More Regression Applications

Lecture 24

Reading: None

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Outline

- Discuss three case studies – empirical papers published in academic journals – to reinforce key concepts from Chapters 14, 18 – 21
  - Tekin and Mocan (2010): "Ugly Criminals"
  - Deryugina and Shurchkov (2015): "Does Beauty Matter in Undergraduate Education?"
  - Andreoni and Vesterlund (2001): "Which is the fair sex? Gender differences in altruism"

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"Ugly Criminals"

Abstract: Being very attractive reduces a young adult's propensity for criminal activity and being unattractive increases it. Being very attractive is also positively associated with wages and with adult vocabulary test scores, which implies that beauty may have an impact on human capital formation. The results suggest that a labor market penalty provides a direct incentive for unattractive individuals toward criminal activity. The level of beauty in high school is associated with criminal propensity seven to eight years later, which seems to be due to the impact of beauty in high school on human capital formation, although this avenue seems to be effective for females only.

Tekin and Mocan (2010), *The Review of Economics and Statistics,* https://www.mitpressjournals.org/doi/10.1162/rest.2009.11757, copy on Readings page in Quercus (optional)

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“Ugly Criminals”: Data

- Uses data from National Longitudinal Study of Adolescent Health
  - Wave III interviews in 2001/02: respondents are 18 – 26 years old
  - Asked many questions
  - Interviewer answered (discretely): “How physically attractive is the respondent?”

Dist. of Attractiveness Ratings (%) among Young Adults (18 – 26)

Category	Males	Females
1. Very unattractive	1.37	2.44
2. Unattractive	5.22	4.81
3. About average	51.82	40.55
4. Attractive	33.66	38.00
5. Very attractive	7.92	14.19
N	7,159	8,020

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<u>Variable Definitions:</u>

- *Wage* is hourly wage rate in dollars (mean ~ $11 and s.d. ~ $7)
- *Test score* is the percentile score for the Peabody Picture Vocabulary test (mean ~ 50 and s.d. ~ 29)
- “*Very Attractive* captures individuals who received the highest rating of 5; *Unattractive,* those with a rating of 1 or 2” p. 16
- “*Personal characteristics* are age, race/ethnicity, non-wage income, self-reported health status, whether he or she was born in the United States, birth weight, and religious affiliation.” “[*Family characteristics* are] the mother’s education, whether the family was on welfare, family income, whether the father was biological or a stepfather, the age of the mother at birth, whether the father was in jail, and birth weight.” p. 17

How many of the personal characteristic variables are dummies?

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Table 7. Effect of Beauty on Wages and Test Scores

		Females		Males	
		Log Wages	*Test Score*	*Log Wages*	*Test Score*
Very Attractive	What is reference	0.065*** (0.014)	2.999*** (0.906)	0.107*** (0.024)	3.706*** (1.163)
Unattractive	(omitted) category?	-0.043** (0.020)	-2.330* (1.210)	-0.041* (0.025)	-1.800 (1.326)
Control Variables: Personal and family attributes		Yes	Yes	Yes	Yes
Interviewer fixed effects		Yes	Yes	Yes	Yes
N		3,730	5,954	3,521	5,209

Note: * Estimated coefficient is statistically different from 0 at the 10% level, ** significant at 5%, and *** significant at 1% or better

After controlling for personal/family attributes and interviewers’ tastes, very attractive females on average have wages that are about ___________ compared to average/attractive females.

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“Does Beauty Matter in Undergraduate Education?”

ABSTRACT: Physically attractive individuals achieve greater success in terms of earnings and status than those who are less attractive. However, whether this “beauty premium” arises primarily because of differences in ability or confidence, bias, or sorting remains unknown. We use a rich dataset from a women’s college to evaluate each of these three mechanisms at the college level. We find that students judged to be more attractive perform significantly worse on standardized tests but, conditional on test scores, are not evaluated more favorably at the point of admission, suggesting that more attractive people do not possess greater abilities at the beginning of college. Controlling for test scores, more attractive students receive only marginally better grades in some specifications, and the magnitudes of the differences are very small. Finally, there is substantial beauty-based sorting into areas of study and occupations.

What are the research questions? Observational data?

Deryugina and Shurchkov (2015): Copy on Readings page in Quercus (optional).

