

Linear Transformations

Sometimes a variable z is constructed from another variable x such that

$$z = a + bx$$

How do the measures of central tendency and variation of the variable z relate to those of x ?

Rules for Means and Variances

Linear Transformations

$$z = a + bx$$

$$\bar{z} = a + b\bar{x}$$

$$s_z^2 = b^2 s_x^2$$

CASE: Curving Grades

An instructor decides to curve grades based on the following formula:

$$\text{New Scores} = 20 + 0.8 \times \text{Old Score}$$

Students in a small graduate class had the following scores:

$$85 \quad 75 \quad 95 \quad 70 \quad 60 \quad \bar{x}=77 \quad s_x = 13.51$$

$$(20+68) \quad (20+60) \quad (20+76) \quad (20+56) \quad (20+48)$$

- a) What was the mean and standard deviation of the class scores?
- b) What was the mean and standard deviation of the curved class scores?

The Three-Step Process in Statistical Analysis.

Step 1: Collecting the Data

- *Sampling design*
- *Experimental design*
- *Observational study*

Step 2: Summarizing/Organizing the Data

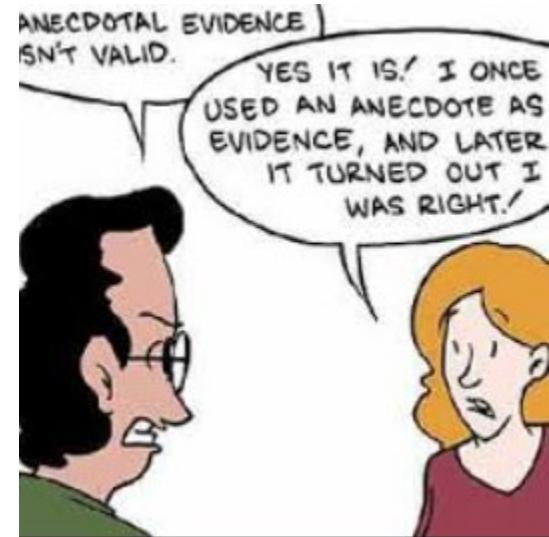
- *Descriptive statistics*
- *Graphical displays*
- *Numerical measures*

Step 3: Drawing Conclusions from the Data

- *Inferential Statistics*
- *Estimation of unknown parameters*
- *Hypothesis testing*

Sources of Data

- Anecdotal Data
- Available Data
- Survey Data
- Experimental Data
- Census Data



Anecdotal Data

Anecdotal data (anecdotal evidence) is based on haphazardly selected individual cases which often come to our attention because they are striking in some way. These cases need not be representative of any larger group of cases.

Anecdotal Data

I pay \$1,000 annually for my car insurance, yet, I have never reported any claims to the insurance company. The insurance company is making an outrageous profit on car insurance.



Smoking is not proven to be hazardous to your health. My uncle smoked 30 cigars a day, and he lived to be over 80 years old, much longer than my mom's friend who died 55 years old, and who never smoked.



Available Data

Available data are data produced for some other purpose but that may help answer a question of interest.

The screenshot shows the Zillow website interface. At the top, there are navigation links: Buy, Rent, Sell, Home Loans, and Agent finder. On the right side, there are links for Manage Rentals, Advertise, Help, and a user profile icon. The main search bar has the zip code "99223" entered. Below the search bar are filters: "For Sale" (highlighted), "\$400k-\$1.3m", "Beds & Baths", "Home type", and "More". There is also a "Save search" button. The left side of the screen features a map of the Spokane area, specifically the 99223 zip code. The map shows various neighborhoods like Highland, Palisades Park, West Central, and Spokane Valley. A blue boundary box highlights a specific area in the northeast part of the city. A callout box within this area provides details for a house listed at \$991K: "5 bd, 4 ba, 3,243 sqft" and "Price cut: \$109,100 (Jun 4)". The map also displays several other red dots representing other listings. To the right of the map, there is a section titled "99223 Real Estate & Homes For Sale". It shows a grid of five house listings:

- \$1,195,000**
4 bds 4 ba 2,000 sqft - House for sale
714 E Edenderry Ct, Spokane, WA 99223
COLDWELL BANKER SCHNEIDER MILLER
- \$798,000**
5 bds 3 ba 4,263 sqft - House for sale
1307 E Blackwood Ln, Spokane, WA 99223
WINDERMERE MANITO, LLC
- Ad** **Forever Home Ready?**
We'll help you decide if now is the best time to invest in your forever home.
Find Out ↗
- \$1,100,000**
5 bds 3 ba 4,237 sqft - House for sale
5118 E 56th Ct, Spokane, WA 99223
COLDWELL BANKER TOMLINSON S
- \$990,900**
5 bds 4 ba 3,243 sqft - House for sale
4924 S Saint Andrews Ln, Spokane, WA 99223
COLDWELL BANKER TOMLINSON S
- \$550,000**
4 bds 3 ba 3,023 sqft - House for sale
4319 S Dearborn St, Spokane, WA 99223
COLDWELL BANKER TOMLINSON S

Census Data

Census data collects data from all cases in the population of interest.

