University of the West of England
BRISTOL

Bristol Business School

Academic Year: 07/08
Examination Period: January 2008

Module Leader: Paul Dunne
Module Code: UMEN3P-15-M
Title of Module: Econometrics

Examination Date: 16 January 2007
Examination Start time: 13:30
Duration of Examination: 2 Hour(s)

Instructions to Students:

Answer Question One in Section A and 2 other questions from Section B

Section A is worth 40% of the marks
Section B is worth 60% of the marks

Materials supplied to the student will be:

Number of Examination Booklets (+ any continuation booklets as required) per Examination	1
Number of Pre-printed OMR (Multiple Choice Answer Sheet)	0
Number of sheets of Graph Paper size G3 (Normal)	0

Additional Instruction to Invigilators:

Calculators May be used subject to University regulations	Yes
Students allowed to keep Examination Question Paper	No
Material supplied by student allowed (must be collected with answer booklet) please specify:	No
Additional Specialised Material : Tables of F and χ^2 distributions	

Treasury tags & adhesive triangles will be supplied as standard

Answer Question 1 in section A and 2 other questions from Section B

Section A - Compulsory: Worth 40% of the marks

Question One

Consider the following estimation results from Microfit:

```
                    Ordinary Least Squares Estimation
*******************************************************************************
 Dependent variable is LC
 49 observations used for estimation from 1950 to 1998
*******************************************************************************
 Regressor              Coefficient       Standard Error         T-Ratio[Prob]
 C                          .48291            .27276             1.7705[.084]
 LC(-1)                    1.3006             .15514             8.3835[.000]
 LC(-2)                   -.52965             .14277            -3.7098[.001]
 LY                         .53920            .077867            6.9246[.000]
 LY(-1)                   -.58446             .13664            -4.2775[.000]
 LY(-2)                    .23525             .11179             2.1045[.042]
 LP                       -.16115            .079246            -2.0335[.049]
 LP(-1)                    .23680             .15905             1.4888[.144]
 LP(-2)                  -.070647            .086534            -.81640[.419]
*******************************************************************************
 R-Squared                    .99933   R-Bar-Squared                   .99920
 S.E. of Regression         .0097335   F-stat.    F(  8,  40)    7476.0[.000]
 Mean of Dependent Variable  12.4349   S.D. of Dependent Variable      .34370
 Residual Sum of Squares    .0037896   Equation Log-likelihood       162.4210
 Akaike Info. Criterion     153.4210   Schwarz Bayesian Criterion    144.9078
 DW-statistic                 2.0276
*******************************************************************************


                              Diagnostic Tests
*******************************************************************************
*    Test Statistics  *        LM Version        *         F Version          *
*******************************************************************************
*                     *                          *                            *
* A:Serial Correlation*CHSQ(   1)=   .54504[.460]*F(   1,  39)=   .43868[.512]*
*                     *                          *                            *
* B:Functional Form   *CHSQ(   1)=  .062481[.803]*F(   1,  39)=  .049793[.825]*
*                     *                          *                            *
* C:Normality         *CHSQ(   2)=   .37664[.828]*       Not applicable       *
*                     *                          *                            *
* D:Heteroscedasticity*CHSQ(   1)=   5.3569[.021]*F(   1,  47)=   5.7690[.020]*
*******************************************************************************
   A:Lagrange multiplier test of residual serial correlation
   B:Ramsey's RESET test using the square of the fitted values
   C:Based on a test of skewness and kurtosis of residuals
   D:Based on the regression of squared residuals on squared fitted values
```

Where:

C: Constant
LC: Log of real consumers' expenditure in 1995 prices
LY: log of real personal disposable income in 1995 prices
LP: log of the consumer price index

a.) Briefly explain what the results tell us about the determination of consumption. (25%)

b.) Briefly explain the meaning of the t ratios, the F-statistic, R-Squared, the DW statistic and the Residual Sum of Squares. (25%)

c.) Briefly explain what diagnostic test A, diagnostic test B, and diagnostic test D are and what they tell us. (20%)

d.) Explain the following tests and what they tell us. (30%)

```
                      Variable Deletion Test (OLS case)
********************************************************************************
 Dependent variable is LC
 List of the variables deleted from the regression:
 LC(-2)          LY(-2)          LP(-2)
 49 observations used for estimation from 1950 to 1998
********************************************************************************
 Regressor              Coefficient       Standard Error         T-Ratio[Prob]
 C                          .30872            .27655            1.1163[.270]
 LC(-1)                     .83282           .085468            9.7443[.000]
 LY                         .60970           .080826            7.5434[.000]
 LY(-1)                    -.46692           .094574           -4.9371[.000]
 LP                        -.11257           .040813           -2.7583[.008]
 LP(-1)                     .11617           .040212            2.8890[.006]
********************************************************************************
 Joint test of zero restrictions on the coefficients of deleted variables:
 Lagrange Multiplier Statistic     CHSQ( 3)=  13.1064[.004]
 Likelihood Ratio Statistic        CHSQ( 3)=  15.2518[.002]
 F Statistic                   F(  3,  40)=   4.8686[.006]
********************************************************************************


              Wald test of restriction(s) imposed on parameters
********************************************************************************
 Based on  OLS regression of LC on:
 C               LC(-1)          LC(-2)          LY              LY(-1)
 LY(-2)          LP              LP(-1)          LP(-2)
 49 observations used for estimation from 1950 to 1998
********************************************************************************
 Coefficients A1 to A9 are assigned to the above regressors respectively.
 List of restriction(s) for the Wald test:
 a9=0;a8=-a7
********************************************************************************
 Wald Statistic                CHSQ( 2)=   1.9893[.370]
********************************************************************************
```

