Studying Social Inequality with Data Science

INFO 3370 / 5371
Spring 2024

Sampling for Population Inference

When you think of data science,
what kind of data do you think of?

Learning goals for today

By the end of class, you will be able to

- explain key ideas of data collection
  - target population
  - sampling frame
  - undercoverage
  - simple random sample
  - unequal probability sample
- access survey data online

Do you prefer the front or the back of the room?

Full count enumeration

- find everyone in the target population
- ask them all the question

Probability sampling

Open R. Run this line

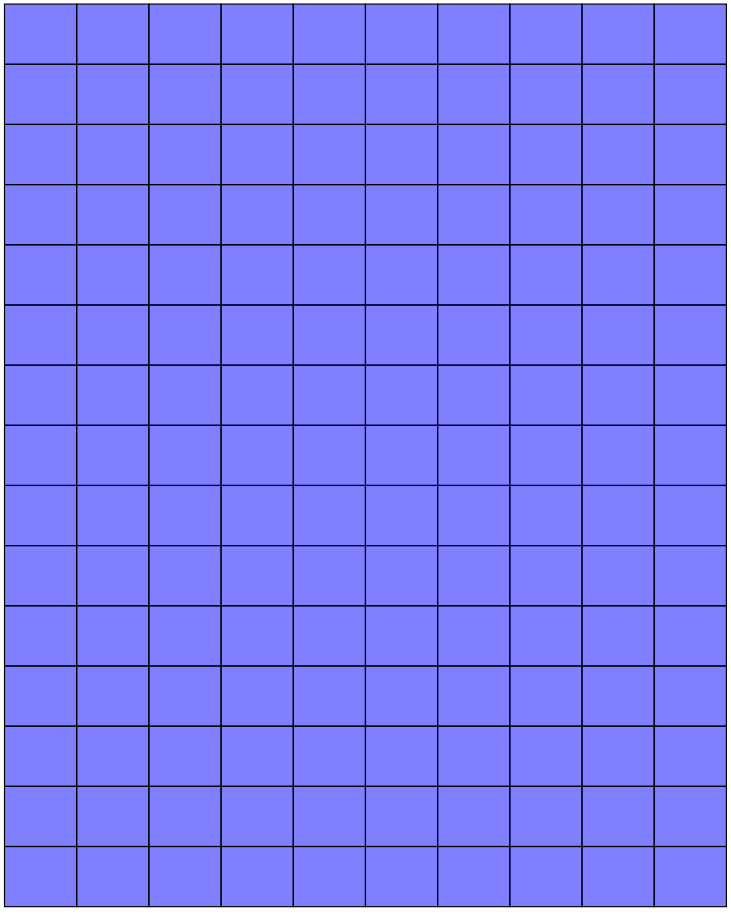
`runif(n = 1)`

If answer $< .1$, then answer the question

- Do you prefer the front or the back of the room?

