

# Why Statistics?

Research Methods for Political Science

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# First things first...

rewriting the relativistic relation as follows:

$$m^2 c^2 = \frac{E^2}{c^2} - \vec{p} \cdot \vec{p}$$

$$\frac{E^2}{c^2} = m^2 c^2 + \vec{p} \cdot \vec{p}$$

$$E^2 = m^2 c^4 + \vec{p} \cdot \vec{p} c^2$$

$$E = \sqrt{m^2 c^4 + \vec{p} \cdot \vec{p} c^2}$$

$$E = \sqrt{m^2 c^4 \left( 1 + \frac{\vec{p} \cdot \vec{p} c^2}{m^2 c^4} \right)}$$

$$E = mc^2 \sqrt{1 + \frac{\vec{p} \cdot \vec{p}}{m^2 c^2}}$$

this is Eq. 2.43  
rearranging

↗  $\times c^2$

↗  $\sqrt{\quad}$

↗

↗

If we now assume that we consider an object that moves at a speed that is far slower than the speed of light,  $v \ll c$ , we can use the usual formula  $\vec{p} \cdot \vec{p} = m^2 v^2$  and a Taylor expansion to approximate the square root:

$$E = mc^2 \sqrt{1 + \frac{\vec{p} \cdot \vec{p}}{m^2 c^2}}$$

$$= mc^2 \sqrt{1 + \frac{m^2 v^2}{m^2 c^2}}$$

$$\approx mc^2 \left( 1 + \frac{m^2 v^2}{2m^2 c^2} \right)$$

$$= mc^2 + \frac{1}{2} m v^2$$

↗  $\vec{p} \cdot \vec{p} = m^2 v^2$

↗  $\sqrt{1+x^2} \approx 1 + \frac{x^2}{2}$  for  $x \ll 1$

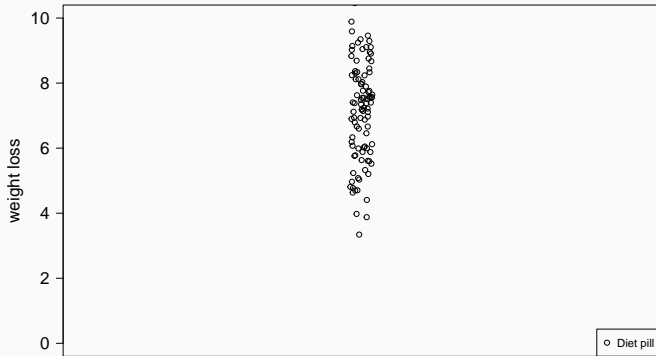
↗

We can therefore conclude that in the non-relativistic limit  $v \ll c$  we find almost exactly the non-relativistic energy-momentum relation  $E = \frac{1}{2} m v^2$ . The only difference is an additional constant term  $mc^2$  which, however, makes no difference in a classical context since it represents a constant energy offset. The calculation in Eq. 2.46 is an important cross-check that hopefully will give you some form of satisfaction.

