaluate inferences and predictions that are based on data
2) Problem Solving: Apply and adapt a variety of appropriate strategies to solve problems

Learning Objectives:
- Students will describe the effect a sample has on calculated statistics.
- Students will describe geographic patterns
- Students will explain geographic bias in a sample
- Students will list potential biases when using a sample

Geospatial Concepts:
- <u>Comparison:</u> Students will compare the data from the different samples and evaluate why they are so different.
- <u>Condition:</u> Students will describe various samples in terms of its location and what might make it unique.

- <u>Pattern:</u> Students will describe the pattern that their sample makes in relation to the map of Oregon. (They should see both clustering and an I-5 string.)

Other Discipline: Statistics and samples in particular are central to the validity of scientific/research studies performed in all fields of study.

Career Connection: Basic statistics are used in many professions including Actuarial Science, Advertising, Bioinformatics, Government Service, and Public Health.

Web-based GIS Tools: Query

Materials: Web-enabled computer with Internet Explorer, Spreadsheet Software such as Excel, Student Worksheet

Prerequisites: Students should have a basic understanding of percent proportions and samples. Knowledge of spreadsheet software and using web-based maps is helpful but not required. Students need to be aware of how to describe spatial patterns (clusteres, difuse, even) and how to use using geographic terms to describe relative location (North of, South of…)

Beginning the Lesson
The teacher leads a discussion regarding sampling in order to answer research questions.
> Assume that there are 1,000,000 of you in a room. ☺ I want to know what kind of pizza to make so that you will buy it, but I do not have the time or the resources to ask EVERYONE. Let's say I have three options:
>> A) I ask all of the people over 6 feet tall what kind of pizza they like.
>> B) I ask everyone less than 125 pounds what kind of pizza they like.
>> C) I ask everyone in the front row what kind of pizza they like.
> What are some of the potential problems/biases with these samples?

The teacher closes the discussion and introduces the activity as looking at similar samples for the State of Oregon. Their goal will be to identify biases from each of the samples.

Developing the Lesson
Students complete the GIS/Spreadsheet activity.

Concluding the Lesson
Students discuss their results in small groups to close out the activity. As a class, the need for using samples (instead of an entire population) is discussed. Students brainstorm what other aggregate data on a population sample they might want to identify potential biases.

Career Connections:
Sampling is a core concept in all scientific studies, across all disciplines. Using databases (including GIS) and spreadsheet software are also essential skills for most science fields. Analysts, statisticians, and field researchers will use these skills the most.

Assessment/Evaluation:

Students will respond to prompts throughout the activity and create a spreadsheet with data. They will also participate in discussions before and after the activity. Furthermore, questions regarding bias/sampling will be part of the exam at the end of a broader unit of study.

Possible Student Responses

Q1) Describe the location of most cities in Oregon. Where does there appear to be no cities?

Most of the cities are along the Interstate corridor on the West side. The density seems to increase toward the north. There are a few isolated cities on the coast and in central Oregon. There are a scattering of cities in the Northeast, but much less dense. There are very few cities in the Southeast.

Q2) Describe the location of most of the large cities in Oregon. Are there any anomalies?

Most of the large cities are in the Northwest, near the Interstate. There are two exceptions: one city lies to the South, the other is in central Oregon.

Q3) Describe the location of these cities. Are there any anomalies?

The cities less than 145 are mainly located in the Northeast corner of Oregon. There does not appear to be any outliers.

Q4) Describe the location of Lane County. How does it compare to the location of our other samples?

Lane County is on near the center of the state going North to South, but it runs from the coast to central Oregon. It contains some of the large cities but is nowhere near the small cities which are up in the Northeast corner.

Q5) How are they (median age, diversity, number persons living together in a single house) different? How are they similar? Based on the location of the different samples, what does this tell you about Oregon?

The actual numerical values are *similar* but they are not the same. The diversity in the small cities is very lows. More than 10% of people living in large cities do not consider themselves white (compared to less than 5% in small cities). The smaller cities also were much older and had smaller family sizes. The Lane County sample landed right in between the other two samples.

Based on location, it appears that the Northeast is less diverse and older. The Western cities are younger and more diverse.

Q6) List at least two potential biases that would have to be addressed for each sample if it was to be used to represent Oregon in a research study. One of your stated biases for each

sample should be based on the statistics that you calculated. The other should be based on the geography of the sample.

Answers will vary greatly
Big Cities: Over-represent minorities, younger than the state; Located near a major road, mostly in the Northwest
Small Cities: Over-represent older population, under-represent minorities; Located in the Northeast
Lane County: Older population, under-represent minorities, Located only in one part of Oregon (West Central)