THE AUSTRALIAN NATIONAL UNIVERSITY

First Semester Practice Final Examination– June, 2024

Econometric Methods

(EMET 2007/4007/6007)

Reading Time: 0 Minutes
Writing Time: 120 Minutes

Instructions

- There are 3 exam questions, each counting 20 raw marks.
- Maximum total raw mark is 60.
- For the calculation of your total course mark, the raw mark on you final exam will be multiplied by 2/3 (because the final exam counts 40% among all assessment items).
- Hurdle requirement:
  You need to attain a minimal raw mark of 12 to pass the course
  (to satisfy the 20% hurdle requirement stipulated in the class summary).
- Answer all exam questions.
- Provide complete and self-contained answers.
- Do not merely state results. You are expected to show your work!
  (Exception: when I explicitly ask to ”state” a result.)
- Permitted material: pen, nothing else.
- Good luck!

Beginning of Exam Questions

Question 1

You study the effect of media consumption on cognitive development (as measured by a standardized math score) for Australian teenagers. Media consumption (for example: watching TV, using social media, Playstation) may affect a child's learning. You investigate the research question: Is media consumption negatively associated with math scores?

You have available sample data on test score, media consumption, and other demographic characteristics for 8,764 Australian teenagers for the year 2018. The data are drawn from the Longitudinal Survey of Australian Children (LSAC).

Here a brief description of some of the variables:

– `mathscr`: respondent's score on a standardized math test (between 0 and 600)

– `mediahrs`: respondent's average daily media consumption in hours

– `male`: dummy equal 1 if respondent identifies as male

Use the following `Python` output (partially edited) to answer the questions below.

PYTHON CODE AND OUTPUT

```
> formula = 'mathscr ~ mediahrs * male'
> reg = smf.ols(formula, data=df, missing='drop').fit(cov_type='HC1', use_t=False)
> print(reg.summary())

================================================================================
                     coef    std err          z      P>|z|     [0.025      0.975]
--------------------------------------------------------------------------------
Intercept        531.2458     11.868     44.763     <2e-16    507.985     554.507
mediahrs          -2.2392     xxxxxx     xxxxxx      0.050    xxxxxxx     xxxxxxx
male              -0.0232      0.008     -2.942      0.003     -0.039      -0.008
mediahrs:male     -1.2766      0.967     -1.324      0.187     -3.172       0.619
================================================================================
```

(a) [3 marks] Interpret and discuss the coefficient estimate for `male`. Is it statistically significant?

(b) [5 marks] Determine the t-statistic for `mediahrs`.

(c) [5 marks] Interpret and discuss the coefficient estimate for the interaction term.

(d) [7 marks] Consider your estimate of the effect of media consumption on math scores. Give an example of an omitted variable that could bias the above results. If this variable would be included, how would you expect your estimates to change? Explain.

Question 2

Are the following statements true or false? Provide a brief and complete explanation. (Note: you will not receive any credit without providing a correct explanation.)

(a) [5 marks]

In the multiple regression model, omitting an explanatory variable may not necessarily lead to omitted variables bias.

(b) [5 marks]

In autoregressions, allowing for additional lags (that is, increasing p in the AR(p) model) increases R^2.

(c) [5 marks]

Given a random sample $Y_1, \ldots, Y_{10}$, the following two estimators are equally good for estimating $\mathrm{E}(Y_7)$:

- the simple average of Y_1 and Y_{10};
- $2/3 \cdot Y_6 + 1/3 \cdot Y_9$.

(d) [5 marks]

In the simple regression model, if $\beta_1 = 0$, then $\hat{\beta}_0 = \bar{Y}$.

Question 3

Consider the linear regression model

$$Y_i = \beta_1 X_{1i} + \beta_2 X_{2i} + u_i, \qquad \beta_1 \neq 0.$$

(a) [10 marks]

Suppose that $\beta_2 = 0$. Define and derive the OLS estimator of β_1. Prove that this estimator is unbiased. Explicitly state any additional assumptions that you may need to establish unbiasedness.

(b) [10 marks]

Now suppose that $\beta_2 \neq 0$. Under which circumstances is

$$\hat{\beta}_1 = \frac{\sum_{i=1}^{n} X_{1i} Y_i}{\sum_{i=1}^{n} X_{1i}^2}?$$

Provide a complete proof.

End of Exam Questions