Full Count Enumeration

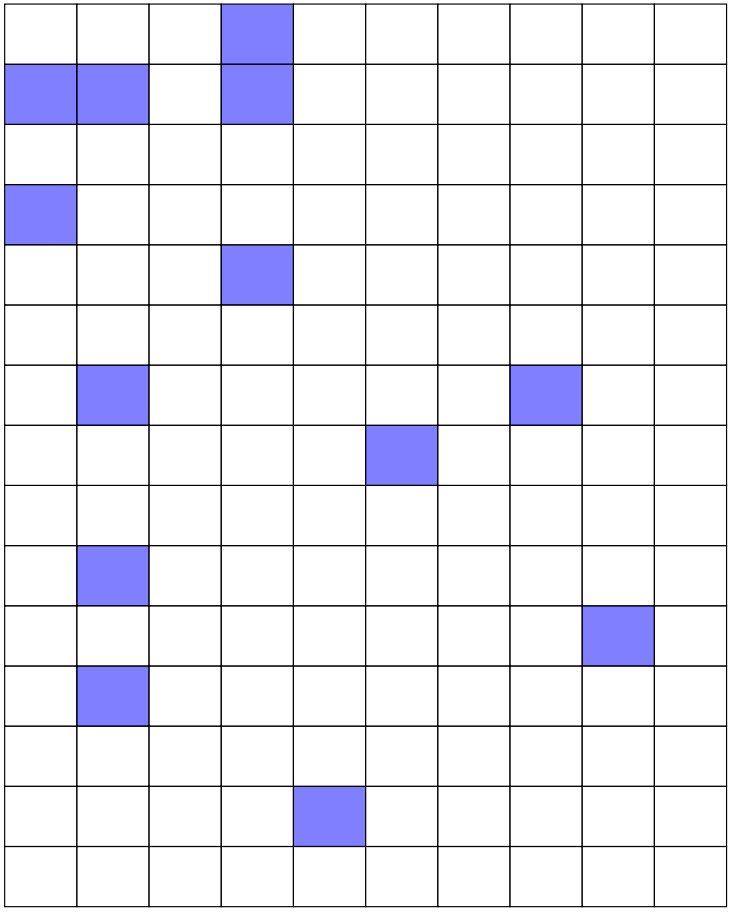
Back of Room



Front of Room

Probability Sample

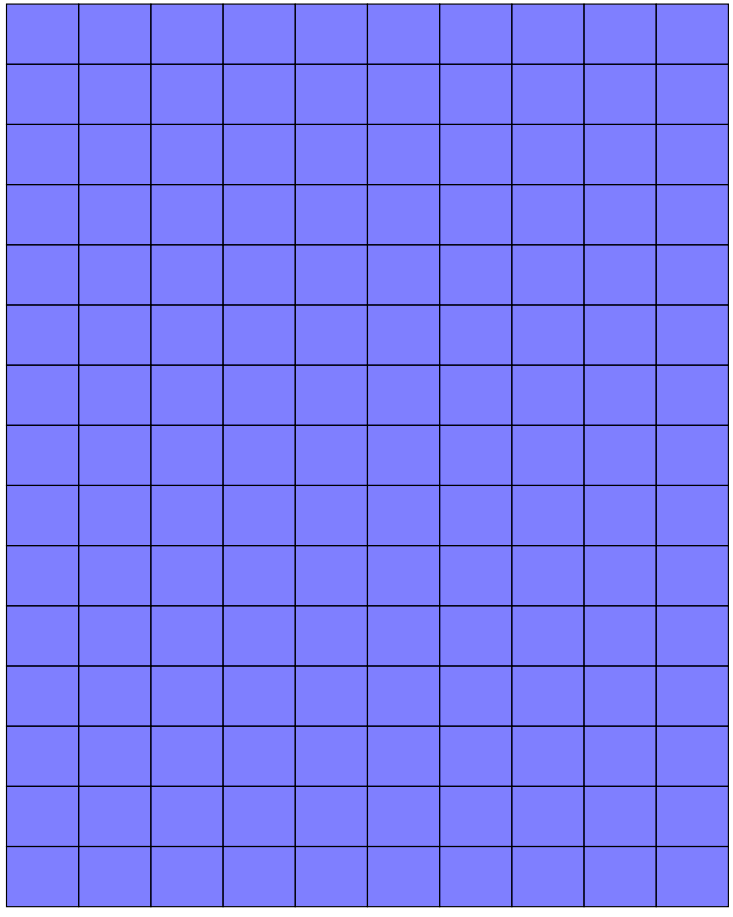
Back of Room



Front of Room

Full Count Enumeration

Back of Room



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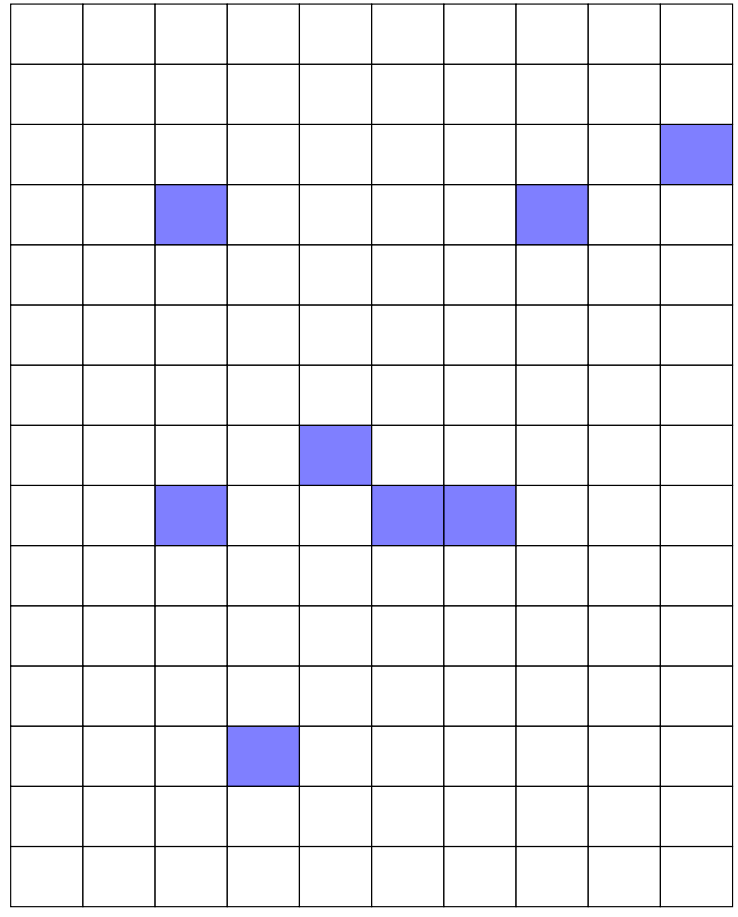

Front of Room

Full Count Enumeration

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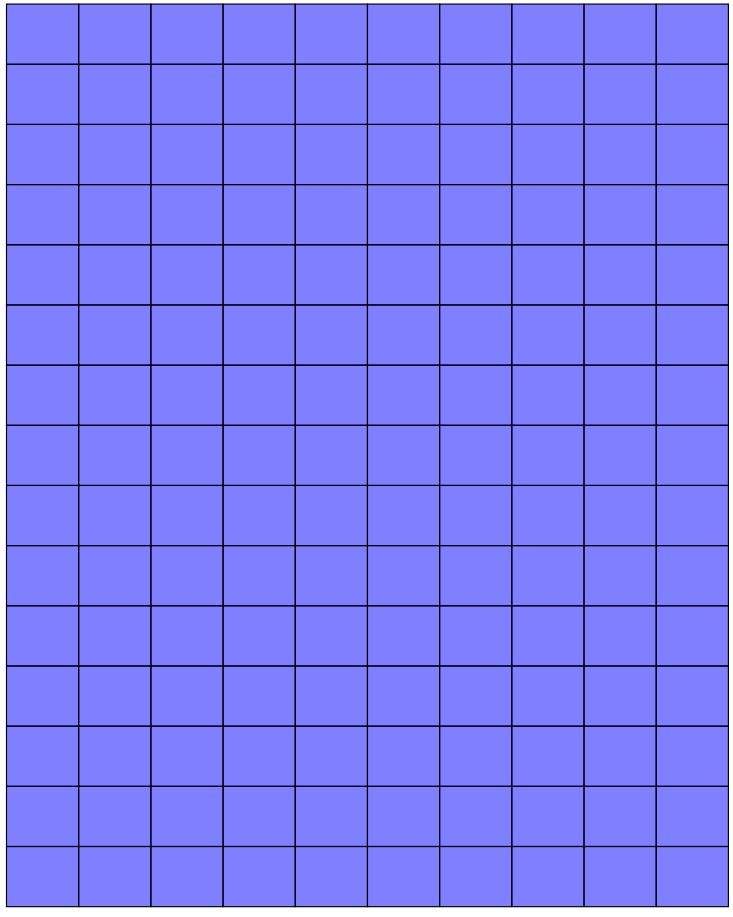

