

1. Which of the following can cause the usual OLS t statistics to be invalid (that is, not to have t distributions under H_0)?

- i. Heteroskedasticity.
- ii. A sample correlation coefficient of .95 between two independent variables that are in the model.
- iii. Omitting an important explanatory variable.

- (i) Yes, violate the assumption of homoskedasticity
 (ii) No, it just requires the coefficient not to be 1.
 (iii) Yes, violate the 4th assumption $E(u|x) = 0$ if the omitted variable is correlated with the independent variables in the model.

2. Consider an equation to explain salaries of CEOs in terms of annual firm sales, return on equity (roe , in percentage form), and return on the firm's stock (ros , in percentage form):

$$\log(\text{salary}) = \beta_0 + \beta_1 \log(\text{sales}) + \beta_2 roe + \beta_3 ros + u.$$

- i. In terms of the model parameters, state the null hypothesis that, after controlling for $sales$ and roe , ros has no effect on CEO salary. State the alternative that better stock market performance increases a CEO's salary.

- (i) $H_0: \beta_3 = 0$
 $H_a: \beta_3 > 0$

- iii. Test the null hypothesis that ros has no effect on $salary$ against the alternative that ros has a positive effect. Carry out the test at the 10% significance level.

- (iii) $H_0: \beta_3 = 0$ significant level 10% = 0.1
 $H_a: \beta_3 > 0$ d.f = 209 - 3 - 1 = 205 > 30 use Z-score
- $$t_{\text{cri}} = 1.282$$
- $$t_{\text{cal}} = \frac{\hat{\beta}_3 - 0}{SE(\hat{\beta}_3)} = \frac{0.0024}{0.00054} = 0.44 \quad 0.44 < 1.282$$

ii. Using the data in CEOSAL1, the following equation was obtained by OLS:

$$\widehat{\log(\text{salary})} = 4.32 + .280 \log(\text{sales}) + .0174 roe + .00024 ros$$

(.32) (.035) (.0041) (.00054)

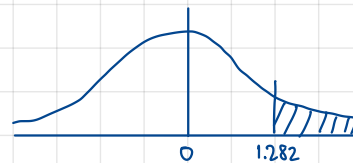
$$n = 209, R^2 = .283.$$

By what percentage is $salary$ predicted to increase if ros increases by 50 points? Does ros have a practically large effect on $salary$?

- (ii) The proportionate effect on $\widehat{\text{salary}} = 0.00024(50) = 0.012 = 1.2\%$

Therefore, a 50 point ceteris paribus increase in ros is predicted to increase salary by 1.2%.

$\therefore$ We cannot reject H_0 at 10% significant level



- iv. Would you include ros in a final model explaining CEO compensation in terms of firm performance? Explain.

Based on this sample, the estimated ros coefficient appears to be different from zero only because of sampling variation. However, if ros is very correlated with the other explanatory variables than omitting it from the regression may still bias the estimates. We can see that the other explanatory variables are still very significant even with ros included in the regression, which provides evidence against this.

C1. The following model can be used to study whether campaign expenditures affect election outcomes:

$$voteA = \beta_0 + \beta_1 \log(expendA) + \beta_2 \log(expendB) + \beta_3 prtysrA + u,$$

where $voteA$ is the percentage of the vote received by Candidate A, $expendA$ and $expendB$ are campaign expenditures by Candidates A and B, and $prtysrA$ is a measure of party strength for Candidate A (the percentage of the most recent presidential vote that went to A's party).

i. What is the interpretation of β_1 ?

$$\Delta vote A = \beta_1 \Delta \log(Expend A)$$

$$= (\beta_1 / 100) [100 \times \Delta \log(Expend A)]$$

$$\approx (\beta_1 / 100) [\% \Delta \log(Expend A)]$$

∴ $\beta_1 / 100$ is the ceteris paribus

percentage point change of vote

received when campaign expenditure

by candidate A increases by 1 percent

iii. Estimate the given model using the data in VOTE1 and report the results in usual form. Do A's expenditures affect the outcome? What about B's expenditures? Can you use these results to test the hypothesis in part (ii)?

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C1
. reg voteA lexpendA lexpendB prtysrA

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Source	SS	df	MS	Number of obs	=	173
Model	38405.1096	3	12801.7032	F(3, 169)	=	215.23
Residual	10052.1389	169	59.480112	Prob > F	=	0.0000
Total	48457.2486	172	281.728189	R-squared	=	0.7926
				Adj R-squared	=	0.7889
				Root MSE	=	7.7123

voteA	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
lexpendA	6.083316	.38215	15.92	0.000	5.328914 6.837719
lexpendB	-6.615417	.3788203	-17.46	0.000	-7.363246 -5.867588
prtysrA	.1519574	.0620181	2.45	0.015	.0295274 .2743873
_cons	45.07893	3.926305	11.48	0.000	37.32801 52.82985

ii. In terms of the parameters, state the null hypothesis that a 1% increase in A's expenditures is offset by a 1% increase in B's expenditures.

