regression

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outline

2016 elections bonus: wrong prediction

intuition of inference (inferential statistics)

multivariate ols: intuition

wages example

interpretation and practice

violations (Wheelan, ch12)

ps4/ps5

- it always helps do define precisely your X, Y, U/A !!
- external validity: need to say if sample was random!
- internal validity: discuss some threats
  - really need experiment or at least a quasi experiment
- don't say increased, large etc–use numbers, esp graphs, be specific!
- INUS one more time–someone give a good example: first X$->$Y, and then how is X: I,N,U,S (spell out!) ?

ps4/ps5

- many people talk about experiments that are not!! need random assignment!! (and it needs to be ethical)
  - intervention or treatment without random assignment is fine, and can still do before after but it is not experiment!!
- again ask me and GA about data, but also go to the library and ask data librarian!!

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wrong prediction! also see Wheelan (2013, ch10)

- concepts from this class help explain
- many states were wrongly predicted!
- remember no prediction argues 100% certainty
  - eg what people say in polls must be accompanied by actual action (voting)
  - majority voicing support for candidate in polls does not cause candidate to win
  - mere INUS condition, eg “shy Trump”
  - and Trump voters may not want to talk to pollsters at all
  - not only candidate support matters; also propensity to vote!
- discussion:

http://www.economist.com/blogs/economist-explains/2016/11/economist-explains-3

not only stats failed with election prediction

- way of running it failed too!
- Hilary was data driven
  - doing what models tell her to do
- Donald had a gut feeling
  - doing what intuition tells him what to do
- and often gut feeling wins!
  - unknown unknowns, INUS condition, etc
  - extreme difficulty to argue anything without experiment
- data and statistics usually help, but are not everything!

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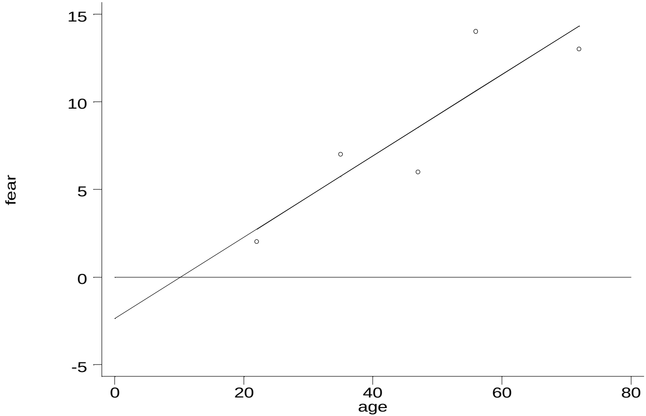
finding answers

- got hypotheis?
- now it's time to analyze the data or critique research
- that's inference: drawing conclusions (making inferences) from data
- just use regression and "control" for other variables [elaborate later]
- this is what we want to know after all!
- We have research questions, turn them into hypotheses
  - (a brief clear testable statement)
  - eg research Q: soc sci PhD good for career ?
  - H1: Soc sci PhD graduates make more than non-PhD
- exciting to know it, right ?

example: age and fear

- Say we have a survey measuring people's fear of crime (0-15)
  - H1: fear of crime increases with age



- $\hat{Y}_i = \hat{\beta}_1 + \hat{\beta}_2 X_i = -2.365 + .232 X_i$

and why regression is better

- the regression advantage:
  look at many variables at the same time
- when just compare 2 means, the problem is that you are often comparing apples to oranges
  - say you compare income for males and females
  - but you need to take into account that females have kids...
  - females are discriminated, etc
- regression will take care of that–keep that in mind

examples

- see some of the useful things you can predict
- http://ianayres.yale.edu/prediction-tools

  eg life expectancy http://www.northwesternmutual.com/learning-center/the-longevity-game.aspx