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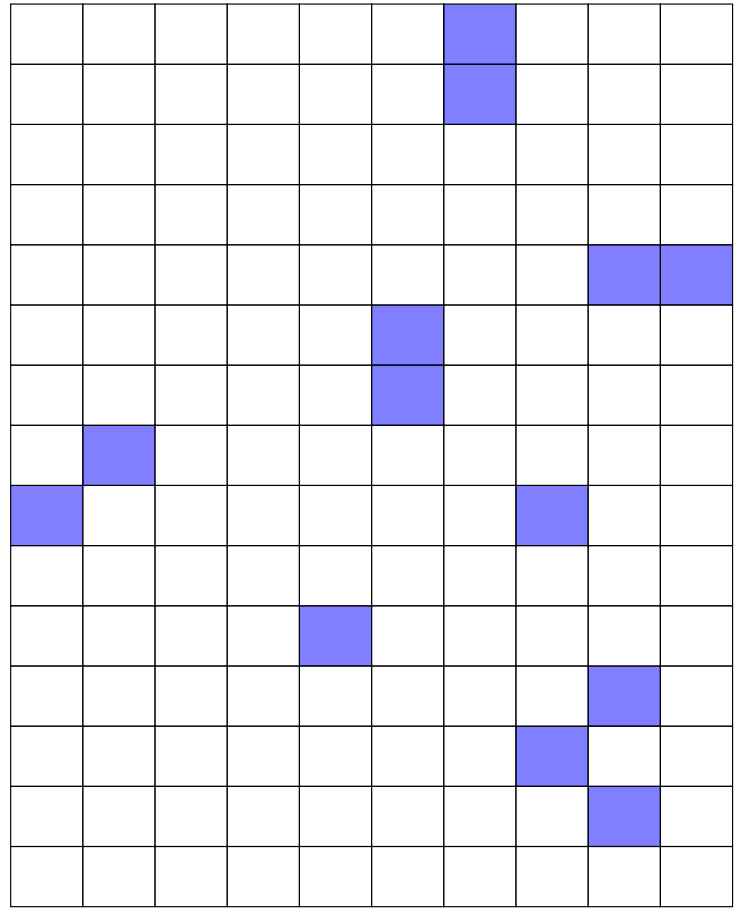
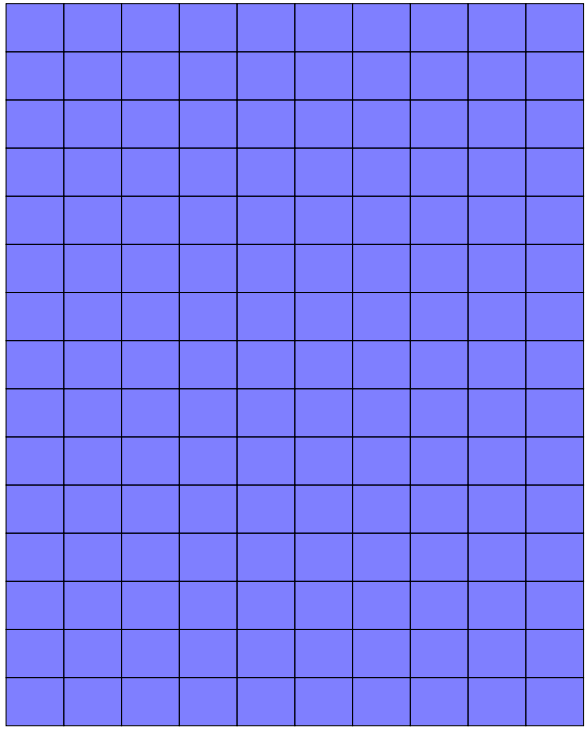


Front of Room

What are the advantages of each strategy?

Full Count Enumeration

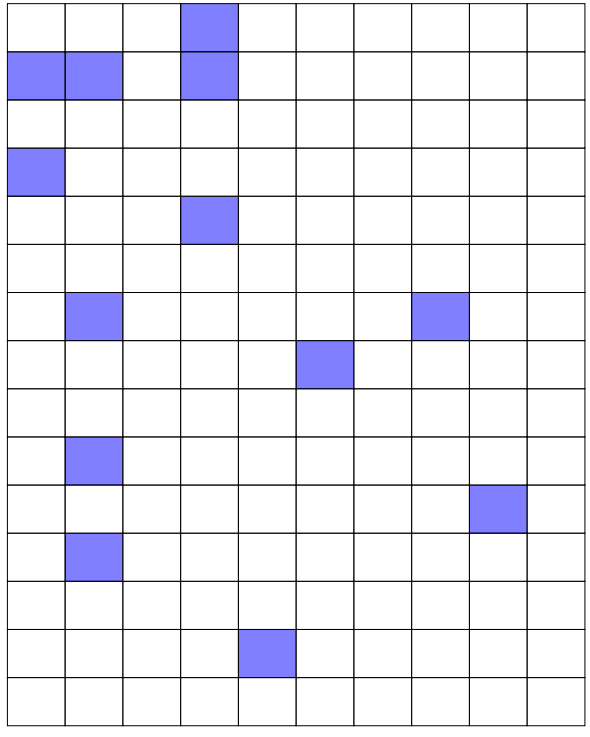
Back of Room



Front of Room

Probability Sample

Back of Room



Front of Room

Probability sampling

What you need

Probability sampling

What you need

target population — who you want to study

Probability sampling

What you need	
target population	who you want to study
sampling frame	list of those people

Probability sampling

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Probability sampling

Sources of error	**What you need**	
	target population	who you want to study
	sampling frame	list of those people
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	people you sampled	
	people who responded	

Probability sampling

Sources of error	**What you need**	
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undercoverage	sampling frame	list of those people
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Probability sampling

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Groves & Lyberg. 2010.
Total Survey Error: Past, Present, and Future.
Public Opinion Quarterly 74(5).

Subgroup estimates

Do the people in the first 3 rows prefer the front?

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Simple random sample

- everyone run `runif`
- everyone respond if $< .1$

Subgroup estimates

Do the people in the first 3 rows prefer the front?

