

# Economics 103 – Statistics for Economists

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Lecture # 1

# This Course: Use Sample to Learn About Population

## Population

Complete set of all items that interest investigator

## Sample

Observed subset, or portion, of a population

## Sample Size

# of items in the sample, typically denoted  $n$

Examples...

# In Particular: Use Statistic to Learn about Parameter

## Parameter

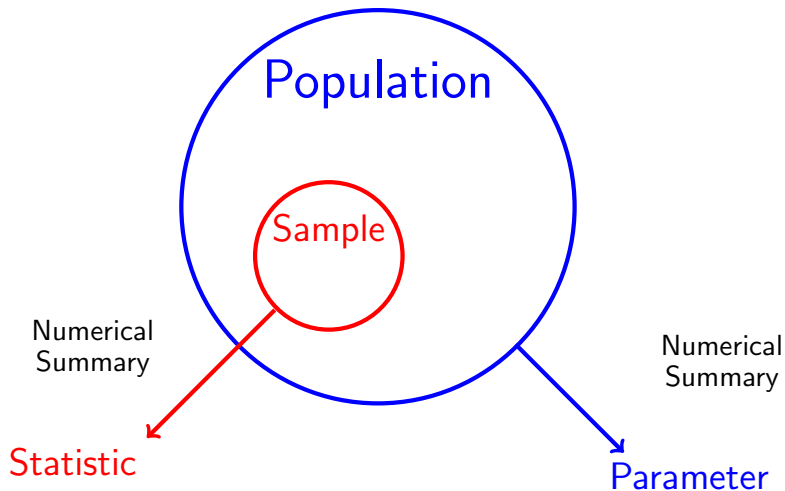
Numerical measure that describes specific characteristic of a population.

## Statistic

Numerical measure that describes specific characteristic of sample.

Examples...

## Essential Distinction You Must Remember!



# The Field of Statistics

## Descriptive Statistics

Graphical and numerical procedures to summarize data.

## Inferential Statistics

Using data to estimate, predict, quantify uncertainty.

# This Course

1. Descriptive Statistics: summarize data
  - ▶ Summary Statistics
  - ▶ Graphics
2. Probability: Population  $\rightarrow$  Sample
  - ▶ deductive: “safe” argument
    - ▶ All ravens are black. Mordecai is a raven, so Mordecai is black.
3. Statistics: Sample  $\rightarrow$  Population
  - ▶ inductive: “risky” argument
    - ▶ I’ve only every seen black ravens, so all ravens must be black.

# Sampling and Nonsampling Error

In statistics we use samples to learn about populations, but samples almost never be *exactly* like the population they are drawn from.

## 1. Sampling Error

- ▶ *Random* differences between sample and population
- ▶ Cancel out on average
- ▶ Decreases as sample size grows

## 2. Nonsampling Error

- ▶ *Systematic* differences between sample and population
- ▶ Does *not* cancel out on average
- ▶ Does *not* decrease as sample size grows

NEW COLORED MAP OF POLAND IN THIS ISSUE

Showing the Territorial Changes Wrought by the War

# The Literary Digest

(Title Reg. U.S. Pat. Off.)



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New York FUNK & WAGNALLS COMPANY London

PUBLIC OPINION *New York* combined with *The LITERARY DIGEST*

Vol. 68, No. 8. Whole No. 1609

FEBRUARY 19, 1921

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# Literary Digest – 1936 Presidential Election Poll



FDR versus Kansas Gov. Alf Landon

## Huge Sample

Sent out over 10 million ballots; 2.4 million replies! (Compared to less than 45 million votes cast in actual election)

## Prediction

Landslide for Landon: *Landonslide*, if you will.

## Spectacularly Mistaken!



FDR versus Kansas Gov. Alf Landon

	Roosevelt	Landon
Literary Digest Prediction:	41%	57%
Actual Result:	61%	37%

# What Went Wrong? *Non-sampling Error (aka Bias)*

Source: Squire (1988)

## Biased Sample

Some units more likely to be sampled than others.

- ▶ Ballots mailed those on auto reg. list and in phone books.

## Non-response Bias

Even if sample is unbiased, can't force people to reply.

- ▶ Among those who recieved a ballot, Landon supporters were more likely to reply.

In this case, neither effect *alone* was enough to throw off the result but together they did.

# Randomize to Get an Unbiased Sample

## Simple Random Sample

Each member of population is chosen strictly by chance, so that:  
(1) selection of one individual doesn't influence selection of any other, (2) each individual is just as likely to be chosen, (3) every possible sample of size  $n$  has the same chance of selection.

What about non-response bias?

## “Negative Views of Trump’s Transition”

Source: [Pew Research Center](#)

*Ahead of Donald Trump’s scheduled press conference in New York City on Wednesday, the public continues to give the president-elect low marks for how he is handling the transition process. . . The latest national survey by Pew Research Center, conducted Jan. 4-9 among 1,502 adults, finds that 39% approve of the job President-elect Trump has done so far explaining his policies and plans for the future to the American people, while a larger share (55%) say they disapprove.*

# Quantifying Sampling Error

## 95% Confidence Interval for Poll Based on Random Sample

### Margin of Error a.k.a. ME

We report  $P \pm \text{ME}$  where  $\text{ME} \approx 2\sqrt{P(1-P)/n}$

### Trump Transition Approval Rate

$P = 0.39$  and  $n = 1502$  so  $\text{ME} \approx 0.013$ . We'd report 39% plus or minus 1.3% if the poll were based on a simple random sample. . .