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multivariate OLS

- multiple (multivariate) regression is the most common tool in social science
- it finds effect of a variable of interest (X) on the dependent variable (Y) controlling/holding constant other vars
- it's a statistical trick that makes sample equal on all characteristics that we control for and imitates experimental setting (randomization)
  - again, in experiment you randomize into treatment and control groups so that both groups are on average the same and then we apply treatment (e.g. drug) to treatment group and see if had effect as compared to control group

multivariate OLS

- most of the time cannot do experiment:
  - can't tell some people to smoke and some not
    can't give college to some and not others
- but can use regression!
- eg: study effect of education (X) on income (Y)
  - but it may not be the same for males and females?
  - just control for gender in regression
- and the effect is as if everybody had the same gender!

multivariate OLS

- $X \rightarrow Y$ can say that X affects Y
- $Y = f(X)$ or: Y is is a function of X (same thing)
- $Y = f(X_1, X_2, ..., X_n, u)$
- in soc sci **always** many Xs

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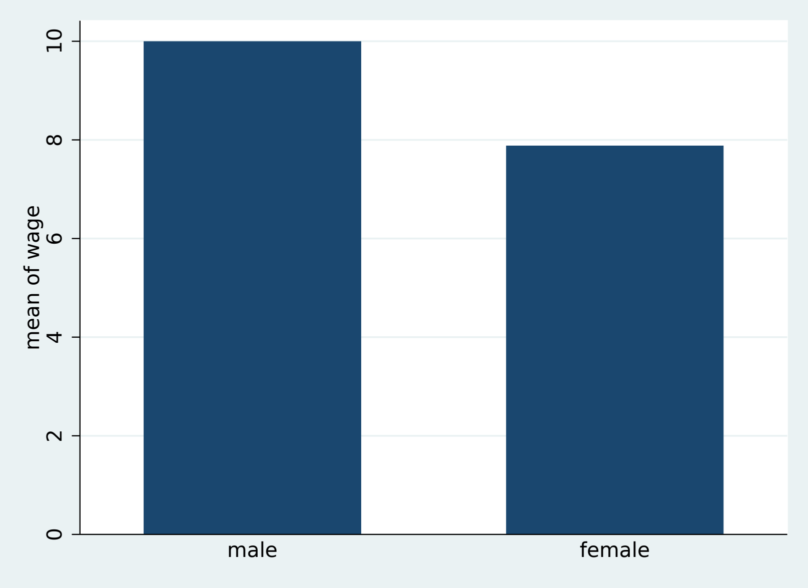
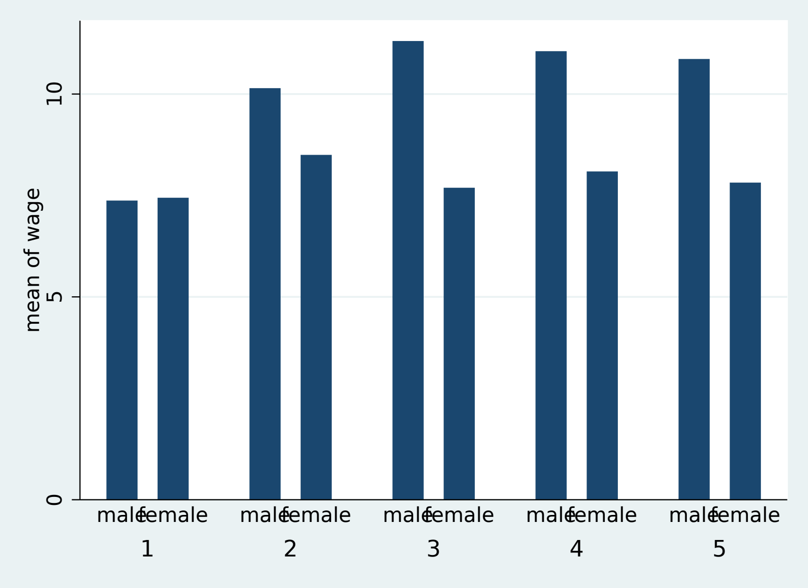
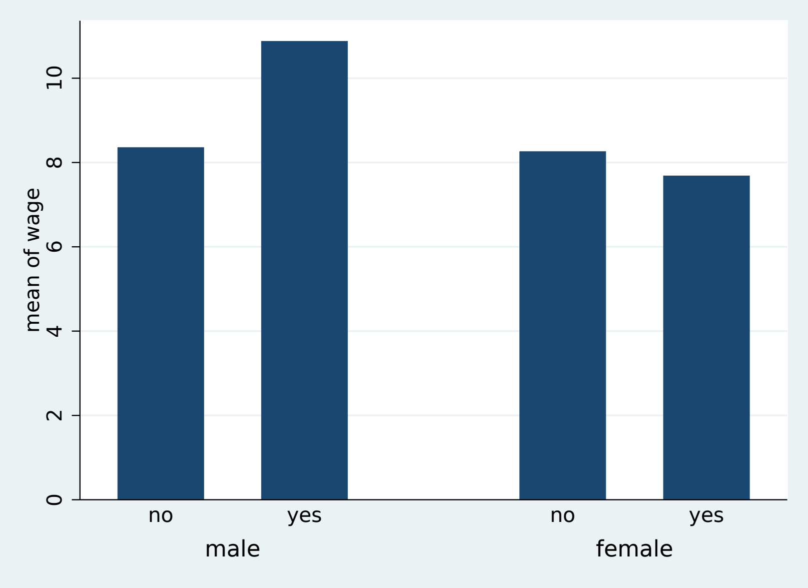
wages