Simple random sample

- everyone run `runif`
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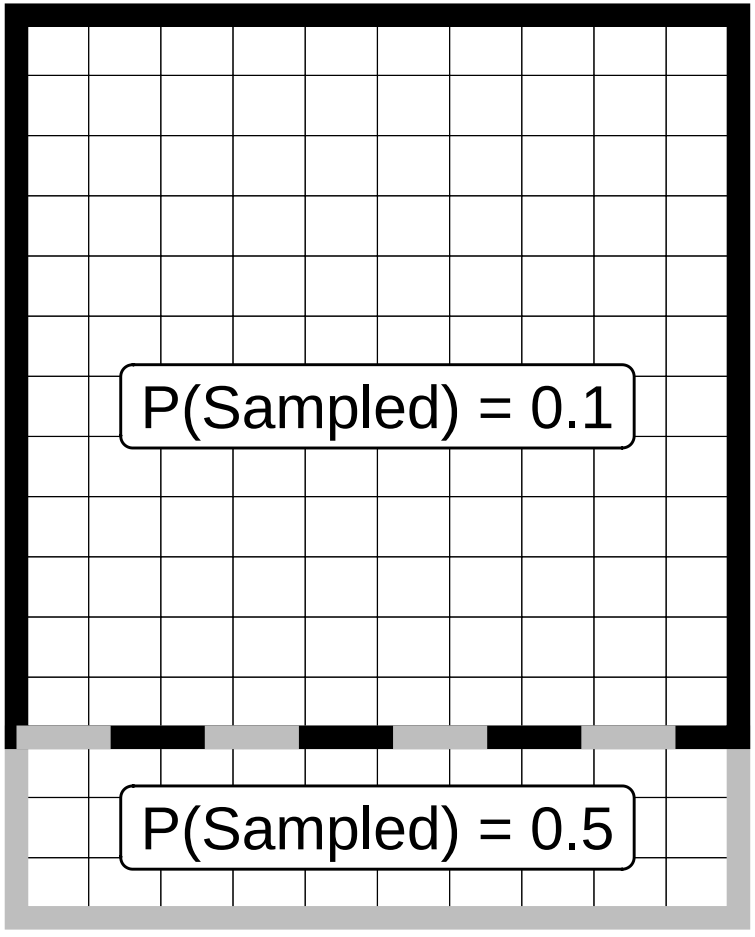
Unequal probability sample

- everyone run `runif`
- first 3 rows: respond if $< .5$
- others: respond if $< .1$

