

## Skills in Course

Econ B2000

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By the end of the class you should have the following skills (the exams will test these):

*General Outcome: Students will be able to apply mathematically rigorous analysis to topics such as analyzing data, hypothesis testing, and regression analysis.*

Before beginning the course, students are expected to know how to:

1. create and interpret basic statistics on large datasets, such as
  - mean
  - median
  - measures of spread such as standard error
2. create and interpret data tabulations including
  - crosstabs of counts and fractions
  - marginal and conditional probabilities
  - conditional means

In the course students will learn topics in these basic areas:

3. conducting hypothesis tests for equality of means and regression t-tests including
  - calculating areas under t and normal distributions
  - calculating t-values
  - getting critical values
  - creating confidence intervals
  - determining p-values
  - explaining significance test results including Type I/Type II error
4. determining regression coefficients using statistical software such as R
  - explaining the coefficient estimates as slope values
  - testing statistical significance of these estimates
  - with datasets with thousands of observations
5. estimating extensions of the basic linear regression including:
  - heteroskedasticity-consistent standard errors
  - nonlinear effects
  - binary dependent variable models, where students must be able to calculate changing marginal effects
  - other specifications and estimation techniques including quantile regression, nearest neighbor, lasso
  - instrumental variables to address endogeneity

- autocorrelation

## Examples

### Topic Area 2

Using ATUS data from 2003-2009, we look at the crosstabs of race and ethnicity; this gives the number of each group:

	Native American Indian / Inuit / Hawaiian	Asian	African-American	White	Total
Non-Hispanic	1440	2834	12385	69721	86380
Hispanic	325	77	337	11659	12398
Total	1765	2911	12722	81380	98778

The fractions of each demographic category are:

	Native American Indian / Inuit / Hawaiian	Asian	African- American	White	Total
Non-Hispanic	0.014578145	0.0286906	0.1253822	0.7058353	0.8744862
Hispanic	0.003290206	0.0007795	0.0034117	0.1180324	0.1255138
Total	0.017868351	0.0294701	0.1287939	0.8238677	

Conditional by row:

	Native American Indian / Inuit / Hawaiian	Asian	African- American	White
Non-Hispanic	0.016670526	0.0328085	0.1433781	0.8071429
Hispanic	0.026213905	0.0062107	0.0271818	0.9403936

So 14% of non-Hispanics are African-American while just 2.7% of Hispanics are African-American.

Conditional by column:

	Native American Indian / Inuit / Hawaiian	Asian	African- American	White
Non-Hispanic	0.815864023	0.9735486	0.9735105	0.8567338
Hispanic	0.184135977	0.0264514	0.0264895	0.1432662

Alternately, 97% of African-Americans are not Hispanic while just 86% of whites are not Hispanic. Native Americans are the most Hispanic ethnic group.

### Topic Areas 1 & 4

Using 2010 CPS data, restrict to only fulltime workers with a non-zero wage. Regression will have earnings (annual wage and salary) as the dependent variable.

The first set of basic explanatory variables is hypothesized to be factors such as age, sex, education, race/ethnicity, marital status, veteran status, and if a union member.

Average values of regression variables, for this subset, are:

Wage/Salary (annual)	\$	49,773.79
Age		41.88
Female		44.5%
White		79.7%
African-American		11.8%
Asian-American		5.8%
Native American/ Indian/ Alaskan/ Inuit/ Hawaiian		2.8%
Hispanic		16.1%
Mexican		9.8%
Puerto Rican		1.4%
Cuban		0.6%
Immigrant		17.5%
1 or more Parents were immigrants		23.8%
Education: no high school		8.6%
Education: High School Diploma		28.9%
Education: Some College (incl no degree or Assoc degree)		27.9%
Education: Some College but no degree		17.5%
Education: Associate in vocational		5.0%
Education: Associate in academic		5.4%
Education: 4-yr degree		22.5%
Education: Advanced Degree		12.1%
Married		62.0%
Divorced or Widowed or Separated		14.8%
Unmarried		23.2%
Union member		2.2%
Veteran (any)		7.4%

The regression estimates are made with three basic specifications: Spec 1 has just the listed variables; Spec 2 included dummies for industry, occupation, and state of residence; Spec 3 has dummy interactions for female\*age, African-American\*age, female\*African-American\*age, Hispanic\*age, female\*Hispanic\*age, and female\*education. An asterisk indicates statistical significance.

	<b>Spec 1</b>	<b>Spec 2</b>	<b>Spec 3</b>
	Coefficient	Coefficient	Coefficient
	<i>std. error</i>	<i>std. error</i>	<i>std. error</i>
Intercept	-\$28,685.56 *	\$13,744.52 *	-\$10,978.43 *
	1954.106	3025.180	3685.959

Age	\$2,517.92 *	\$2,012.04 *	\$3,052.09 *
	93.814	88.514	133.158
Age-squared	-\$23.60 *	-\$18.55 *	-\$29.40 *
	1.055	.994	1.504
Female	-\$17,380.74 *	-\$14,587.20 *	\$26,912.27 *
	360.019	393.294	4202.955
African American	-\$6,136.77 *	-\$5,315.62 *	\$17,924.27 *
	552.138	545.564	7559.610
Asian	-\$783.89	-\$3,140.09 *	-\$3,196.33 *
	861.879	851.007	849.324
Native American Indian or Alaskan or Hawaiian	-\$4,615.72 *	-\$3,077.92 *	-\$3,030.05 *
	1054.697	1025.422	1022.749
Hispanic	-\$5,176.56 *	-\$4,433.05 *	\$32,492.36 *
	596.068	588.188	5715.141
Immigrant	-\$7,377.88 *	-\$4,669.63 *	-\$4,080.20 *
	776.395	731.493	733.482
1 or more parents were immigrants	\$4,513.48 *	\$1,231.87	\$892.78
	718.087	677.532	677.771
Education: High School Diploma	\$7,658.27 *	\$3,819.68 *	\$4,208.53 *
	701.918	667.305	826.691
Education: Some College but no degree	\$15,430.94 *	\$7,791.73 *	\$9,434.14 *
	756.430	734.022	900.898
Education: Associate in vocational	\$15,719.42 *	\$8,376.06 *	\$9,873.19 *
	1003.190	966.454	1098.448
Education: Associate in academic	\$19,907.99 *	\$9,660.31 *	\$11,310.63 *
	978.304	948.764	1091.644
Education: 4-yr degree	\$35,565.50 *	\$20,756.84 *	\$24,651.87 *
	738.325	761.377	949.760
Education: Advanced Degree	\$63,729.94 *	\$40,911.95 *	\$46,708.57 *
	815.818	896.308	1109.431
Married	\$8,100.77 *	\$7,074.38 *	\$6,912.90 *
	486.083	459.856	459.565
Divorced or Widowed or Separated	\$1,646.98 *	\$1,893.12 *	\$1,881.97 *
	633.993	595.046	594.911
Union member	-\$3,992.75 *	\$2,282.96 *	\$2,372.64 *
	1169.615	1108.181	1105.552
Veteran (any)	-\$1,186.63	-\$884.41	-\$905.22
	687.786	648.453	659.002
R-squared	0.213	0.315	0.319

Sample age-wage profiles are shown below, for a white male with just a high-school diploma, unmarried, neither immigrant, veteran nor union member. The estimated peak earning year is 53 in Specification 1, 54 in Specification 2, and 52 in Specification 3.

