INTR 5057 Research Design & Methods

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Day 12, 2016-12-09

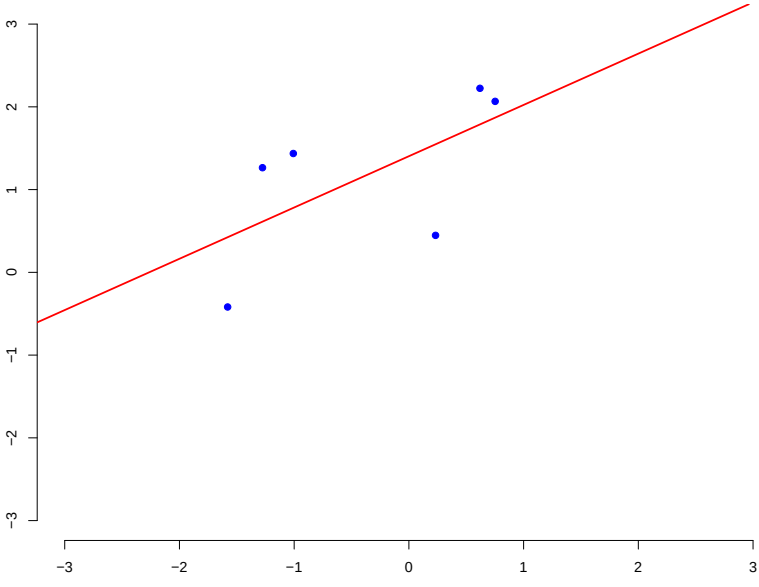
Misc.

- Guest.
- Homeworks #1 and #2 graded. Qs later.
- Voluntary homework (tricky).
- Final paper.

Final Paper

- (1) Pick a journal article on topic of your interest that uses quantitative methods, and write a critique of the methods used in the article. Be parsimonious in your summary of the article, and focus on your critique.
- (2) A research proposal for an MA thesis that uses quantitative methods.
- 800 words. Due on 3 January 2017

Correlation



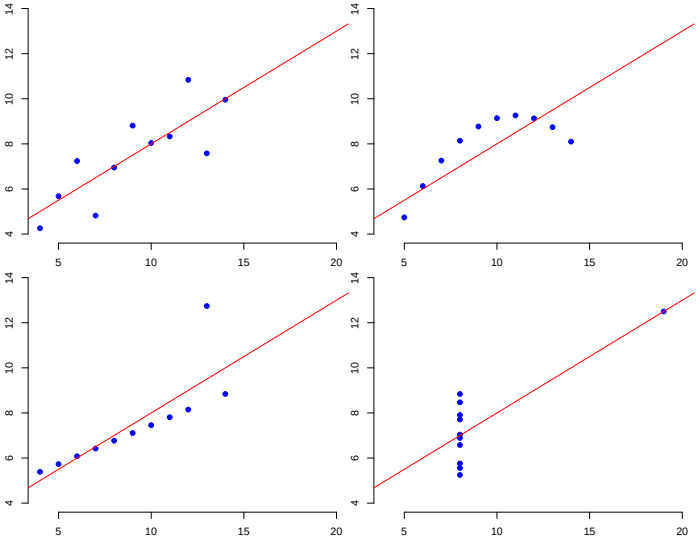
Correlation

A measure of association between two continuous variables.

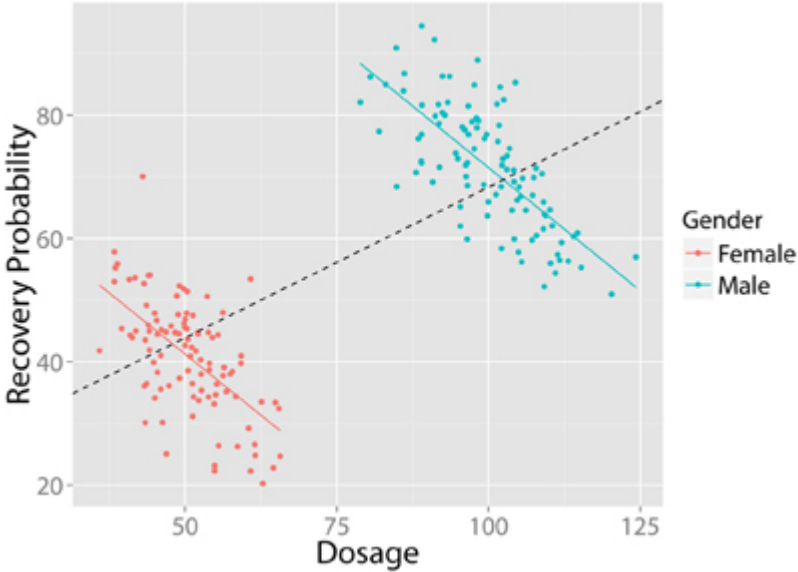
$$\rho_{x,y} = \frac{cov(x, y)}{\sigma_x \sigma_y}$$