Sample Design

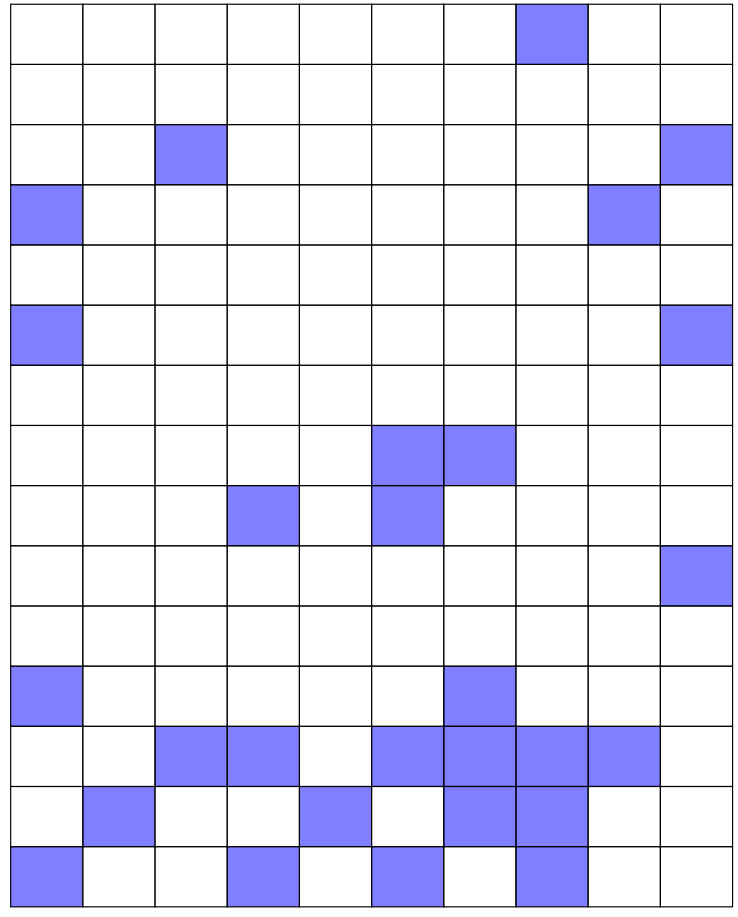
Back of Room



Front of Room

Sample

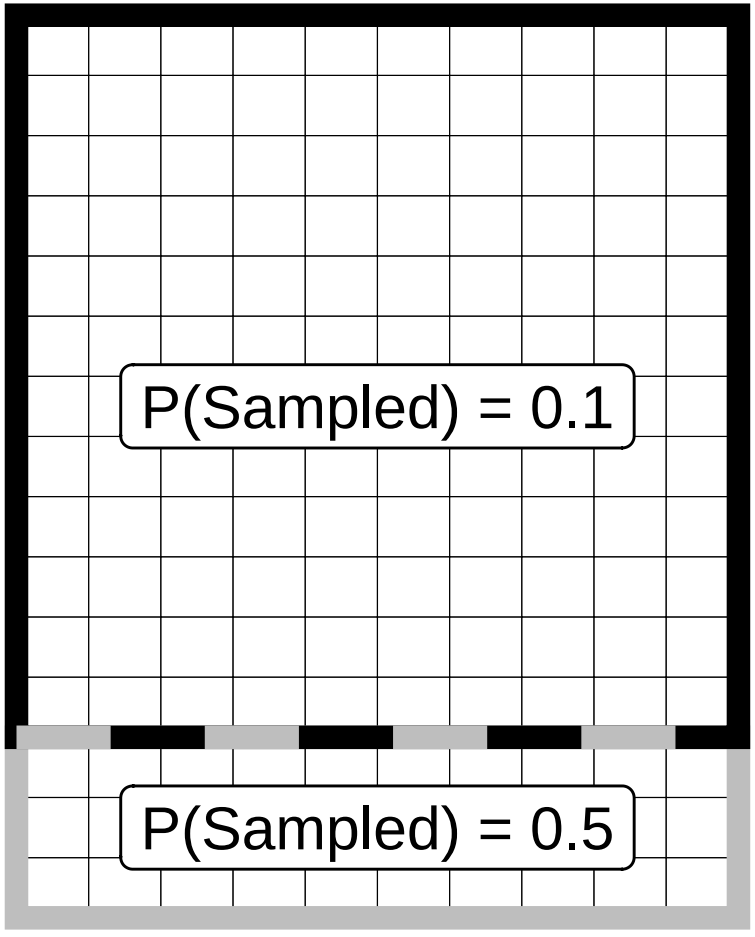
Back of Room



Front of Room

Sample Design

Back of Room



Front of Room

Sample

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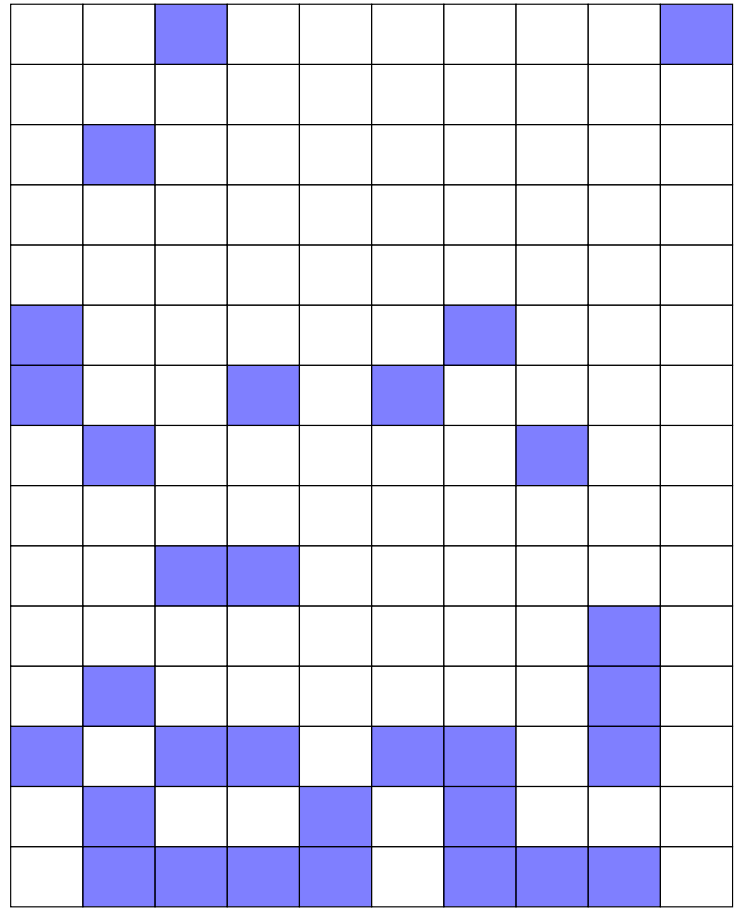

Front of Room

Sample Design

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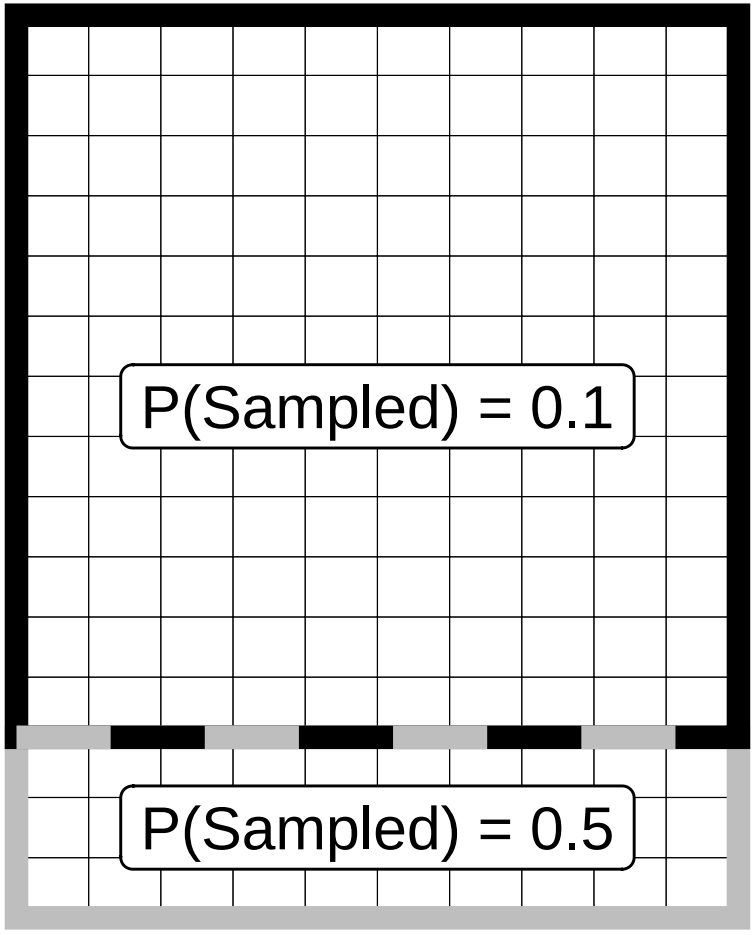

Front of Room

Sample

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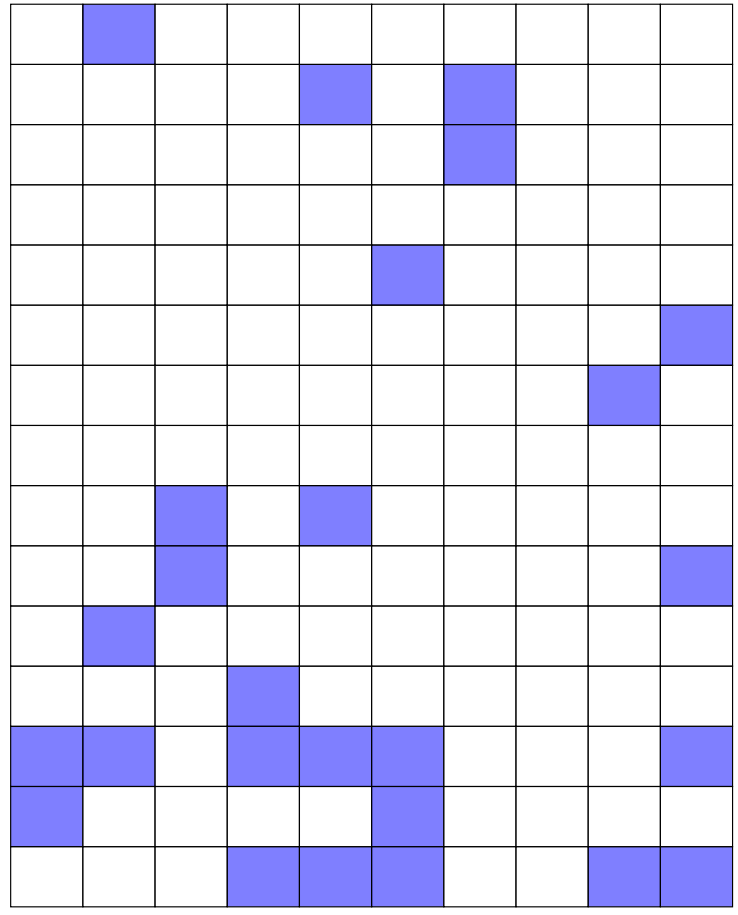