Section B - Choose 2 Questions

Question Two

In the following linear model:

$$y_t = \alpha + \beta x_t + u_t$$

a.) Derive the least squares estimator of β and show it is equivalent to the maximum likelihood estimator when $u_t \sim N(0, \sigma^2)$. (40%)

b.) Show that the least squares estimator of β is unbiased. (30%)

c.) Discuss how the results in sections a and b would be affected if a lagged dependent variable was introduced into the equation. (30%)

Question Three

a.) Define a stationary process. Explain what it means for variables to be I(0), I(1) and I(2). (30%)

b.) Explain in detail what the tables below tell us about the variable LC (Log of real consumers' expenditure in 1995 prices) and GC which is the first difference of LC. (40%)

Unit root tests for variable LC

The Dickey-Fuller regressions include an intercept and a linear trend

44 observations used in the estimation of all ADF regressions.
Sample period from 1955 to 1998

Test Statistic	LL	AIC	SBC	HQC
DF -1.8859	116.6918	113.6918	111.0155	112.6993
ADF(1) -3.3177	124.5943	120.5943	117.0259	119.2710
ADF(2) -2.7248	124.6959	119.6959	115.2355	118.0418
ADF(3) -2.4175	124.7031	118.7031	113.3505	116.7181
ADF(4) -2.1918	124.7053	117.7053	111.4607	115.3895
ADF(5) -2.7282	126.5430	118.5430	111.4062	115.8963
ADF(6) -2.2201	126.7560	117.7560	109.7271	114.7785

95% critical value for the augmented Dickey-Fuller statistic = -3.5136
LL = Maximized log-likelihood AIC = Akaike Information Criterion
SBC = Schwarz Bayesian Criterion HQC = Hannan-Quinn Criterion

Unit root tests for variable GC

The Dickey-Fuller regressions include an intercept but not a trend

43 observations used in the estimation of all ADF regressions.

```
Sample period from 1956 to 1998
        Test Statistic      LL          AIC          SBC          HQC
DF          -4.1475      116.2008     114.2008     112.4396     113.5513
ADF(1)      -4.5662      117.8868     114.8868     112.2450     113.9125
ADF(2)      -4.2954      118.4034     114.4034     110.8810     113.1044
ADF(3)      -3.9860      118.7766     113.7766     109.3736     112.1529
ADF(4)      -2.9209      119.1309     113.1309     107.8473     111.1825
ADF(5)      -3.3518      120.5139     113.5139     107.3497     111.2407
ADF(6)      -3.0121      120.5444     112.5444     105.4996     109.9464
*************************************************************************
95% critical value for the augmented Dickey-Fuller statistic =  -2.9303
LL  = Maximized log-likelihood      AIC = Akaike Information Criterion
SBC = Schwarz Bayesian Criterion    HQC = Hannan-Quinn Criterion
```

c.) Explain what cointegration is and how you would test for it using the Engle-Granger method. How would your answer change if you were dealing with more than 2 variables? (30%)

Question Four

Consider:

$$Y_t = BX_t^{\beta 1} X_{t-1}^{\beta 2} Y_{t-1}^{\beta 3}$$

a.) Show how you would transform this model to estimate it by OLS, making it an ARDL(1,1) model. Show at least 3 dynamic models that are nested in the first order general dynamic model. (40%)

b.) Derive the static long run equilibrium of the equations in part a. (40%)

c.) Give an example of a dynamic model which may have both a short and a long run theoretical interpretation. (20%)

Question Five

Consider the demand and supply model:

$$Q^d_t = \delta_0 + \delta_1 P_t + u_{1t}$$

$$Q^s_t = \gamma_0 + \gamma_1 P_t + \gamma_2 Y_t + \gamma_3 W_t + u_{2t}$$

$$Q^d_t = Q^s_t$$

where Q^d is the quantity demanded of a good, Q^s the quantity supplied, P the price of the good, Y income, W the weather conditions and u_{1t} and u_{2t} are white noise errors.

(a) Assess the identification of the equations with reference to the rank and order conditions. (50%)

(b) Derive the reduced form of the system and show how indirect least squares can be used to get estimates of the structural parameters. (50%)

Question Six

Consider the following model

$$y_t = a + \beta x_t + u_t$$

where $E(u_t) = 0$
$E(u_t) = \sigma^2$
$E(u_s, u_t) \neq 0 \ \forall s \neq t$

a.) What problems would least squares estimators of this model have and what are the likely causes? (40%)

b.) Explain the methods by which you could test for first order serial correlation and then for higher order serial correlation. (40%)

c.) How would your answers change if there was a lagged dependent variable? (20%)

Question Seven

Explain what heteroscedasticity is and how you might test for it. (60%)
If you found evidence of heteroscedasticity in an estimated model how would you proceed? (40%)

Question Eight

Discuss in detail the relationship between the Wald, LR and LM principles of constructing test statistics and their use in specification testing in time series models.