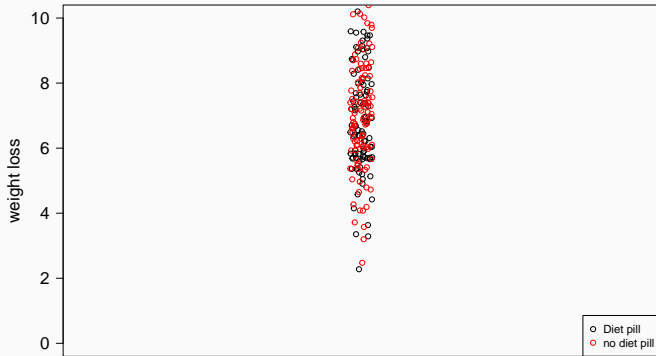
# Why we need Statistics

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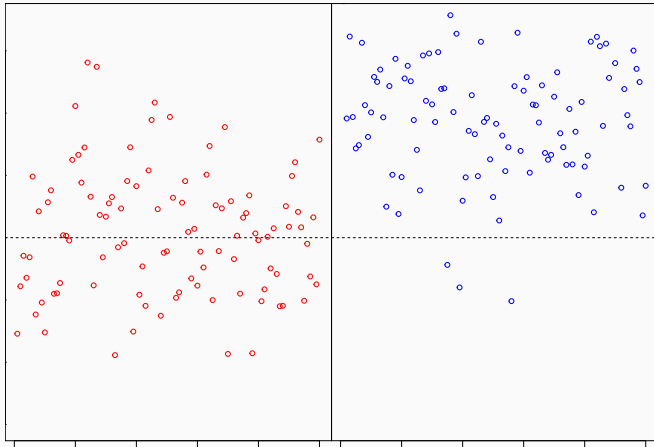
# Why we need statistics: Anecdotes are the enemy



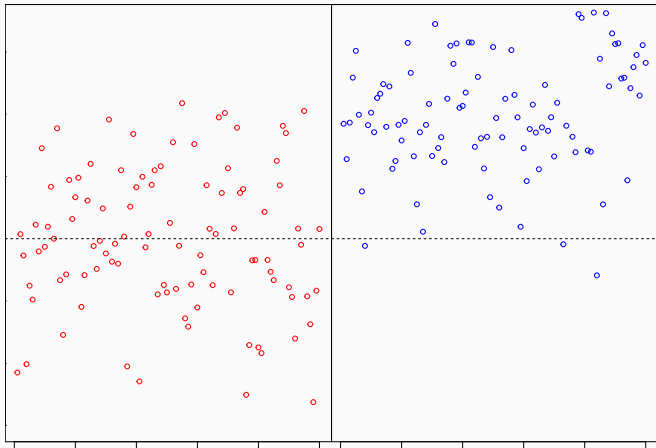
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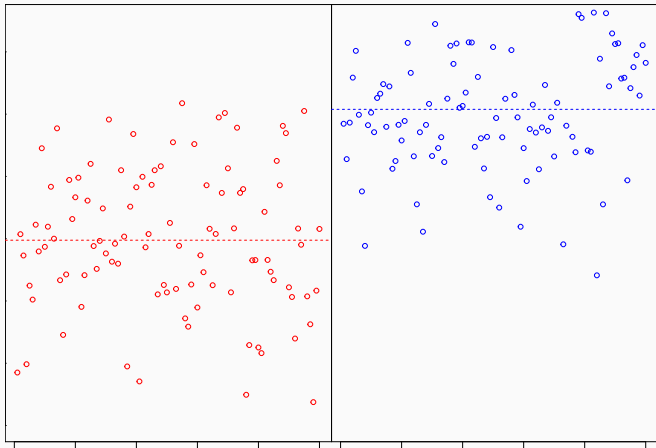
# Why we need statistics: What is big enough?



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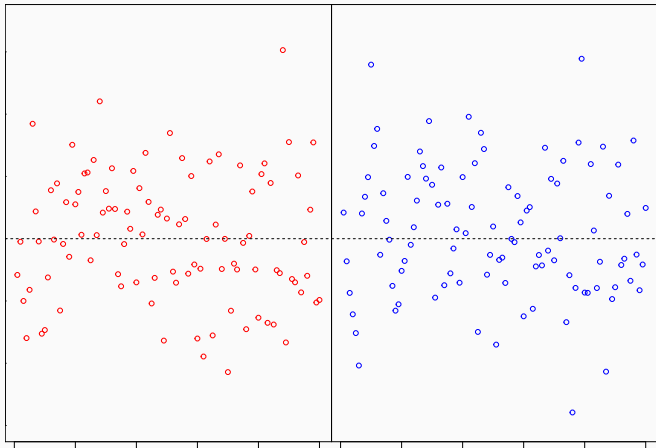