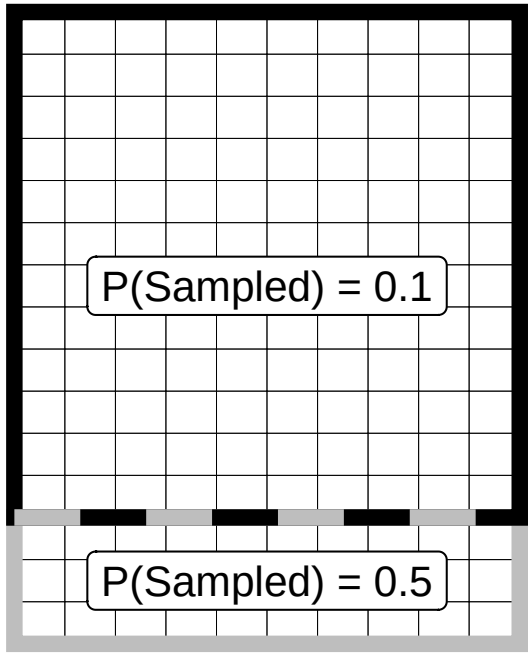
Front of Room

full count enumeration	talk to everyone (ideal but costly!)
simple random sample	sampling frame known, equal probabilities (good for population average)
unequal probability sample	sampling frame known, unequal probabilities (good for subgroups)

What if we want to estimate the population average from an unequal probability sample?

Sample Design

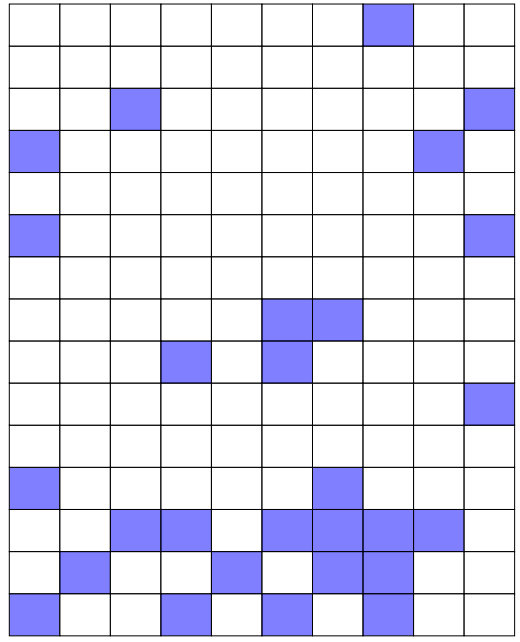
Back of Room



Front of Room

Sample

Back of Room



Front of Room

Sampling weights: Population mean estimator

Among those sampled if `runif` $< .1$,
on average 1 in 10 people sampled.
Each person represents 10 people.
$w_i = \frac{1}{\text{P(Sampled)}} = \frac{1}{.1} = 10$

Among those who sampled if `runif` $< .5$,
on average 1 in 2 people sampled.
Each person represents 2 people.
$w_i = \frac{1}{\text{P(Sampled)}} = \frac{1}{.5} = 2$

Unweighted estimator

$$\hat{\text{E}}_{\text{Unweighted}}(Y) = \frac{\sum_i y_i}{n}$$

(easily misleading!)

Weighted estimator

$$\hat{\text{E}}_{\text{Weighted}}(Y) = \frac{\sum_i w_i y_i}{\sum_i w_i}$$

(correct)

full count enumeration	talk to everyone (ideal but costly!)
simple random sample	sampling frame known, equal probabilities (good for population average)
unequal probability sample	sampling frame known, unequal probabilities (good for subgroups) **(weight for population average)**

A real question:
The unemployment rate

A real question: The unemployment rate

Imagine you are the Bureau of Labor Statistics.
How would you design a sample to estimate unemployment?

1. What would be your sampling frame?
2. How would you define sampling probabilities?
3. What mode of data collection?
   - Mail, phone, web, in person, etc.
4. What if people didn't respond?

Current Population Survey: Sample Design

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Begin with a **sampling frame**: all housing units in the U.S.

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- 1,987 Primary Sampling Units (PSUs)
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- Stratified (grouped) within states
  - Stratum: Group of PSUs with similar characteristics
  - One PSU always chosen per stratum
  - **Why?** Ensure representation across strata

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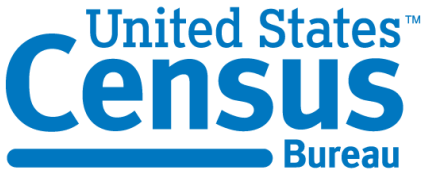
- 1,987 Primary Sampling Units (PSUs)
  - County or contiguous counties within a state
- Stratified (grouped) within states
  - Stratum: Group of PSUs with similar characteristics
  - One PSU always chosen per stratum
  - **Why?** Ensure representation across strata
- Within PSU, sample geographic clusters of housing units
  - **Why?** Reduce travel costs for field representatives

