Tutorial 7

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12/04/2019

Part A

Question 1: Calculating growth rates

There are two ways to calculate a growth rate/return:

1. Simple growth rate/return

$$R_t = \frac{P_t - P_{t-1}}{P_{t-1}}$$

2. Logarithmic growth rate/return

$$r_t = \ln(\frac{P_t}{P_{t-1}}) = \ln(P_t) - \ln(P_{t-1}) = \Delta \ln(P_t)$$

Question 1: Annualising growth rates

There are also two ways to annualise growth rates/returns

1. Multiplying by number of periods in a year, for example

$$r^*_{t,simple} = r_t \times 4$$

2. Compounding (geometric average)

$$r^*_{t,compound} = (1 + r_t)^4 - 1$$

Question 2: Assumption E.1 linear in parameters

This assumption means that the linear regression can be written in the form $\mathbf{y} = \mathbf{X}\beta + \mathbf{u}$. Without it holding OLS is not possible at all.

- This does not rule out the use of non-linear *variables* e.g. $x^2, x^3, \sin(x), \ln(x)$ etc.
- But we cannot have non-linear relationships in our βs

Examples where this is violated:

- $y = \beta_0 + \beta_1 x_1 + \sqrt{\beta_1} x_2 + u$
- $y = \beta_0 + \beta_1 x_1 + \beta_1 \beta_2 x_2 + u$

While an equation may appear non-linear in parameters, it can be sometimes transformed to become linear in parameters.

Question 3

Part B

Question 1a

This tutorial will investigate the relationship between campaign expenditure and probability of winning a competitive seat for two different candidates A and B. We will call A the "candidate" and B the "opponent"

- Open up the vote.wf1 workfile and estimate a regression of the form
  $votea = \beta_0 + \beta_1 \ln(expenda) + \beta_2 \ln(expendb) + \beta_3 democa + u$
- How do we interpret the coefficient $\hat{\beta}_1$?
- https://flux.qa/LDPPHD
- Why is $\hat{\beta}_2$ negative?

Interpretation of logarithms

Log of a dependent variable

- $\ln(y) = \beta_0 + \beta_1 x$
- $100\beta_1 \approx \%\Delta y$ for a one unit change in x

For example let $\ln(y = 9 + 0.04x$ and $x_1 = 2$, $x_2 = 3$

- $\Delta x = x_2 - x_1 = 1$
- Approximate percentage change in y is $0.04 \times 100\% = 4\%$ i.e. $\%\Delta y \approx 4\%$

Interpretation of logarithms

Log of an independent variable

- $y = \beta_0 + \beta_1 \ln(x)$
- $\beta_1/100 \approx \Delta y$ for a one percent change in x

For example let $y = -4 + 15.34 \ln(x)$ and $x_1 = 200$, $x_2 = 202$

- $\%\Delta x = \frac{x_2 - x_1}{x_1} = 1\%$
- Approximate change in y is $15.34/100 = 0.1534$

Question 1b

Test the overall significance of the model using an F-test with a significance level of $\alpha = 0.01$.

What is the value of the F-stat? Hint: use the formula below

$$F_{stat} = \frac{R^2/k}{(1-R^2)/(n-k-1)}$$

https://flux.qa/LDPPHD

F-stat formulas

Two ways of calculating the F-stat.

1. Using SSR,
$$F = \frac{(SSR_r - SSR_{ur})/q}{SSR_{ur}/(n-k-1)}$$
2. Using R^2,
$$F = \frac{(R^2_{ur} - R^2_r)/q}{(1-R^2_{ur})/(n-k-1)}$$

The formula for testing overall signficance in 1b is a special case of 2.

- The restricted model is $y = \beta_0 + u$
- It's R^2 is *always* 0, so $R^2_r = 0$ and it drops out of the formula
- We're testing $H_0 : \beta_1 = \beta_2 = \cdots = \beta_k = 0$ so the number of restrictions is $q = k$

Question 1c

Test the hypothesis that controlling for campaign expenditure, being a democratic candidate is not significant in predicting the vote percentage at the 5% level. Use two methods:

1. Compare the t-stat with the appropriate critical value
2. Compare the p-value with the significance level

Question 1d

Test the *joint* hypothesis that controlling for campaign expenditure, being a democratic candidate is not significant in predicting the vote percentage AND that the effect of every percentage change in expenditure by A on the vote percentage can be completely offset by the same percentage change in expenditure by B.

- What is the null hypothesis? https://flux.qa/LDPPHD

Question 1d: continued

The unrestricted (full) model is

$$votea = \beta_0 + \beta_1 \ln(expenda) + \beta_2 \ln(expendb) + \beta_3 democa + u$$

What form should the restricted model take so we can conduct an F-test?

- Remember the restricted model is a special case of the full model in which $H_0 : \beta_1 = -\beta_2, \beta_3 = 0$ is true.

Question 1e

Now drop democa from the model and test the alternative hypothesis that if the opponent (B) increases their expenditure by 1%, then the candidate (A) will have to increase their expenditure by more than 1% to offset the effect on the vote share that the candidate (A) receives.

- If H1 is true, when the opponent (B) increases their expenditure by 1%, then the candidate (A) will have to increase their expenditure by *more than* 1% to maintain the current vote share
- The opponent's (B) expenditure is more powerful than the candidate's (A) expenditure
- The magnitude of β_2 is greater than β_1
- But since the sign of β_2 is negative (if B increases expenditure, then A will lose vote share) we want to test the alternative that $\beta_1 + \beta_2 < 0$
- i.e. β_2 is more negative than β_1 is positive