## Why we need statistics: What is big enough?

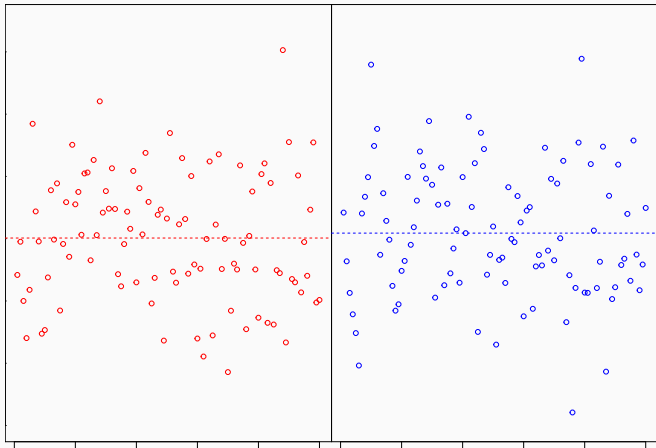




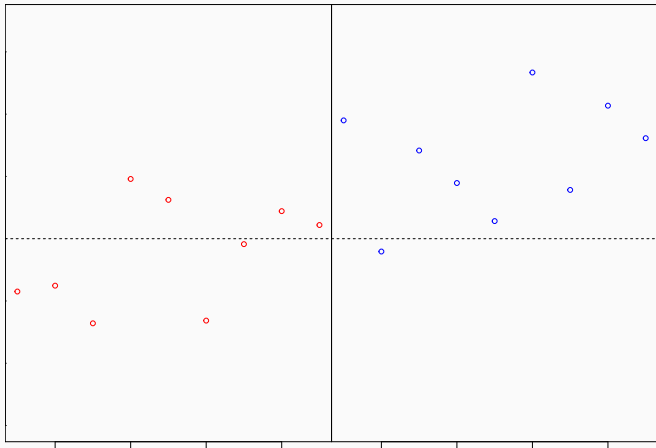
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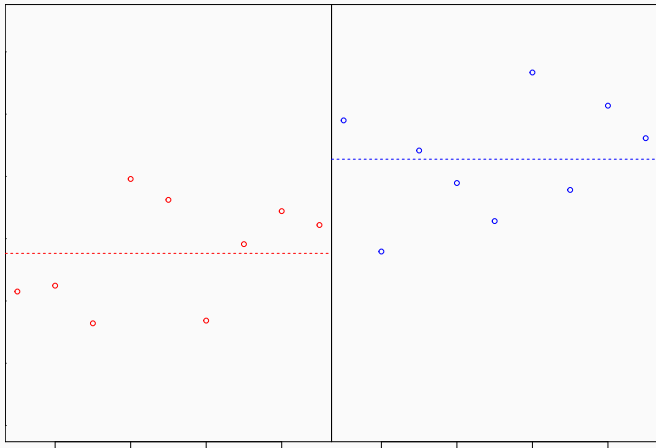
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## Why we need statistics: The curse of belief bias

	conclusion feels true	conclusion feels false
Argument is valid	92% say "valid"	46% say "valid"
Argument is invalid	92% say "valid"	8% say "valid"

## Why We need Statistics: Gender Bias?

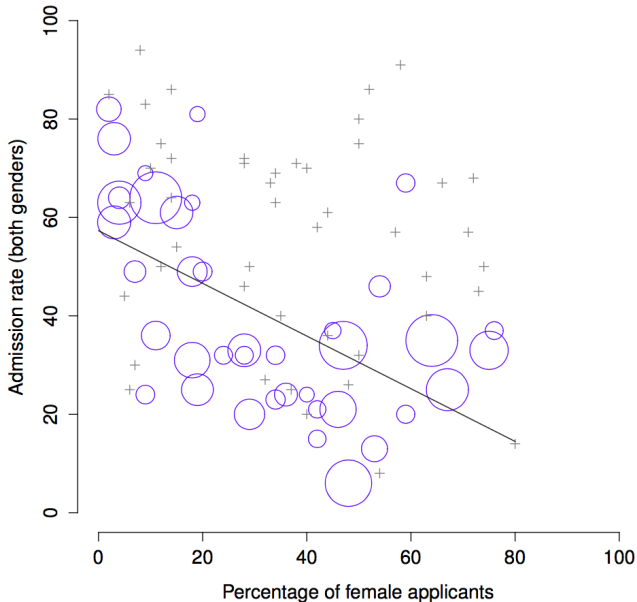
Is there gender bias among graduate school admissions to University of California, Berkeley?