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Excerpt (p. 942): Our dataset consists of 794 alumnae who graduated from an anonymous women’s college between the years 2002 and 2011. To measure attractiveness, we use pictures [from student ID cards] taken [by campus officials] when the alumnae were first-year students. The pictures were subsequently rated by current male and female students from a college in another state. Each picture was rated by at least 25 male and 25 female raters. [We combine these to form an attractiveness rating, which we standardize so that a rating of 1 means the person is 1 standard deviation above average.]

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Excerpt (p. 942): The attractiveness rating is then matched to the alumna’s academic record, which includes her GPA, major, SAT scores [a test most students in the U.S. take in high school], race, non-merit-based financial aid awards, and scores from a quantitative reasoning (QR) test that all first-year students are required to take. Like the SAT, the QR test is scored blindly, without observing the test taker’s appearance. Finally, we observe each student’s admission rating, as assigned by three or more application reviewers. The college uses a “holistic” approach to assign admission ratings, considering each student’s academic record (including high school GPA, SAT and other standardized test scores), extracurricular activities, recommendation letters, two essays, and, in some cases, artwork or music. [There are no photos or interviews for admission so physical attractiveness cannot directly affect the rating.]

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Basic Summary Statistics

Table 1: Summary Statistics

	Above Median Attractiveness Rating (Attractive)					*Below Median Attractiveness Rating (Unattractive)*					*Entire Sample*	
	Mean	SD	Min	Max	Obs.	Mean	SD	Min	Max	Obs.	Mean	SD
Standardized attractiveness rating	0.70	0.54	-0.03	2.42	397	-0.69	0.47	-2.69	-0.03	397	0	1
Admissions rating	6.34	1.36	0	10	397	6.62	1.29	1.67	10	395	6.48	1.34
cGPA	3.48	0.28	2.5	3.98	396	3.48	0.29	2.3	4	396	3.47	0.31
Math SAT score	678	62	510	800	387	689	57	490	800	378	684	60
Verbal SAT score	696	61	490	800	387	712	59	450	800	378	704	61
QR test score	13.08	2.65	2	18	397	13.42	2.55	4.5	18	397	13.25	2.60

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Table 2: Attractiveness and Test Scores

	Dependent variable:					
	Standardized Math SAT		Standardized Verbal SAT		Standardized QR test	
Specification:	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
Explanatory variables:						
Standardized attractiveness rating	-0.10		-0.14		-0.20	
	(0.03)		(0.03)		(0.09)	
Attractiveness quintile = 2		0.04		-0.14		0.00
		(0.10)		(0.11)		(0.27)
Attractiveness quintile = 3		-0.12		-0.27		-0.20
		(0.10)		(0.11)		(0.29)
Attractiveness quintile = 4		-0.08		-0.30		-0.31
		(0.10)		(0.11)		(0.27)
Top attractiveness quintile		-0.29		-0.40		-0.55
		(0.10)		(0.11)		(0.27)
Observations	764	764	764	764	793	793
R^2	0.22	0.22	0.11	0.11	0.12	0.12

Notes: Robust standard errors in parentheses. All specifications include year-of-enrollment and race fixed effects, as well as controls for the amount of financial aid received.

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Table 3: Selection Into Subject Areas

	Dependent variable is percentage of all courses that the student took that are in:		
	the sciences	the humanities	economics
Specification:	*(7)*	*(8)*	*(9)*
Explanatory variables:			
Standardized attractiveness rating	-1.92	-0.05	1.59
	(0.62)	(0.63)	(0.45)
Standardized Math SAT score	4.30	-3.72	3.23
	(0.75)	(0.75)	(0.54)
Standardized Verbal SAT score	-1.86	2.26	-1.84
	(0.70)	(0.71)	(0.51)
Admission rating	1.04	-0.25	0.08
	(0.57)	(0.57)	(0.41)
Observations	762	762	762
R^2	0.12	0.15	0.14

Notes: Robust standard errors in parentheses. All specifications include year-of-enrollment and race fixed effects, as well as controls for the amount of financial aid received.

After discussing the results in Table 3, on page 952 the authors conclude: “Thus, there is substantial beauty-based course selection.”
What do they mean by “substantial”?