$$H_0: \beta_2 = -\beta_1$$

$$H_a: \beta_2 \neq -\beta_1$$

iv. Estimate a model that directly gives the t statistic for testing the hypothesis in part (ii). What do you conclude? (Use a two-sided alternative.)

reWrite hypothesis $\theta_1 = \beta_1 + \beta_2 \Rightarrow H_0: \theta_1 = 0 \quad H_a: \theta_1 \neq 0$

$$\text{rearrange} \quad \hat{vote A} = \beta_0 + \theta_1 \log(Expend A) + \beta_2 [\log(Expend B) - \log(Expend A)] + \beta_3 prtysrA$$

when estimate equation we obtain $\hat{\beta}_1 \approx -0.532$

$$se(\hat{\beta}_1) \approx 0.533$$

$$\text{then } t_{cal} = \frac{-0.532 - 0}{0.533} \approx -1 \quad \therefore \text{cannot reject } H_0 \beta_2 = -\beta_1$$

regression model in usual form :

$$Vote A = (11.48) + (15.92) \log(Expend A) - (17.46) \log(Expend B)$$

$$+ 0.152 (prtysrA) \\ (2.45)$$

C6. Use the data in WAGE2 for this exercise.

i. Consider the standard wage equation

$$\log(wage) = \beta_0 + \beta_1 educ + \beta_2 exper + \beta_3 tenure + u.$$

State the null hypothesis that another year of general workforce experience has the same effect on $\log(wage)$ as another year of tenure with the current employer.

$$(i) H_0: \beta_2 = \beta_3$$

ii. Test the null hypothesis in part (i) against a two-sided alternative, at the 5% significance level, by constructing a 95% confidence interval. What do you conclude?

(ii) α is insignificant at a 95% confidence interval, Thus we can't reject H_0 . We can conclude that one additional year of general workforce experience has the same effect on $\log(wage)$ as another year.

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. reg lwage educ exper tenure

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Source	SS	df	MS	Number of obs	=	935
Model	25.6953242	3	8.56510806	F(3, 931)	=	56.97
Residual	139.960959	931	.150334005	Prob > F	=	0.0000
Total	165.656283	934	.177362188	R-squared	=	0.1551
				Adj R-squared	=	0.1524
				Root MSE	=	.38773

lwage	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
educ	.0748638	.0065124	11.50	0.000	.062083 .0876446
exper	.0153285	.0033696	4.55	0.000	.0087156 .0219413
tenure	.0133748	.0025872	5.17	0.000	.0082974 .0184522
_cons	5.496696	.1105282	49.73	0.000	5.279782 5.713609

C8. The data set 401KSUBS contains information on net financial wealth (*nettfa*), age of the survey respondent (*age*), annual family income (*inc*), family size (*fsize*), and participation in certain pension plans for people in the United States. The wealth and income variables are both recorded in thousands of dollars. For this question, use only the data for single-person households (so $fsize = 1$).

i. How many single-person households are there in the data set?

2017 observations

ii. Use OLS to estimate the model

$$nettfa = \beta_0 + \beta_1 inc + \beta_2 age + u,$$

and report the results using the usual format. Be sure to use only the single-person households in the sample. Interpret the slope coefficients. Are there any surprises in the slope estimates?

$\hat{\beta}_1$ can be interpreted as a \$1000 increase in income corresponds to a \$799 increase in net financial wealth. We interpret $\hat{\beta}_2$ as a 1 year increase in age corresponds to a \$842 increase in net financial wealth.

iii. Does the intercept from the regression in part (ii) have an interesting meaning? Explain.

$$\hat{\beta}_0 = -43.04$$

This is an individual's net financial wealth when their income is \$0 and their age is 0. In other words, a net financial wealth of newborn babies.

iv. Find the p -value for the test $H_0: \beta_2 = 1$ against $H_1: \beta_2 < 1$. Do you reject H_0 at the 1% significance level?

$$t\text{-statistic} = (0.843 - 1 / 0.092) \approx -1.71$$

Against the one-sided alternative $H_1: \beta_2 < 1$

$\therefore$ reject the null hypothesis at the end of the 5% significance level but not at the 1% sig level.

v. If you do a simple regression of *nettfa* on *inc*, is the estimated coefficient on *inc* much different from the estimate in part (ii)? Why or why not?

We get an estimate of $\hat{\beta}_1 = 0.821$ which is not very different from the estimate of 0.799 in the last regression. Since this is an omitted variable question we need to know the correlation between age and income, which we find to be only 0.039. This explains why the coefficient does not change.

C.8

. reg nettfa inc age if fsize ==1

Source	SS	df	MS	Number of obs	=	2,017
Model	544916.989	2	272458.495	F(2, 2014)	=	136.46
Residual	4021048.06	2,014	1996.54819	Prob > F	=	0.0000
				R-squared	=	0.1193
				Adj R-squared	=	0.1185
Total	4565965.05	2,016	2264.86361	Root MSE	=	44.683

nettfa	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
inc	.7993167	.0597307	13.38	0.000	.6821762 .9164572
age	.8426563	.0920169	9.16	0.000	.6621982 1.023115
_cons	-43.03981	4.080393	-10.55	0.000	-51.04204 -35.03758