ECN6540 ECONOMETRIC METHODS – COURSEWORK 2022

The answers to the questions must be type-written. The preference is that symbols and equations should be inserted into the document using the equation editor in Word. Alternatively, they can be scanned and inserted as an image (providing it is clear and readable). Maximum words 1,500 excluding any Stata output and commands.

The coursework comprises two questions where the second is a short Stata assignment. Both questions 1 and 2 carry equal weight and the marks shown within each question indicate the weighting given to component sections. Any calculations must show all workings otherwise full marks will not be awarded.

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ANSWER ALL QUESTIONS SET.

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1. a. In the following regression model $Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \varepsilon_i$ (where i denotes the unit of observation) under the scenario that the two independent variables X_1 and X_2 are highly collinear:

i) provide an algebraic expression for the correlation coefficient between the two independent variables; [5 marks]

ii) explain, using the appropriate formula, the effect of high collinearity on the standard errors of the parameter estimates and on the t-statistics. [5 marks]

b. The following sums were obtained from a sample of 240 time series observations (i.e. t=1,2,…,240) on the variables Y and X.

$$\sum Y_t = 144,\ \sum X_t = 216,\ \sum Y_t^2 = 888,\ \sum X_t^2 = 2160,\ \sum X_t Y_t = 1080$$

i) Calculate the least squares estimates of the intercept and slope parameters in the regression model: $Y_t = \beta_0 + \beta_1 X_t + \varepsilon_t$ [15 marks]

ii) Briefly explain the assumption of no autocorrelation in the context of the error term ε_t. [5 marks]

iii) Explain the consequences of $corr(X_t, \varepsilon_t) \neq 0$. [5 marks]

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c. Using Chinese data over the period 2006 quarter 1 to 2012 quarter 4 sales are modelled as a function of lagged sales, disposable income, consumer confidence, and seasonal effects:

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$$sales_t = \beta_0 + \beta_1 sales_{t-1} + \beta_2 \log(Y)_t + \beta_3 \left(\frac{1}{cc}\right)_t + \sum_{k=2}^{4} \delta_k d_{kt} + \epsilon_t$$

Variable Definitions

sales	=	nominal sales (in ¥ million)
log(Y)	=	Natural logarithm of nominal income
recip_cc	=	1 ÷ [consumer confidence, cc] (%)
d_2	=	1 if second quarter of year; 0 otherwise
d_3	=	1 if third quarter of year; 0 otherwise
d_4	=	1 if fourth quarter of year; 0 otherwise

After undertaking auxiliary regressions the following ANOVA results were obtained in Stata. 'L' denotes the lag operator.

```
regress L.sales logY recip_cc d2 d3 d4

      Source |       SS           df       MS
-------------+----------------------------------
       Model |  10605.7128
    Residual |  1884.14964
-------------+----------------------------------
       Total |
```

```
regress logY L.sales recip_cc d2 d3 d4

      Source |       SS           df       MS
-------------+----------------------------------
       Model |    .05355609
    Residual |
-------------+----------------------------------
       Total |   .102314625


regress recip_cc L.sales logY d2 d3 d4

      Source |       SS           df       MS
-------------+----------------------------------
       Model |
    Residual |   .000022837
-------------+----------------------------------
       Total |   .000045554
```

Calculate the R-squared and the variance inflation factor (VIF) associated with each auxiliary regression. Discuss the implications of the value of the VIFs for OLS analysis and potential solutions. [10 marks]

d. The following Stata output shows the results of estimating the model from part (c) and sample means of continuous variables.

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i) Calculate the slope and elasticity associated with income and consumer confidence, based at the sample mean. [10 marks]

ii) Explain why a reciprocal functional form is used. [5 marks]

iii) What does the estimate on the lagged dependent variable imply? [5 marks]

iv) Test for autocorrelation at the 5% level. [20 marks]

v) Interpret the seasonal (quarterly) effects. Rewrite the model in part (c) to allow for a *concurrent* regression and explain in detail how this could be tested. [15 marks]

```
regress sales L.sales logY recip_cc d2 d3 d4

      Source |       SS           df       MS
-------------+----------------------------------
       Model |  11816.1851         6  1969.36419
    Residual |  1195.78871        20  59.7894355
-------------+----------------------------------
       Total |  13011.9738        26  500.460532
------------------------------------------------------------------------------
       sales | Coefficient  Std. err.      t    P>|t|
-------------+----------------------------------------------------------------
       sales |
         L1. |    .220576                1.24
             |
        logY |   98.99456   35.01764     2.83   0.010
    recip_cc |   -4616.62   1618.058    -2.85   0.010
          d2 |   23.94257   10.42623     2.30   0.033
          d3 |   32.59669   8.305721     3.92   0.001
          d4 |   63.50859   6.105048    10.40   0.000
       _cons |  -371.7605    144.322    -2.58   0.018
------------------------------------------------------------------------------

Durbin-Watson d-statistic(  7,    27) =  1.929705
```

```
sum sales L.sales logY cc recip_cc

    Variable |        Obs        Mean    Std. dev.
-------------+---------------------------------------
       sales |
         --. |         28    98.12636    23.61535
         L1. |         27    96.28344    21.91756
             |
        logY |         28    4.532284    .0645629
          cc |         28    160.7179    26.71612
    recip_cc |         28    .0064294    .0013157
```

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STATA ASSIGNMENT

2. The following data set "wages.dta" is cross sectional based upon 2,220 individuals in 2020 from the U.S. The variables in the data are:

wage	=	hourly wage rate in cents
educ	=	years of schooling of the individual
fatheduc	=	father's years of schooling
motheduc	=	mother's years of schooling
black	=	dummy variable (0 white, 1 black)
IQ	=	Intelligence score
married	=	dummy variable (0 unmarried, 1 married)
exper	=	years of labour market experience

Load the data into Stata. Then type the following commands:

```
set seed 200212232
replace wage=wage*abs(rnormal(0,1))
```

where the number after "set seed" is your student registration number e.g. 200212232 (this ensures that each student has unique data). Next save your data as "ECN6540_Assignment_mydata.dta". It is important that you work with this file if you close and reopen Stata at a later date.

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a. Load your unique data from the file "ECN6540_Assignment_mydata.dta". Using a semi-log wage specification estimate a wage equation where YOU choose the independent variables BUT THESE MUST include, "black", "married", "educ", "fatheduc" and "motheduc" at a minimum. [5 marks]

b. Interpret the estimated parameters of your model. [10 marks]

c. Test whether the individual parameters estimated are individually statistically significant and jointly statistically significant BY HAND and then compare with the Stata output. [15 marks]

d. Test your estimated model for heteroscedasticity using the WHITE test BY HAND (without using any inbuilt Stata test commands). [20 marks]

e. Use tsset id in order to set "id" as the time series identifier (although note that the data is cross sectional). Test whether the model estimated in part (a) exhibits auto correlation at the 5% level. What does this result imply? [5 marks]

f. Test whether the parameters associated with "`fatheduc`" and "`motheduc`" in part (a) are equal to unity at the 5% level BY HAND (without using any inbuilt Stata test commands). Use Stata to construct the appropriate RSS. [15 marks]

g. Using your initial model from part (a) test whether "`black`" and "`married`" individuals exhibit different returns to education ("`educ`") at the 1% level BY HAND (without using any inbuilt Stata test commands). Use Stata to construct the appropriate RSS. [20 marks]

h. At the end of your document provide the text from your Stata *.do file. [10 marks]

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