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Table 4: Attractiveness and Admissions Ratings & Attractiveness and cGPA

	Dependent variable:		
	Admission Rating	Admission Rating	cGPA
Specification:	*(10)*	*(11)*	*(12)*
Explanatory variables:			
Standardized attractiveness rating	-0.131	-0.038	0.016
	(0.049)	(0.042)	(0.010)
Standardized Math SAT score		0.432	0.017
		(0.050)	(0.012)
Standardized Verbal SAT score		0.408	0.005
		(0.045)	(0.011)
Admission rating			0.059
			(0.009)
Observations	791	762	760
R^2	0.13	0.35	0.18

Notes: Robust standard errors in parentheses. All specifications include year-of-enrollment and race fixed effects, as well as controls for the amount of financial aid received.

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"Which is the fair sex? Gender differences in altruism"

ABSTRACT [1st sentence]: We study gender differences in altruism by examining a modified dictator game with varying incomes and prices.

- A modified dictator game?
- Participants (students) are all in a lecture hall
- You each make eight decisions to allocate tokens between yourself and another *anonymous* person in the room: your partner
- How many points each token is worth to you and your partner varies across eight decisions
- Each point is always worth 10 cents to all players
- How many tokens will you keep? Pass to your partner?

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DECISION SHEET

For each of the eight decisions, the number of tokens you choose to *Hold* plus the number you choose to *Pass* must equal the total tokens you are asked to divide.

While the points-per-token vary, remember that each *point* is always worth $0.10.

Write your token allocations in the blank spaces. Fill in all 16 blanks.

DECISIONS:

1. Divide 40 tokens: *Hold* _____ @ 1 point each, and *Pass* _____ @ 3 points each.

2. Divide 60 tokens: *Hold* _____ @ 1 point each, and *Pass* _____ @ 2 points each.

3. Divide 75 tokens: *Hold* _____ @ 1 point each, and *Pass* _____ @ 2 points each.

4. Divide 60 tokens: *Hold* _____ @ 1 point each, and *Pass* _____ @ 1 point each.

5. Divide 100 tokens: *Hold* _____ @ 1 point each, and *Pass* _____ @ 1 point each.

6. Divide 60 tokens: *Hold* _____ @ 2 points each, and *Pass* _____ @ 1 point each.

7. Divide 75 tokens: *Hold* _____ @ 2 points each, and *Pass* _____ @ 1 point each.

8. Divide 40 tokens: *Hold* _____ @ 3 points each, and *Pass* _____ @ 1 point each.

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ECO220Y (2014, 2015, 2016)

Table 2: Mean Payoff to Other Party (Canadian $s)

Budget	Token endowment	Income m	p_o/p_s	All subjects (n=868)	Males (n=334)	Females (n=534)	t-stat
1	40	4.00	1/3	4.74	5.39	4.34	3.71
2	60	6.00	1/2	4.83	5.41	4.47	3.66
3	75	7.50	1/2	5.97	6.56	5.60	3.03
4	60	6.00	1	2.17	1.98	2.30	-3.17
5	100	10.00	1	3.36	2.98	3.60	-3.80
6	60	12.00	2	1.91	1.64	2.08	-3.80
7	75	15.00	2	2.32	2.00	2.52	-3.63
8	40	12.00	3	1.18	1.01	1.28	-3.14
Average				3.31	3.37	3.27	1.17

"Which is the fair sex? Gender differences in altruism"

ABSTRACT: We study gender differences in altruism by examining a modified dictator game with varying incomes and prices. Our results indicate that the question "which is the fair sex?" has a complicated answer—when altruism is expensive, women are kinder, but when it is cheap, men are more altruistic. That is, we find that the male and female "demand curves for altruism" cross, and that men are more responsive to price changes. Furthermore, men are more likely to be either perfectly selfish or perfectly selfless, whereas women tend to be "equalitarians" who prefer to share evenly.

Observational or experimental data? y variable? x variables?