	Nb of applicants	% admitted
Males	8442	44%
Females	4321	35%

## Why We need Statistics: Gender Bias?

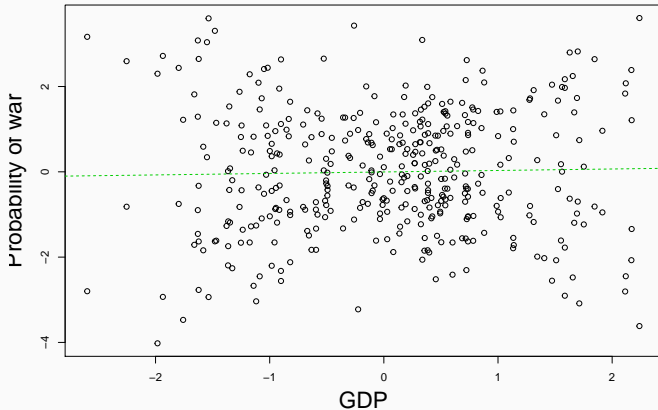
Dept.	Male Applic.	% admitted	Female Applic.	% admitted
A	825	62%	108	82%
B	560	63%	25	68%
C	325	37%	593	34%
D	417	33%	375	35%
E	191	28%	393	24%
F	272	6%	341	7%

# Why We need Statistics: Gender Bias?

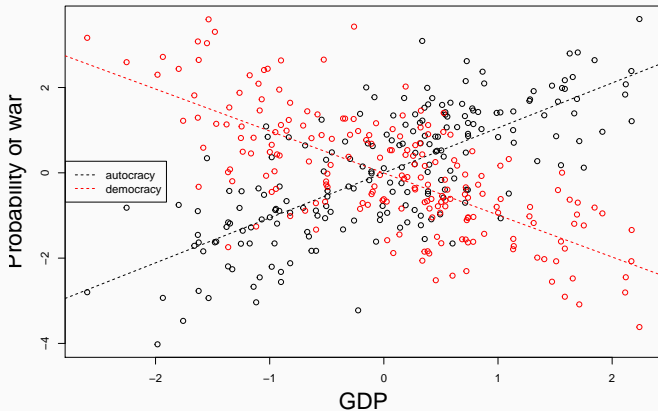




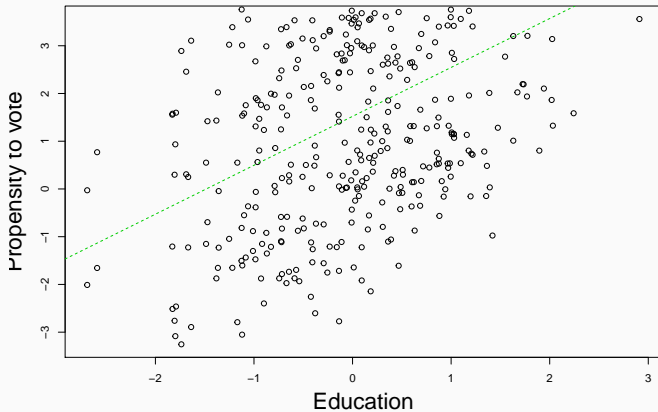
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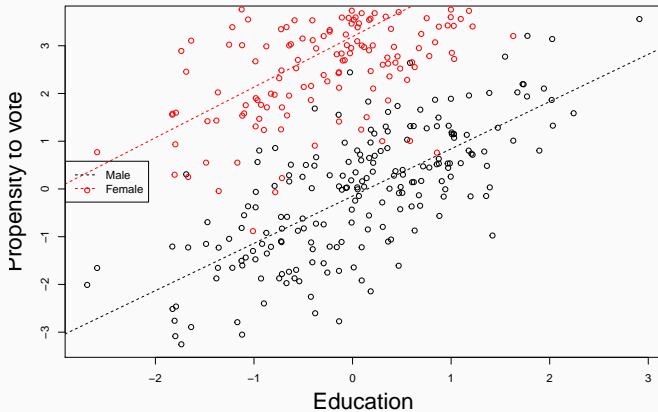
# Why we need statistics



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# What is statistics?