Ranges from -1 to 1 on a closed interval.

$$\rho = 0.82$$



Simpson's Paradox



Simpson's Paradox

- In the whole population association in one direction.
- In subsets of the population association in the opposite direction.
- Not really a paradox when you think about it.
- A serious problem is that people rush ahead with causal interpretations.

Association & Causality

- Non-statisticians say *"correlation does not imply causation."*
- Statisticians say *"association does not imply causation."*
- Calling all association "correlation" is like calling all motor vehicles "cars."

Goals

Goals

- Describe.
- Explain.
- Predict/Forecast.
- ...

Table 1: Electoral and Replacement Volatility in Post-Communist Europe

	Verification		Without Bosnia-Herzegovina		Corrected Bosnia-Herzegovina	
	Electoral Volatility	Replacement Volatility	Electoral Volatility	Replacement Volatility	Electoral Volatility	Replacement Volatility
GDP Change from 1989	0.639	−4.623***	0.116	−6.066	0.004	−6.002
	(0.693)	(1.326)	(3.206)	(7.178)	(3.233)	(6.609)
GDP Change Between Elections	−2.059	9.019	−1.891	6.677	−1.076	4.576
	(5.219)	(10.128)	(5.898)	(10.704)	(5.229)	(10.064)
Effective Number of Electoral Parties	0.446	−0.346	0.452	−0.264	0.471	−0.462
	(0.313)	(0.533)	(0.316)	(0.558)	(0.326)	(0.546)
Log Weighted District Magnitude	−0.784	0.638	−0.789	0.603	−0.824	0.820
	(0.887)	(2.931)	(0.882)	(2.893)	(0.886)	(2.872)
Presidential System	−4.631	6.784	−4.847	5.532	−4.928	6.659
	(4.126)	(9.435)	(4.606)	(10.241)	(4.623)	(10.296)
Semi-Presidential System	−2.788	4.255	−2.813	4.017	−2.596	2.621
	(2.211)	(5.897)	(2.286)	(5.885)	(2.266)	(5.887)
Proportional Representation	0.827	0.077	0.852	−0.146	0.987	−0.739
	(2.228)	(6.004)	(2.265)	(5.943)	(2.223)	(5.948)
Ethnic Fractionalization	−6.163	−2.677	−6.716	−5.298	−5.713	−11.828
	(6.397)	(18.978)	(6.784)	(22.939)	(6.772)	(22.931)
Years Since Collapse of Communism	0.848	−2.633	0.828	−1.989	0.732	−1.959
	(0.807)	(2.153)	(0.863)	(2.117)	(0.797)	(1.976)
Years Since Collapse Squared	−0.031	0.070	−0.029	0.045	−0.026	0.049
	(0.042)	(0.101)	(0.044)	(0.097)	(0.043)	(0.093)
Constant	13.059**	41.941***	13.586***	43.661***	12.885**	48.191***
	(5.318)	(13.329)	(5.115)	(14.057)	(5.034)	(14.509)
Countries	21	21	20	20	21	21
Pairs of Elections	89	89	86	86	89	89
R^2	0.116	0.139	0.114	0.119	0.112	0.109

* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$ (two-tailed).

Regression

- Whether we like it or not, **regression** is the workhorse of quantitative social science.