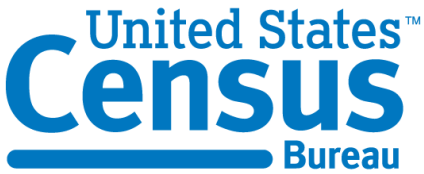
Current Population Survey: Sample

More than 75,000 households are sampled

Current Population Survey: Contacting respondents

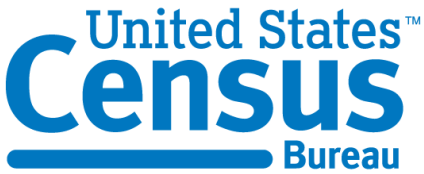


Current Population Survey: Contacting respondents



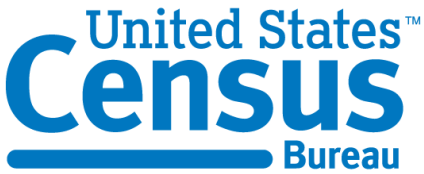
1. Send a letter

Current Population Survey: Contacting respondents



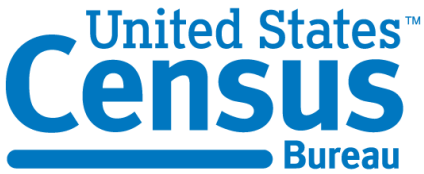
1. Send a letter
2. Call or visit in person

Current Population Survey: Contacting respondents



1. Send a letter
2. Call or visit in person
3. Try many times if needed

Current Population Survey: Contacting respondents



1. Send a letter
2. Call or visit in person
3. Try many times if needed

Learn about the experience for participants here

Current Population Survey: Mode of Data Collection

Computer-assisted telephone interview

HELLO

Current Population Survey
Hello. This is ..... from the U.S. Census Bureau.

May I please speak to Respondent name?

1 This is correct person
2 Correct person called to phone
3 Person not home now or not available now (incl. temp ill/hosp.)
4 Person unknown at this number
5 Person no longer lives there (Includes deceased individuals)
6 Other outcome OR problem interviewing household.

census.gov/programs-surveys/cps/technical-documentation/questionnaires.html

Current Population Survey: Mode of Data Collection

Computer-assisted telephone interview

LABFOR

I am going to ask a few questions about work-related activities (THE WEEK BEFORE LAST/LAST WEEK). By (the week before last/last week), I mean the week beginning on Sunday, (DATE), and ending on Saturday, (DATE).

1 Continue

census.gov/programs-surveys/cps/technical-documentation/questionnaires.html

Current Population Survey: Mode of Data Collection

Computer-assisted telephone interview

(THE WEEK BEFORE LAST/LAST WEEK), did (name/you) do ANY work for (pay/either pay or profit)?

1 Yes
2 No
3 Retired
4 Disabled
5 Unable to work

census.gov/programs-surveys/cps/technical-documentation/questionnaires.html

Current Population Survey

Annual Social and Economic Supplement

- Extended survey
- Conducted each March

Q48aa

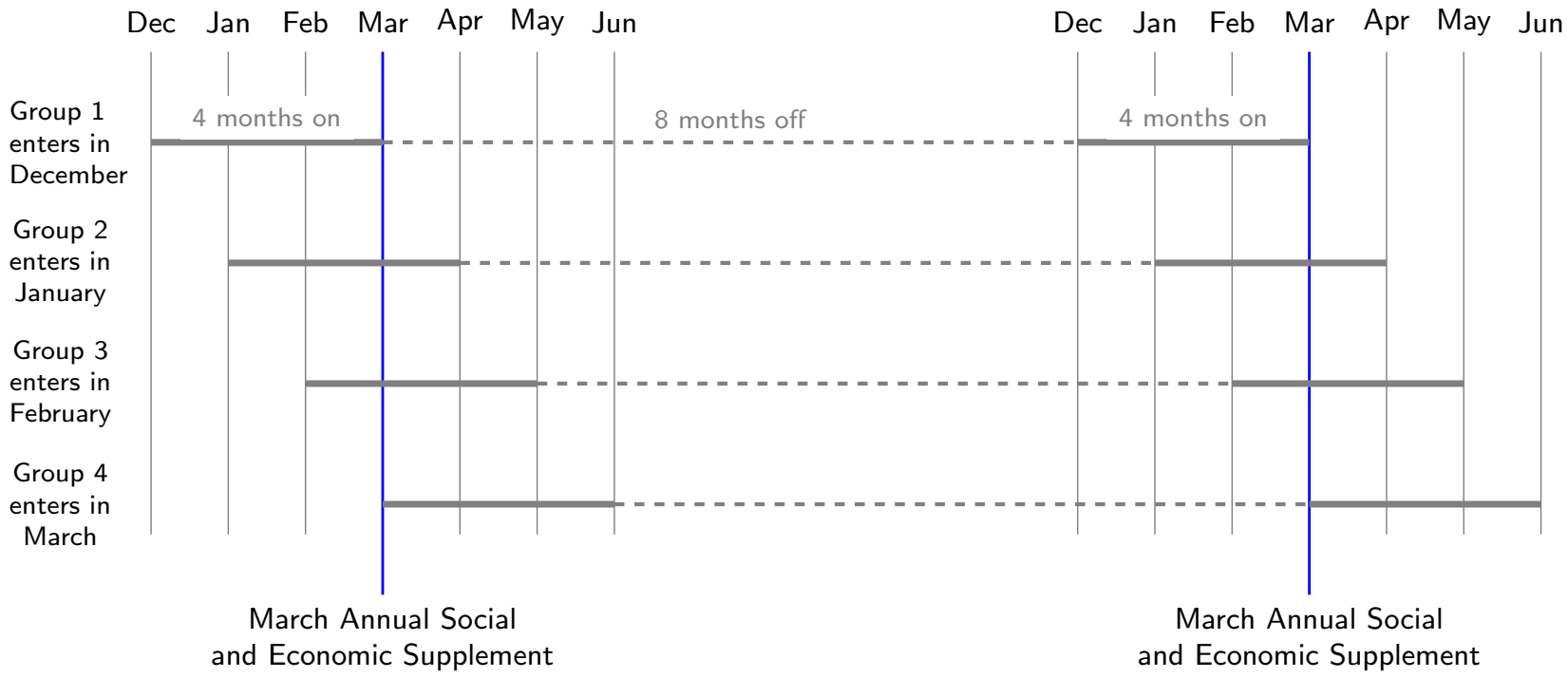
How much did (name/you) earn from this employer before taxes and other deductions during 2021?