Andreoni and Vesterlund (2001), *The Quarterly Journal of Economics*, https://doi.org/10.1162/003355301556419, copy on Readings page in Quercus (optional)

Link: Chapters 14 & 21

- "Comparing Two Means" (Chap. 14), 3 cases:
  - Two independent samples, unequal variances
    - E.g. Money passed by males (n=334) v. females (n=534) in Budget 4 (and separately for other 7 budgets)
  - Two independent samples, equal variances
    - E.g. Assuming variance for males equals that of females
  - Paired data
    - E.g. Money passed by people (n=868) in Budget 5 vs. 4
- Special cases of regression analysis

Andreoni and Vesterlund (2001)

Table 1: Mean Payoff to Other Party (U.S. $s)

Budget	Token endowment	Income m	p_o/p_s	All subjects (n=142)	Males (n=95)	Females (n=47)	t-stat
1	40	4.00	1/3	3.79	4.18	3.01	1.96
2	60	6.00	1/2	4.03	4.30	3.49	1.48
3	75	7.50	1/2	4.68	5.00	4.03	1.53
4	60	6.00	1	1.54	1.36	1.91	-2.26
5	100	10.00	1	2.52	2.33	2.92	-1.42
6	60	12.00	2	1.42	1.21	1.82	-2.07
7	75	15.00	2	1.71	1.42	2.29	-2.35
8	40	12.00	3	0.89	0.67	1.32	-2.97
Average				2.57	2.56	2.60	-0.24

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Table 3: Mean Payoff to Other Party: A&V (2001) versus ECO220Y (2014, 2015 and 2016)

	Males				*Females*			
Bud.	A&V Mean (s.d.)	ECO220 Mean (s.d.)	Diff. (s.e.)	P-value (2-tailed)	A&V Mean (s.d.)	ECO220 Mean (s.d.)	Diff. (s.e.)	P-value (2-tailed)
1	4.18 (4.22)	5.39 (4.44)	-1.21 (0.50)	0.0157	3.01 (2.83)	4.34 (3.43)	-1.33 (0.44)	0.0036
2	4.30 (3.77)	5.41 (4.10)	-1.12 (0.45)	0.0134	3.49 (2.63)	4.47 (3.01)	-0.98 (0.40)	0.0190
3	5.00 (4.67)	6.56 (5.02)	-1.56 (0.55)	0.0052	4.03 (2.77)	5.60 (3.70)	-1.56 (0.43)	0.0006
4	1.36 (1.48)	1.98 (1.58)	-0.62 (0.17)	0.0005	1.91 (1.31)	2.30 (1.20)	-0.38 (0.20)	0.0596
5	2.33 (2.51)	2.98 (2.50)	-0.65 (0.29)	0.0272	2.92 (2.27)	3.60 (2.07)	-0.68 (0.34)	0.0537
6	1.21 (1.57)	1.64 (1.75)	-0.43 (0.19)	0.0245	1.82 (1.68)	2.08 (1.54)	-0.26 (0.25)	0.3126
7	1.42 (1.96)	2.00 (2.19)	-0.57 (0.23)	0.0154	2.29 (2.12)	2.52 (1.88)	-0.23 (0.32)	0.4687
8	0.67 (1.11)	1.01 (1.28)	-0.34 (0.13)	0.0121	1.32 (1.27)	1.28 (1.20)	0.03 (0.19)	0.8588
Obs.	95	334	-	-	47	534	-	-

ECO220Y (2014, 2015, 2016)

$$H_0: \mu_{M4} - \mu_{F4} = 0; H_1: \mu_{M4} - \mu_{F4} \neq 0$$

Unequal variances (general):

$$t = \frac{(\bar{X}_{M4} - \bar{X}_{F4}) - \Delta_0}{\sqrt{\frac{s_{M4}^2}{n_M} + \frac{s_{F4}^2}{n_F}}}$$

$$t = \frac{(1.98 - 2.30) - 0}{\sqrt{\frac{1.58^2}{334} + \frac{1.20^2}{534}}}$$

$$t = \frac{-0.32}{0.101} = -3.17$$

Assuming equal variances:

$$t = \frac{(\bar{X}_{M4} - \bar{X}_{F4}) - \Delta_0}{\sqrt{\frac{s_{p4}^2}{n_M} + \frac{s_{p4}^2}{n_F}}}$$