Regression

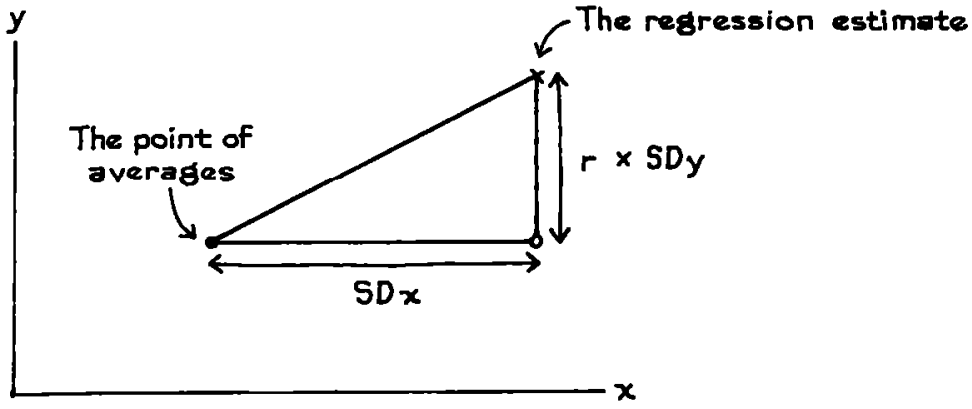
- Whether we like it or not, **regression** is the workhorse of quantitative social science.
- Any previous experiences with regression?

Regression

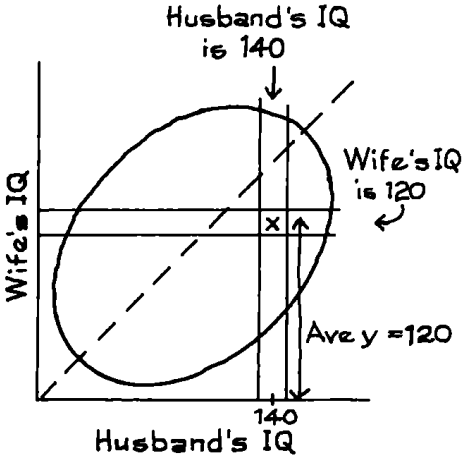
- One variable as a function of one or more other variables.
- **Conditional association**.
- Typically used to **explain** or **predict**.

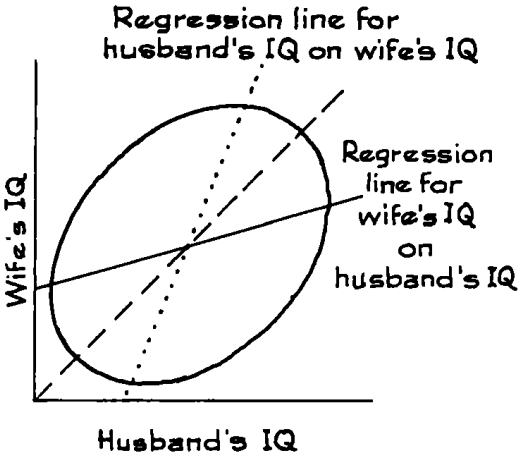
Regression

Figure 2. Regression method. When x goes up by one SD, the average value of y only goes up by r SDs.



Regression


Husband's IQ
is 140
Wife's IQ
is 120
Wife's IQ
Ave y =120
140
Husband's IQ


Regression line for
husband's IQ on wife's IQ
Regression
line for
wife's IQ
on
husband's IQ
Wife's IQ
Husband's IQ

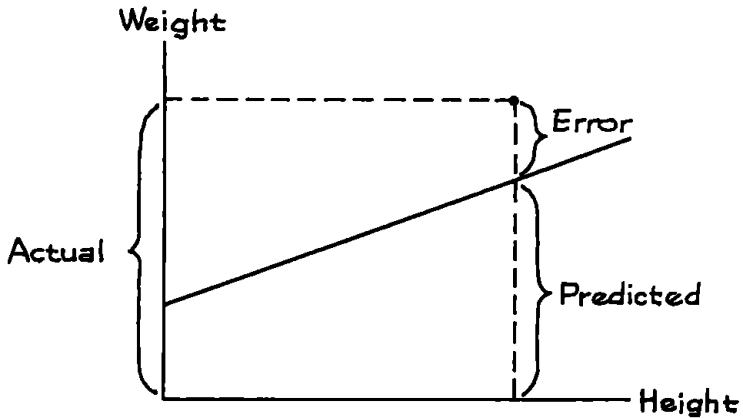
Linear Regression

$$y_i = \alpha + \beta \times x_i + \epsilon_i$$

- y: LHS, "dependent variable," outcome
- x: RHS, "indepdent variable," predictor, determinant
- α: intercept, "constant"
- β: slope, coefficient, "effect"
- ϵ: residual, "error"