wages by quintile of experience



wages by marital status and experience



descriptive stats

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Variable	Obs	Mean	Std. Dev.	Min	Max
wage	534	9.02	5.1	1	44.5
educ	534	13.01	2.6	2	18
exp	534	17.82	12.3	0	55

	wage	educ	exp
wage	1.00		
educ	0.38	1.00	
exp	0.08	-0.35	1.00

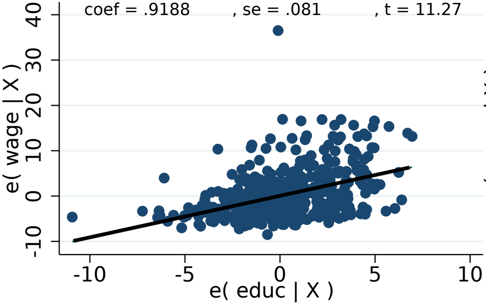
interpreting coefficients

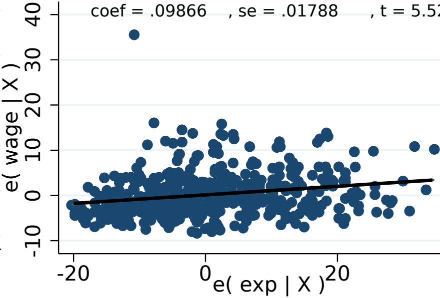
- pretty much only one way to interpret reg correctly
- 1 unit ($ % etc) increase in X leads to β unit ($ % etc) increase/decrease in Y ($> 1X$: remember ceteris paribus!)
-
- and as per Wheelan ch11: focus on:
- sign
- size
- significance:
  - t-stat, t=coeff/se, sig if $|t| > 2$
  - p is prob of getting this result or larger if no assoc (Wheelan p198), sig if $p < .05$
  - $95\% CI = \pm 2 * se$

multivariate ols

-

wage	Coef.	Std. Err.	t	P>|t|
educ	.9188352	.081526	11.27	0.000
exp	.0986602	.0178812	5.52	0.000
married	.5704847	.4357421	1.31	0.191
_cons	-5.07037	1.224631	-4.14	0.000

- 



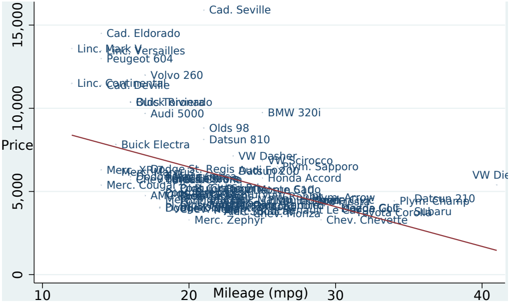
- ext cre: why married insignificant?

now let's turn to cars!