$$s_{p4}^2 = \frac{(n_M - 1)s_{M4}^2 + (n_F - 1)s_{F4}^2}{n_M + n_F - 2}$$

$$= \frac{(333)1.58^2 + (533)1.20^2}{334 + 534 - 2} = 1.846$$

$$t = \frac{-0.32}{0.095} = -3.37$$

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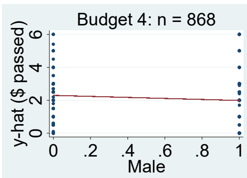
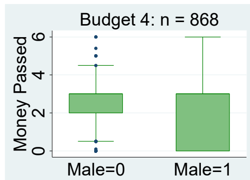
Homoscedasticity => Equal Variances

```
. regress money_passed male if budget4==1;

      Source |       SS       df       MS              Number of obs =     868
-------------+------------------------------           F(  1,   866) =   11.34
       Model |  20.9206814     1  20.9206814           Prob > F      =  0.0008
    Residual |  1597.25572   866  1.84440615           R-squared     =  0.0129
-------------+------------------------------           Adj R-squared =  0.0118
       Total |  1618.17641   867  1.86640877           Root MSE      =  1.3581

------------------------------------------------------------------------------
money_passed |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        male |  -.3190832   .0947424    -3.37   0.001    -.5050347   -.1331316
       _cons |   2.295131   .0587703    39.05   0.000     2.179782     2.41048
------------------------------------------------------------------------------
```





But, with Robust Standard Errors…

```
.  regress money_passed male if budget4==1, robust;

Linear regression                                      Number of obs =     868
                                                       F(  1,   866) =   10.02
                                                       Prob > F      =  0.0016
                                                       R-squared     =  0.0129
                                                       Root MSE      =  1.3581

------------------------------------------------------------------------------
             |               Robust
money_passed |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        male |  -.3190832   .1007783    -3.17   0.002    -.5168815   -.1212848
       _cons |   2.295131   .0519189    44.21   0.000      2.19323    2.397033
------------------------------------------------------------------------------
```

These standard errors are *robust* to violations of Assumption #3 (the homoscedasticity assumption).

ECO220Y (2014, 2015, 2016)

Table 2: Mean Payoff to Other Party

Budget	Token endowment	Income m	p_o/p_s	All subjects (n=868)	Males (n=334)	Females (n=534)	t-stat
1	40	4.00	1/3	4.74	5.39	4.34	3.71
2	60	6.00	1/2	4.83	5.41	4.47	3.66
3	75	7.50	1/2	5.97	6.56	5.60	3.03
4	60	6.00	1	2.17	1.98	2.30	-3.17
5	100	10.00	1	3.36	2.98	3.60	-3.80
6	60	12.00	2	1.91	1.64	2.08	-3.80
7	75	15.00	2	2.32	2.00	2.52	-3.63
8	40	12.00	3	1.18	1.01	1.28	-3.14
Average				3.31	3.37	3.27	1.17

Reshape Data: Unit of Observation is a Decision by a Student

```
. regress money_passed male, robust;

Linear regression                                      Number of obs =     6944
                                                       F(  1,  6942) =     1.38
                                                       Prob > F      =   0.2401
                                                       R-squared     =   0.0002
                                                       Root MSE      =   3.1823
```

What does 6944 mean?

Why use robust standard errors in this case?

money_passed	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
male	.0983501	.0837065	1.17	0.240	-.0657404	.2624405
_cons	3.273057	.0427419	76.58	0.000	3.18927	3.356844

Inference about a comparing two population means, independent samples, unequal variances:

$$t = \frac{(\bar{X}_M - \bar{X}_F) - \Delta_0}{\sqrt{\frac{s_M^2}{n_M} + \frac{s_F^2}{n_F}}}$$

This formula on your Aid Sheets for Chapter 14 has a *robust standard error* in the denominator.

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```
. summarize money_passed if male==1
```

Variable	Obs	Mean	Std. Dev.	Min	Max
money_passed	2672	3.371407	3.720474	0	15

```
. summarize money_passed if male==0
```

Variable	Obs	Mean	Std. Dev.	Min	Max
money_passed	4272	3.273057	2.793558	0	15

$H_0: (\mu_M - \mu_F) = 0$

$H_1: (\mu_M - \mu_F) \neq 0$

If you use the "assuming equal variances" formula on your Aid Sheets for Chapter 14 instead, you get the regular (not robust) se.

$$t = \frac{(\bar{X}_M - \bar{X}_F) - \Delta_0}{\sqrt{\frac{s_M^2}{n_M} + \frac{s_F^2}{n_F}}} = \frac{(3.37141 - 3.27306)}{\sqrt{\frac{3.72047^2}{2672} + \frac{2.79356^2}{4272}}} = \frac{0.09835}{0.08371} = 1.17$$

Robust standard error

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Full Set of Budget Dummies

```
. regress money_passed budget1-budget3 budget5-budget8, robust;