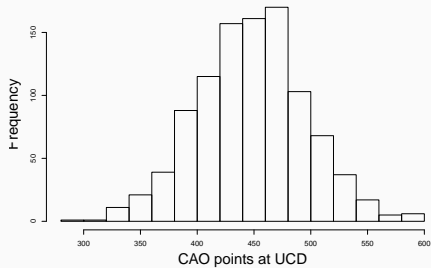
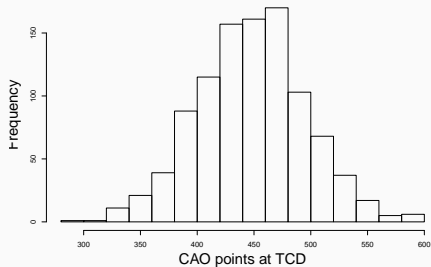
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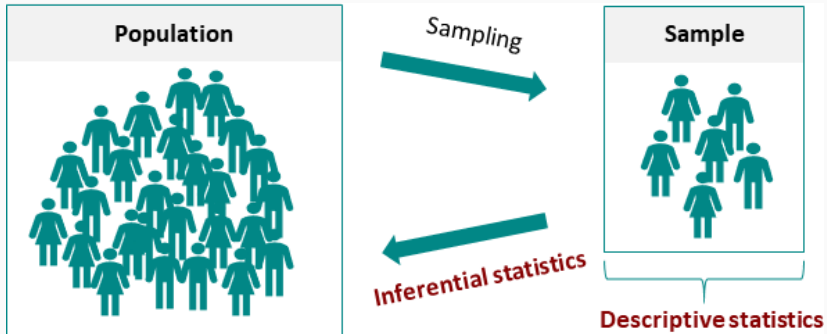
A branch of mathematics dealing with the collection, analysis, interpretation, and presentation of masses of numerical data

- Descriptive statistics
- Inferential statistics

# Descriptive statistics



# Inferential Statistics



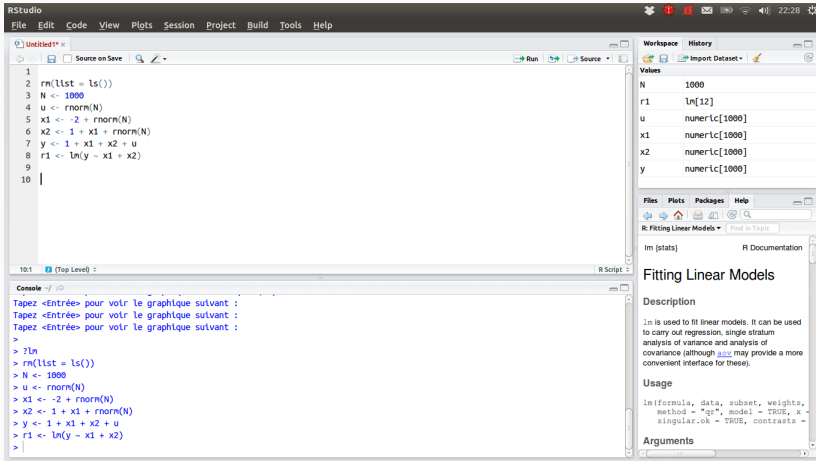


**Heads-up for next week**

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# R: What you will need

- R: download at [www.r-project.org](http://www.r-project.org), install
- RStudio: go to [www.rstudio.com](http://www.rstudio.com) and install



## R: What you will need

Brief demo. Try things, have fun. Errors are part of the path

We are here to help

# Have fun