- let's say we want to explain price with mpg and weight
  -
- research Q: fuel efficient cars don't have to cost a fortune
- hypothesis: the higher the mpg, the lower the price
-
- but the problem with fuel efficient cars is that they are tiny
  - and cannot really use them for much

interpret: β, p, t, CI; predict price for 10mpg

-
```
----------------------------------------------------------------------
 price | Coef.   Std. Err.   t     P>|t|    [95% Conf. Interval]
-------+--------------------------------------------------------------
   mpg |  -238.8   53     -4.50   0.000    -344, -133
 _cons |   11253   1170    9.61   0.000    8919, 13587
----------------------------------------------------------------------
```



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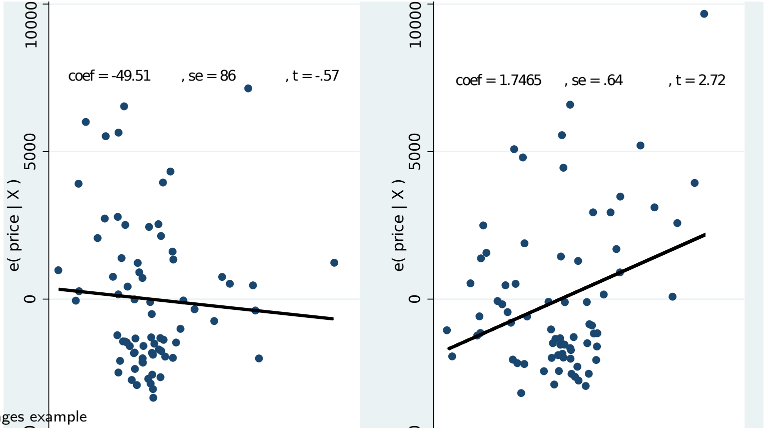
- **interpret:β, p, t, CI; predict price for 10mpg**

price	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]
mpg	-49.5186	.15	-0.57	0.567	-221, 122
weight	1.746	.64	2.72	0.008	.46, 3
_cons	1946	3597	0.54	0.590	-5226, 9118



predicted values (p200 Wheelan, 2013)

- weight=-118+4.3*(height in)+.12*(age)-4.8*(female)
- 53yo female who is 5'5:
- -118+(4.3*65)+(.12*53)-(4.8*1)=163
- 35yo male who is 6'3:
- -118+(4.3*75)+(.12*35)-(4.8*0)=209
- remember life expectancy game? same thing!!
  - `https://www.northwesternmutual.com/learning-center/tools/the-longevity-game`
- banks, insurance companies, etc
  - use models like this to predict whether you'll repay loan
  - and hence how risky you are, and whether you should get one

a "complete" explanation

- wage=f(native ability, education, family background, age, gender, race, height, weight, strength, attitudes, neighborhood influences, family connections, interactions of the above, chance encounters,...)
- multiple regression will tell you the effect of one variable while controlling for the effect of other variables (again, as if everybody was the same on other vars)
- $wage_i = \beta_1 + \beta_2 X_{2i} + \beta_3 X_{3i} + ... + \beta_n X_{ni} + u_i$

outline

practice regressions interpretations

- Happy Tourists, Unhappy Locals http://link.springer.com/article/10.1007/s11205-016-1436-9

ps6: flip the class!