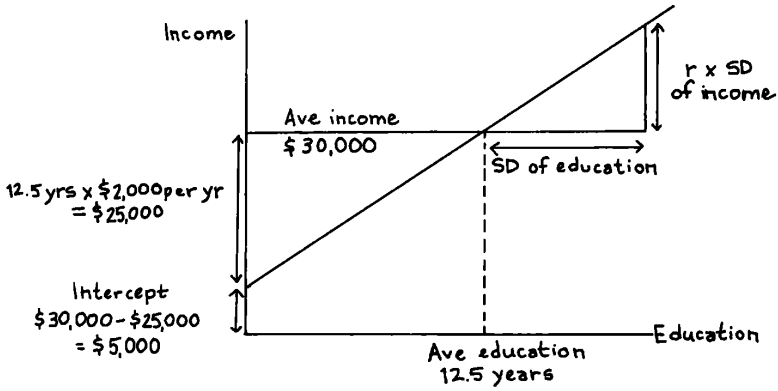
Regression

Figure 2. Prediction error equals vertical distance from the line.



Regression

Figure 3. Finding the slope and intercept of the regression line.



$$\text{Slope} = \frac{r \times \text{SD of income}}{\text{SD of education}}$$

Linear Regression

$$y_i = \alpha + \beta x_i + \epsilon_i$$

- Ordinary Least Squares (OLS): $\Sigma_i \epsilon_i^2$.
- Probabilistic I.:

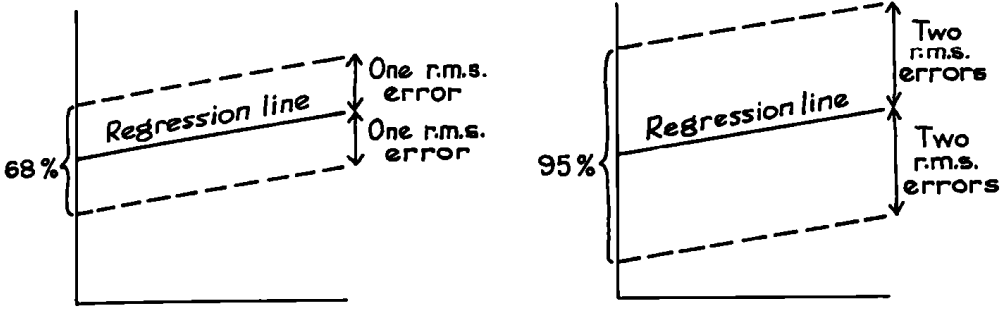
$$\epsilon_i \sim \mathit{Normal}(0, \sigma)$$

- Probabilistic II.:

$$y_i \sim \mathit{Normal}(\alpha + \beta x_i, \sigma)$$

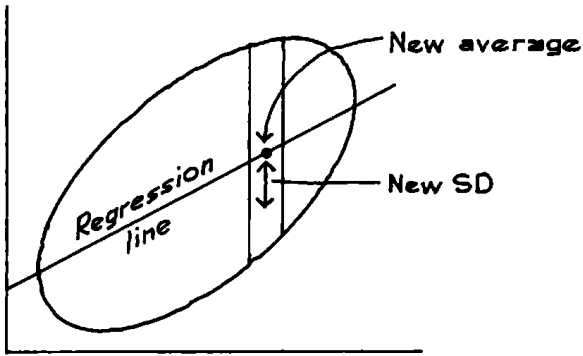
Regression

Figure 3. Rule of thumb. About 68% of the points on a scatter diagram fall inside the strip whose edges are parallel to the regression line, and one r.m.s. error away (up or down). About 95% of the points are in the wider strip whose edges are parallel to the regression line, and twice the r.m.s. error away.



Regression

Figure 10. A football-shaped scatter diagram. Take the points inside a narrow vertical strip. Their y-values are a new data set. The new average is given by the regression method. The new SD is given by the r.m.s. error of the regression line. Inside the strip, a typical y-value is around the new average—give or take the new SD.



Null Hypothesis Significance Testing

Probability in Classical Statistics

- What's the definition of probability in classical stats?

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- Can in classical stats probability represent degrees of belief?
- No, it cannot.
- OTH, in Bayesian statistics it can.