Census Data



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Health clinics. Fire departments. Schools. Even roads and highways. The census can shape many different aspects of your community.



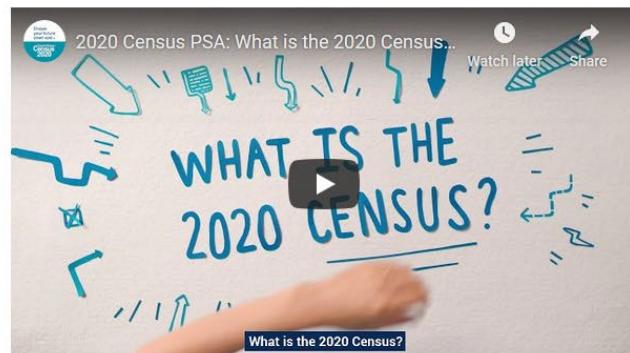
Census results help determine how billions of dollars in federal funding flow into states and communities each year.



The results determine how many seats in Congress each state gets.



It's mandated by the U.S. Constitution in Article 1, Section 2: The U.S. has counted its population every 10 years since 1790.



[SEE HOW YOUR ANSWERS CAN SHAPE YOUR FUTURE](#)

Census Data



Reports in the Benchmarks Dashboard

In addition to the Configuration Summary tab, there are eight tabs in the APS Benchmarks dashboard. Below are a few critical reports included on each tab.

A screenshot of the APS Benchmarks dashboard. At the top, there is a navigation bar with the title "APS Benchmarks" and a dropdown menu "Default View". To the right of the dropdown are four small icons: a lock, a refresh, a save, and a gear. Below the navigation bar is a horizontal row of ten tabs, each with a small icon and text: Cohort Profile (highlighted with a red border), Institution KPIs, Enrollment, Course Completion, Course Planning, Other Departments, Instructional Workload, Instructional Costs, and Config.

Tabs

Cohort Profile

Provides overview of cohort characteristics.

► Critical reports:

- Cohort Profile by Enrollment Size
- Cohort Profile by Geographical Region
- Cohort Profile by Carnegie Classification

Institution KPIs

Includes key performance metrics, where users can compare their institution to the cohort.

► Critical distribution and trends reports:

- Enrollment
- Attempted Credit Hour
- Course Completion Rate
- Class Capacity

Enrollment

Enrollment-related metrics to compare department size and growth.

► Critical reports:

- Attempted Credit Hours per Student
- Student Enrollment in Registered Coursework
- 3 Year Average Growth in Attempted Credit Hours per Student by Standard Department

Course Completion

Course completion metrics by department.

► Critical reports:

- Earned Credit Hours per Student
- Course Completion Rate
- Course Completion Rate by Standard Department

Observational Study or Experiment

- **Observational study**

We observe individuals and measure variables of interest but do not attempt to influence the responses



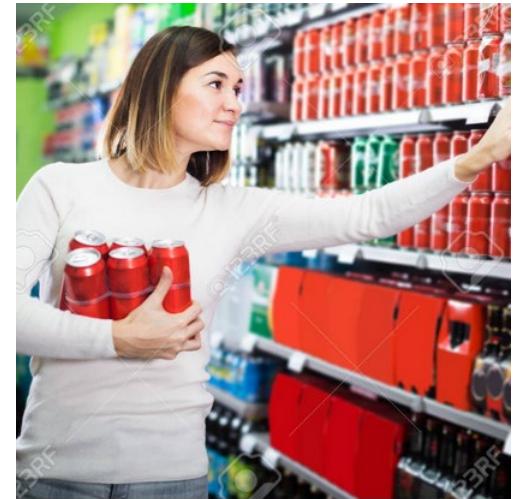
- **Experiment**

We deliberately impose some treatment on individuals and we observe their responses.



Observational Study or Experiment?

- 100 customers who bought “PEPSI”, and 100 customers who bought “COCA-COLA” in a supermarket, were selected to participate in the study.
- Each subject were given a survey to fill out rating the soft drink on a scale [P, F, G, E].



Observational Study or Experiment?

- 200 customers who bought softdrinks in a supermarket, were selected to participate in the study.
- 100 participants were selected at random to drink a can of “PEPSI”, and the other 100 a can of “COCA-COLA” and each participant would rate the drink on a scale [P, F, G, E].



Matched Pairs Experiment

- 100 customers who bought softdrinks in a supermarket, were selected to participate in the study.
- The 100 participants were each given both a can of “PEPSI”, and a can of “COCA-COLA” (50 of them in reversed order) and each participant would rate each drink on a scale [P, F, G, E].



Double-Blind Experiment

- 100 customers who bought softdrinks in a supermarket, were selected to participate in the study.
- The 100 participants selected at random two cans of softdrink (only identified by a serial number), and filled out the attached survey rating each drink on a scale [P, F, G, E].