- was it difficult?
- any challenges?
- need to cover anything about regression again?

do scatterplots

- it is useful to produce a scatterplot
  - you'd see outliers
    and whether the relationship is due to them
  - blackboard: relationships biased due to outliers
  - say marriage rate and divorce rate across states

think about it

- always interpret results!
- give it some thought
- ask yourself whether results make sense and why
- think about measurement and what it means
  - eg does marriage cause divorce or sth about NV?
- and as always, remember design principles:
  - INUS condition
  - threats to validity
- and note that in addition to regression
  - it is critical to have theory/logic/mechanism
  - see Wheelan (2013, p207)

Wheelan in ch11 mentions Whitehall studies

- fascinating stuff!
- high status causes better health!
  - great book 'Status Syndrome' http://a.co/jaUuwT7
- say nobel prize or oscar boosts one's health and longevity
  - these successful folks live longer and in better health
  - than exact same people (income, lifestyle, etc) but without status

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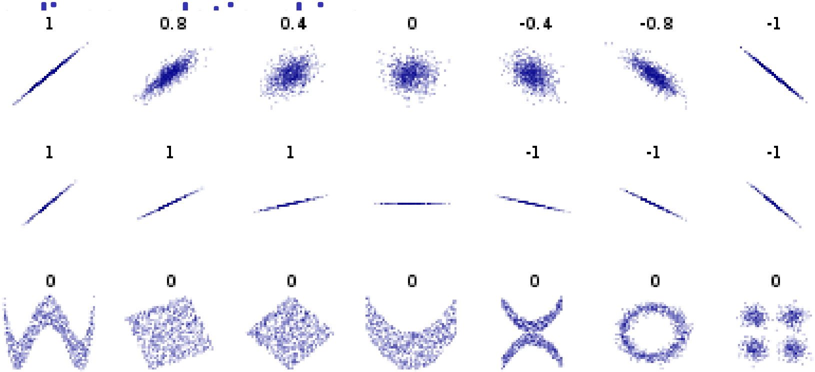
do not kill people with regressions (p212 Wheelan, 2013)

- recently tens of thousands of females
  were killed or made sick with estrogen,
  because regressions showed that estrogen was good
- regression estimates are never causal by themselves!
- remember the gold standard: experiment!
- ◦ again, INUS, unknown unknowns, corr≠causation, etc



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- like corr, won't detect nonlinear relationships!
    - example of nonlinear rel? extra credit!
    - [need quadratics, logs, etc] BUT!:
- just break it up into subsets/subsamples! dig deeper!
    - say for males and females separately
    - say for low and hi val separately

reverse causality (p216 Wheelan, 2013)

- more lessons−− >bad golf, or
- bad golf−− >more lessons
- solution:
  - lag variable: bad golf last month−− >more lessons now
  - use exogenous shock–remember from res_des.pdf:
  - terrorist attack−− >policing−− >crime
- or think about it! miserable people choose cities?
  - then i looked at only people who were born in urban/rural

omitted variable bias (p217 Wheelan, 2013)

- golf$- >$heart disease and cancer?
  - control for age!
  - age is killing people, not golf!

extrapolate beyond data (p220 Wheelan, 2013)

- only interpret within range of data!
- draw say regression of fear on age
  - and reg line hits y-axis at -3

data mining (p221 Wheelan, 2013)

- if you torture your data enough, it will confess
- likewise, if you throw enough variables, you will
- find significant relationships
- but remember: you need theory, causal mechanism/path, story!

run it

- excel
  - http://www.westmont.edu/~phunter/ma5/excel/regression.html
  - http://www3.wabash.edu/econometrics/EconometricsBook/Basic%20Tools/ExcelAddIns/OLSRegression.htm
  - http://finance.wharton.upenn.edu/~bodnarg/courses/readings/regression
- python
  - http://www.learndatasci.com/predicting-housing-prices-linear-regression-using-pythor
  - https://stackoverflow.com/questions/19991445/run-an-ols-regression-with-pandas-data-frame

LEVITT, S. D. AND S. J. DUBNER (2010): Freakonomics, vol. 61, Sperling & Kupfer.

WHEELAN, C. (2013): Naked statistics: stripping the dread from the data, WW Norton & Company.