But Pew Reports an ME of 2.9% – more than twice as large as the one we calculated! What's going on here?!

# Non-response bias is a huge problem. . .

Source: Pew Research Center

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## Surveys Face Growing Difficulty Reaching, Persuading Potential Respondents

	1997	2000	2003	2006	2009	2012
	%	%	%	%	%	%
<b>Contact rate</b> (percent of households in which an adult was reached)	90	77	79	73	72	62
<b>Cooperation rate</b> (percent of households contacted that yielded an interview)	43	40	34	31	21	14
<b>Response rate</b> (percent of households sampled that yielded an interview)	36	28	25	21	15	9

PEW RESEARCH CENTER 2012 Methodology Study. Rates computed according to American Association for Public Opinion Research (AAPOR) standard definitions for CON2, COOP3 and RR3. Rates are typical for surveys conducted in each year.

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## Survey to find effect of Polio Vaccine

Ask random sample of parents if they vaccinated their kids or not and if the kids later developed polio. Compare those who were vaccinated to those who weren't.

Would this procedure:

- (a) Overstate effectiveness of vaccine
- (b) Correctly identify effectiveness of vaccine
- (c) Understate effectiveness of vaccine



## Problem

Parents who vaccinate their kids may differ systematically from those who don't in *other ways* that impact child's chance of contracting polio!

Wealth is related to vaccination *and* whether child grows up in a hygienic environment.

# Confounder

Factor than influences both outcomes and whether subjects are treated or not. Masks true effect of treatment.

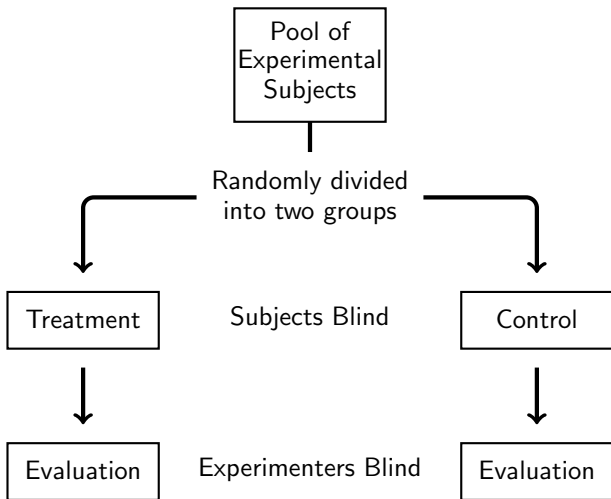
# Experiment Using Random Assignment: Randomized Experiment

Treatment Group Gets Vaccine, Control Group Doesn't

## Essential Point!

Random assignment *neutralizes* effect of all confounding factors: since groups are initially equal, on average, any difference that emerges must be the treatment effect.

## Placebo Effect and Randomized Double Blind Experiment



## Gold Standard: Randomized, Double-blind Experiment

*Randomized blind experiments ensure that on average the two groups are initially equal, and continue to be treated equally. Thus a fair comparison is possible.*

Randomized, double-blind experiments are generally the best way to untangle causation.

Sugar Doesn't Make Kids Hyper

<http://www.youtube.com/watch?v=mkr9YsmrPAI>

Randomization is not always possible, practical, or ethical.

## Observational Data

Data that do not come from a randomized experiment.

It is very difficult to untangle cause and effect using observational data because of confounders.

# Does Racial Discrimination Affect Criminal Sentencing?

Source: [Penn Law Website](#)

*Social scientists have studied the issue for decades, but the seemingly simple question Does race affect sentencing? is surprisingly difficult to answer on the basis of empirical evidence.*

*Abrams explains: "The most straightforward way you might look at it is to say, Lets look at what sentences people get and see whether sentence length varies by race. If it looks like people of one race receive longer sentences than another, that might indicate that the criminal justice system is unfair. But the shortcoming to that approach is that its also possible that sentences can differ for many reasons; for example, its possible people of different races might have different criminal histories on average, and that could also explain the difference in sentence length"*

# Reducing Bias in Observational Studies

## Regression

Technique that allows us to remove influence of confounders.

Works well if we can identify and gather data on all of them. But...



# Does Racial Discrimination Affect Criminal Sentencing?

Source: [Penn Law Website](#)

*To address that difficulty [confounders] social scientists have ... applied control variables to standard regression equations, a statistical method for identifying significant correlations between observed events. For instance, controlling for type of crime committed or for the defendants criminal history, researchers look to see whether the results of their equation still show racial disparity. "The problem with that is you still leave the possibility that any differences you see are due to unobserved variables, differences that might be there but that you can't control for" Abrams says. "That might be demeanor in the courtroom, it might be the quality of the attorney you can afford, it might be some details about the crime that you might not capture in your data. If those things are correlated with race, which they probably are, you're not going to know whether the effect you think you're detecting is really race or is something else"*