- Enter dollar amount
- Enter 0 for none

_____

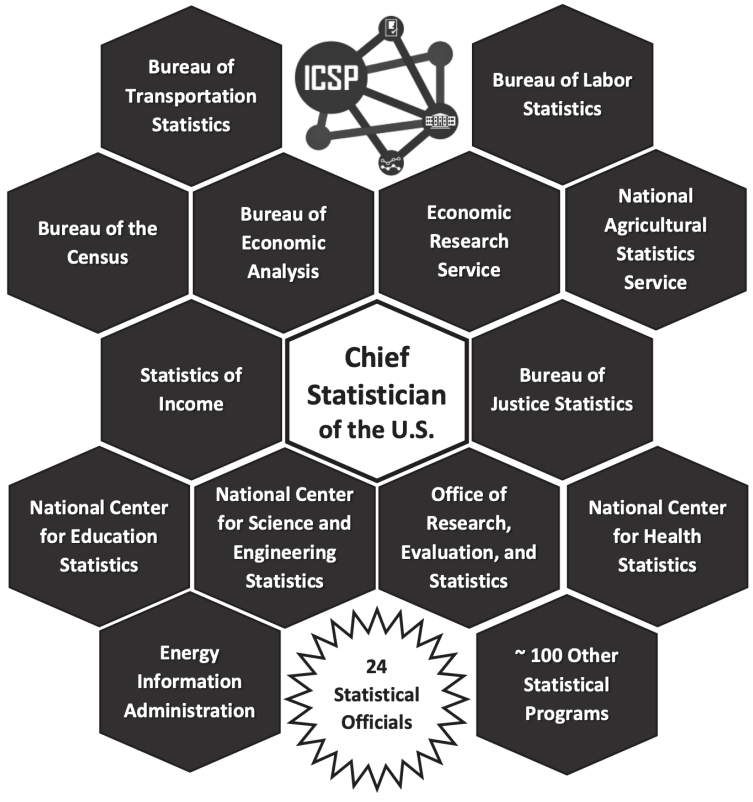
Questionnaire from 2022

Rotating panels



The Current Population Survey (CPS) is only one of many surveys in the federal statistical system

Chart 15-1. THE DECENTRALIZED FEDERAL STATISTICAL SYSTEM



source

The Integrated Public Use Microdata Series (IPUMS) distributes these data and more

- Easy to access
- Harmonized documentation
- Select the variables you want
- Compare over history

UNIVERSITY OF MINNESOTA

Sarah Flood, Miriam King, Renae Rodgers, Steven Ruggles, J. Robert Warren and Michael Westberry. Integrated Public Use Microdata Series, Current Population Survey: Version 10.0 [dataset]. Minneapolis, MN: IPUMS, 2022. https://doi.org/10.18128/D030.V10.0

U.S. Census and American Community Survey microdata from 1850 to the present. Learn More

VISIT SITE

Current Population Survey microdata including basic monthly surveys and supplements from 1962 to the present. Learn More

VISIT SITE

World's largest collection of census microdata covering over 100 countries, contemporary and historical. Learn More

VISIT SITE

Health survey data for Africa and Asia, including harmonized data collections for DHS and PMA. Learn More

VISIT SITE

Tabular U.S. Census data and GIS boundary files from 1790 to the present. Learn More

VISIT SITE

Tabular and GIS data from population, housing, and agricultural censuses around the world. Learn More

VISIT SITE

Historical and contemporary time use data from 1930 to the present. Learn More

VISIT SITE

Historical and contemporary U.S. health survey data from NHIS (1963-present) and MEPS (1996-present). Learn More

VISIT SITE

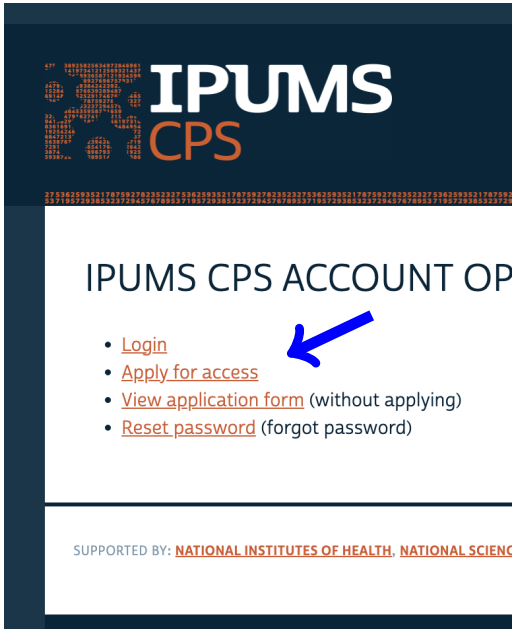
Survey data on the science and engineering workforce in the U.S. from 1993 to the present. Learn More

VISIT SITE

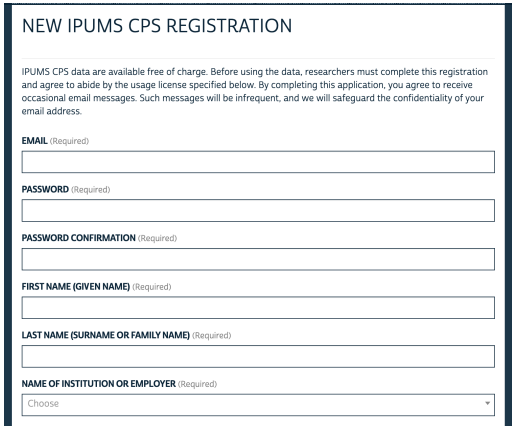
How to access IPUMS-CPS

1) Visit https://cps.ipums.org/cps/. Click **Register**

2) Click **Apply for access**



3) Complete the form



General research statement: I am in a class using these data to study socioeconomic inequality in America.

Learning goals for today

By the end of class, you will be able to

- explain key ideas of data collection
  - target population
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  - undercoverage
  - simple random sample
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- access survey data online