Linear regression                                      Number of obs =     6944
                                                       F(  7,  6936) =   341.06
                                                       Prob > F      =   0.0000
                                                       R-squared     =   0.2493
                                                       Root MSE      =   2.7587
```

money_passed	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
budget1	2.570968	.139695	18.40	0.000	2.297123	2.844813
budget2	2.658986	.1274211	20.87	0.000	2.409202	2.908771
budget3	3.795392	.1525096	24.89	0.000	3.496426	4.094357
budget5	1.187442	.0897047	13.24	0.000	1.011594	1.363291
budget6	-.2599078	.0723093	-3.59	0.000	-.4016562	-.1181594
budget7	.1479263	.0827918	1.79	0.074	-.014371	.3102235
budget8	-.9923963	.0624764	-15.88	0.000	-1.114869	-.8699235
_cons	2.17235	.0463707	46.85	0.000	2.081449	2.263251

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```
.  xi: regress money_passed budget1-budget3 budget5-budget8 i.stud, robust;
                          (_Istud_1 for stud==A010ECO220Y, Feb. 14, 2014 omitted)

Linear regression                                      Number of obs =    6944
                                                       F(874,  6069) =   12.53
                                                       Prob > F      =  0.0000
                                                       R-squared     =  0.5516
                                                       Root MSE      =  2.2792
```

What if added a full set of student fixed effects: i.e. a dummy for each student (except one)?

Note: (868 – 1) + (8 – 1) = 874 (i.e. $k = 874$)

```
------------------------------------------------------------------------------
             |               Robust
money_passed |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     budget1 |   2.570968   .1130991    22.73   0.000     2.349253    2.792682
     budget2 |   2.658986   .0956745    27.79   0.000      2.47143    2.846542
     budget3 |   3.795392    .118522    32.02   0.000     3.563046    4.027737
     budget5 |   1.187442    .076437    15.53   0.000     1.037599    1.337286
     budget6 |  -.2599078   .0807719    -3.22   0.001    -.4182494   -.1015663
     budget7 |   .1479263   .0857755     1.72   0.085    -.0202242    .3160768
     budget8 |  -.9923963   .0785683   -12.63   0.000    -1.146418   -.8383746
    _Istud_2 |      3.375   1.836626     1.84   0.066    -.2254395     6.97544
    _Istud_3 |      3.875   .9187467     4.22   0.000      2.07393     5.67607
         ...
  _Istud_867 |      3.125   .9163724     3.41   0.001     1.328585    4.921415
  _Istud_868 |      3.875   .8388546     4.62   0.000     2.230547    5.519453
       _cons |  -.3885513   .7588858    -0.51   0.609    -1.876237    1.099134
------------------------------------------------------------------------------
```

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Usual Purposes of Fixed Effects

- A full set of fixed effects is common with multi-dimensional observational data
  - Multiple subscripts: panel data or other types (e.g. each person makes 8 choices)
  - Idea: fixed effects can control for some lurking variables (e.g. differences across people)
    - In our experimental data, 8 budgets have *zero* correlation with individual characteristics so coefficients are unaffected by including fixed effects (but some s.e.'s do go down)
    - Observational data: budgets would differ by individual

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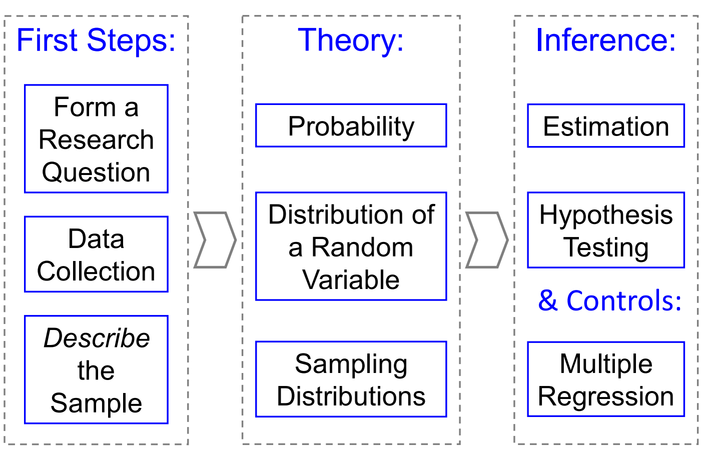
ECO220Y: Overview



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