ECON 3161 Fall 2023

Homework 4

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- **Instruction: There are 60 points in total. This homework needs computer coding. Stata software is recommended, but you can use other software you prefer. Please copy and paste your code to the end of your answer file. Then upload your answer file on canvas.**

1.) The following model is used to study whether campaign expenditures affect election outcomes:

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

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

(i) (5 pts) What is the interpretation of β_1?

Solution: It indicates the expected change in the percentage of votes received by Candidate A for a one-unit increase in the natural logarithm of the campaign expenditures of Candidate A ($expendA$), holding other variables constant. In simpler terms, it measures the effect on Candidate A's vote percentage for a certain percentage change in their campaign expenditure, taking into account the other variables in the model.

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

voteA	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
log_expendA	6.083316	.38215	15.92	0.000	5.328914	6.837719
log_expendB	-6.615417	.3788203	-17.46	0.000	-7.363246	-5.867588
prtystrA	.1519574	.0620181	2.45	0.015	.0295274	.2743873
_cons	45.07893	3.926305	11.48	0.000	37.32801	52.82985

(ii) (8 pts) Find the p-value for the test $H_0 : \beta_1 = 0$ against $H_a : \beta_1 \neq 0$. Do you reject the H_0 at the 1% significance level? (Hint: you can look at the p-value in the regression output or use test command in stata to do the test. More detail about the test command can be found here: https://www.stata.com/manuals13/rtest.pdf. You can look at the examples on page 5–8.)

Solution: We can reject the H_0 at the 1% significance level because $p = 0.0000 < 0.01$.

(iii) (5 pts) Give the 95% confidence interval for β_3. (Hint: this can be seen from the regression output)

Solution: The C.I. for β_3 is approximately $[0.0295, 0.2744]$

(iv) (5 pts) 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.

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

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. test (log_expendA + log_expendB = 0)

 ( 1)  log_expendA + log_expendB = 0

       F(  1,   169) =    1.00
            Prob > F =    0.3196
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(v) (5 pts) Estimate a model that directly give the t statistic for testing the hypothesis in question 4. What do you conclude? (Use a two-sided alternative and 5% significance level. Hint: this is a test of a single linear combination of the parameters.)

Solution: From here, we can see the t-statistic is $\sqrt{1.00} = 1.00$. Knowing the p-value is 0.3196, we cannot reject the null hypothese because $p = 0.3196 \not< 0.05$

(vi) Now suppose you want to test if candidate A's expenditure, candidate B's expenditures and the party strength jointly statistically significant, answer the following questions:

(a) (5 pts) What test will you use?

Solution: To test if candidate A's expenditure, candidate B's expenditures, and the party strength are jointly statistically significant, we can use the F-test.

(b) (6 pts) Write down your null hypothesis and alternative hypothesis.

Solution: $H_0 : \beta_1 = 0, \beta_2 = 0, \beta_3 = 0 vs. H_a : \beta_j \neq 0$ for at least one $j = 1, 2, 3$

(c) (8 pts) Write down your restricted and unrestricted models.

Solution:

Restricted: $voteA = \beta_0 + u$

Unrestricted: $voteA = \beta_0 + \beta_1 log(expendA) + \beta_2 log(expendB) + \beta_3 prtystrA + u$

(d) (8 pts) Write down your test statistic. What is the distribution of the test statistic?

Solution: $F = \frac{SSR(\text{Restricted}) - SSR(\text{Unrestricted})}{q} \div \frac{SSR(\text{Unrestricted})}{n-k-1}$

q is the number of restrictions, n is the number of observations, and k is the number of regressors (including the intercept).

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. test (lexpendA=0) (lexpendB=0) (prtystrA=0)

 ( 1)  lexpendA = 0
 ( 2)  lexpendB = 0
 ( 3)  prtystrA = 0

       F(  3,   169) =  215.23
            Prob > F =    0.0000
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(e) (5 pts) Conduct your test. Will you reject the H_0 at 5% significance level? (Hint: you can look at the p-value in the regression output or use test command in stata to do the test.)

Solution: From here, we can see the p-value is 0.0000, so we reject the null hypothese because $p = 0.0000 < 0.05$.