Inference in Classical Statistics

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Inference in Classical Statistics

- From a sample to a population.
- When is classical stats appropriate?
- Stochastic (i.e., random) samples.
- Or experiments with random treatment assignment.

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Inference in Classical Statistics

- Does classical stats apply if the data is not a stochastic sample or from a randomized experiment?
- A lot of it does not.
- Then why do people use it?
- They don't know any better, or know they can get away with it.

Uncertainty in Classical Statistics

- Comes from sampling.
- Standard errors.
- Confidence intervals.

Classical Standard Errors

- **Standard error** is a one-number summary of the variability of the estimate.

Classical Confidence Intervals

- **An X% confidence interval** is an interval that if we take many samples the same way, and compute the interval the same way, X% of them will contain the true population value.
- We don't know if our sample is one of those X%.

Null Hypothesis Significance Testing

- What's your experience?

Null Hypothesis Significance Testing

- One of the pillars of frequentist stats.
- Almost everywhere in quant. soc. sci.
- All the '***,' '**,' '*' in tables.
- No time for subtlety: NHST is misunderstood, and ritualistically abused.




Null Hypothesis Significance Testing

- One of the pillars of frequentist stats.
- All the '***,' '**,' '*' in tables.
- No time for subtlety: NHST is misunderstood, and ritualistically abused.
- A common element of cargo cult social science.

Null Hypothesis Significance Testing

- Two sources: significance testing and hypothesis testing.
- Origin in making business decisions (Student at Guiness).
- Decide whether to retain or reject a hypothesis by looking on how far the data is from the hypothesis.

Null Hypothesis Significance Testing

- Null hypothesis usually, but not necessarily states that something (a correlation, a coefficient, a difference between groups) is 0.

Null Hypothesis Significance Testing

- The data is compared to a hypothetical world where the null hypothesis is true.
- How far would samples be from the true value if in the population the null hypothesis is true.
- p value: what % of the samples would be as far or futher from the null as is our data.

Null Hypothesis Significance Testing

- Human mind craves certainity.
- p values are continuous.
- People desire discrete beliefs (true/false).
- p vals converted to decisions by comparing to a significance level.

Null Hypothesis Significance Testing

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- What are the common significance levels?
- 0.05 (5%), 0.01 (1%), 0.01 (0.1%)
- Do you know why these?
- No good reason.
- One should select the level based on the consequences of the decision. Almost noone does that. Meaning the test results are useless.

So?

- In statistics **significance** means **visibility**, **not importance**!
- In frequentist statistics **confidence** means **reliability**.

So?

- When someone is going on about statistical significance ask them what is the substantive or practical significance.
- Just because we can see something it doesn't mean it's important.
- Just because the picture is blurry, it doesn't mean there's nothing there.

So?

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So?

- I crave certainty, I want decisions, what can I do?
- Fight the craving.
- I need to make a decision, what can I do?
- If you have experimental or stochastic sample data, you can use NHST, but compute the right sig. level.

So?

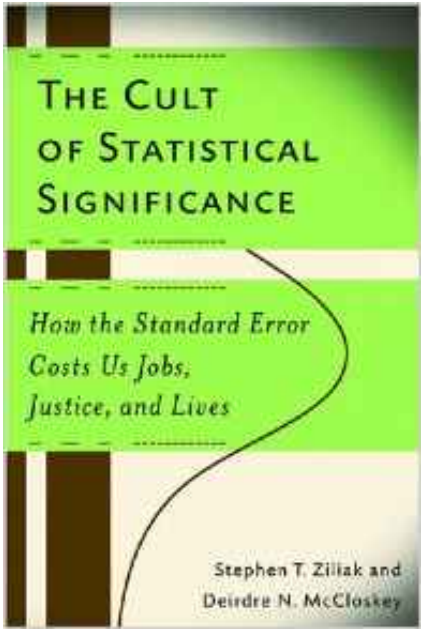
- My data is not a random sample or from a randomized experiment.

So?

- My data is not a random sample or from a randomized experiment.
- Go Bayesian.

So?

- My data is not a random sample or from a randomized experiment.
- Go Bayesian.
- Many frequentist point and interval estimates are numerically close to Bayesian ones.


THE CULT
OF STATISTICAL
SIGNIFICANCE
How the Standard Error
Costs Us Jobs,
Justice, and Lives
Stephen T. Ziliak and
Deirdre N. McCloskey