

**USING TIME SERIES ECONOMETRICS:
A HANDS ON INTRODUCTION
AND REFRESHER COURSE.**

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Contents

Part 1: General Information

Part 2: Reading List and Course Outline

- Reading List and Advice
- Lecture and Workshop Outlines

Part 3: Internet Resources

- Course Website
- Suggestions for Improvement

Part 4: Applied Exercises

- Exercise 1
- Exercise 2
- Exercise 3: CAPM
- Exercise 4

1. General Information

Sessions: Wednesday 2.30 from February 26th 2003 for 6 weeks

Location: Room 3E12 and nearby computer room

Organisation: Wednesday: just over an hour lecture and then 1 hour working on the computers doing exercises.

Lecturer: Paul Dunne, room 3D22 extension 2053

Aims/Objectives:

To provide an introduction and/or refresher course in Econometrics and so to provide participants with the skills and knowledge to undertake empirical research. Good recent econometric practice is emphasised throughout.

Reading List and Advice

Principal Texts

There are many textbooks, which can be used. It is worth having a look at them and finding the one that best suits your individual requirements. Those who have done an undergraduate econometric course might consider following the topics in one of the more advanced texts.

You should review basic Maths and Stats in the textbooks.

See: Thomas Ch 1 to 5, Salvatore Ch 1 to 5, Gujarati Ch 1 to 5 and Appendix A and Dougherty Ch 1 to 3. All texts are referenced below.

For those completely new to econometrics the following provide relatively straightforward expositions:

R Carter Hill et al (2001) "Undergraduate Econometrics", Second Edition, John Wiley.

Stewart, J. (1984) 'Understanding Econometrics', Hutchinson.

This is a useful starting point with more words per equation than any other econometrics text.

Gujarati, D. N. (1995) 'Essential Econometrics', McGraw Hill.

Another simple introduction than the one above.

Salvatore (1981) 'Statistics and Econometrics', Schaum Series.

Provides lots of worked examples

Kennedy, P. (1998) 'A Guide to Econometrics', Blackwell.

A useful text with an intuitive approach. It lacks notation and technical detail but explains concepts well.

For those with some knowledge of econometrics:

Gujarati, D. N. (1995) 'Basic Econometrics', McGraw Hill.

A useful introductory text with a detailed discussion.

Software Manuals

Pesaran, M. H. and Pesaran, B. "MICROFIT 4.0, Windows version", 1997, Oxford University Press, ISBN 0-19-268531-7. This is the manual for the MICROFIT package that you will be using. It is available in the MUBS library and can be bought separately from bookshops and contains useful examples and exercises. It is denoted as MICROFIT MANUAL (MM) hereafter.

Lecture and Class Outlines

Topic 1: Research and econometric methodology

Lecture:

Introduction in De Marchi and Gilbert (eds) (1989)'History and Methodology of Econometrics' Clarendon Press, Oxford.

Granger C (1990) 'Where are the Controversies in Econometric Methodology' Introduction to Granger CWJ (ed) (1990)'Modelling Economic Time Series', Oxford University Press. p1-23.

Pesaran MH (1990) 'Econometrics', in Eatwell et al (eds)'The New Palgrave'.

Smith RP (1992) 'Econometrics' in M Sawyer (ed) 'The Handbook of Radical Political Economy' Edward Elgar.

Workshops: Introduction to Microfit 4.0. MM Ch 1 – 3, 8 - 9. Microfit Exercise 1.

Topic 2: Basic statistical theory and OLS

Lecture: Basic statistical theory; the Simple Regression Model: Assumptions of the classical linear model; (Ordinary) Least Squares Estimators; Properties of Least Squares Estimators; Multiple Regression: Goodness of Fit; Interpretation; Statistical Inference;

Stewart (1) Ch 2,3; Salvatore Ch 6,7; Gujarati Ch 2,3,7,8; Kennedy Ch 3,4.

Workshops: Microfit exercises. MM Ch 1 – 4, 10.

Topic 3: Introduction to Problems with OLS and Solutions

Lectures: Violation of the Assumptions of the Classical Regression Model

Outline of Autocorrelation, Heteroskedasticity and Multicollinearity; Outliers and Dummy variables; Functional Form, RESET test; Omitted Variable Bias; Testing Restrictions.

Stewart (1) Ch 3; Maddala Ch 5,6,7; Gujarati Ch 10,11,13,14; Kennedy Ch 5-7,11.

Workshops: Microfit exercises. MM Ch 10.

Topic 4: Dynamic Models, Stochastic processes and cointegration

Lectures: Dynamic Models; Time Series Analysis; Testing for unit roots; Trends and Random Walks; Cointegration; Engle-Granger.

Maddala Ch 6,13,14; Gujarati Ch 14; Kennedy Ch 9; Hill 15-17.

Workshops: Microfit exercise; MM Ch 6,10,11, 16; Lessons and exercises 11.1, 11.3, 16.1, 16.2; data gdp95.fit, phil.fit.

Part 3: Internet Resources

Course Website

Many resources for this course will be placed on:

<http://saeconometrics.abrc.co.uk>

You can log on as

Also:

<http://carecon.org.uk/Users/paul/mei.htm>

Provide useful info and the datasets used in the exercises.

Suggestions for Improvement

Suggestions for improvement of any aspect of the course or documentation are welcome and can be made via the website or by emailing the individual lecturers at the addresses given above.

Part 4: Applied Exercises:

Introduction

These exercises introduce you to Microfit 4.0, a very powerful interactive econometrics package that is also relatively easy to use. It has a clear structure of screen editors and windows facilities for data processing, file management, graphic display, estimation, hypothesis testing and forecasting windows. It is driven by icons and written commands.

It is important that you follow the steps exactly the first time you use the package. You will soon get used to moving through the screens to find the task you want. When typing in commands always use the "return" / "enter" key at the end.

Documentation: There is a Microfit manual, but you will not need to reference it at this stage, as the applied exercises are fairly straightforward and there is a very good help facility in the programme. MFIT is menu driven you do not need a manual to run the programme.

EXERCISE 1

1. Getting Started

Logon to the network using one of the temporary student accounts:

Passname: <temp-ess-01> to <temp-ess-21>

Password: password

and access Microfit

2. Data Input:

- Click on File and choose the New option
- Choose Annual as the data frequency
- Give 1977 as the Start year and 1987 as the End year
- Give 2 as the number of variables
- Click on OK

In the next window overwrite X1 and X2 with RC and RPDI respectively and insert descriptions of the variables, RC is real consumption, RPDI is real personal disposable income.

Click on Go

Now input the following data in the relevant cells

	RC	RPDI
1977	176.0	195.6
1978	186.0	209.9
1979	193.8	221.7
1980	193.8	224.9
1981	193.8	222.2
1982	195.6	221.7
1983	204.3	227.9
1984	207.9	232.4
1985	215.3	237.8
1986	226.8	244.8
1987	238.5	252.2

When you have finished you can check and edit if necessary and when you are ready click on Go.

There are a number of icons above the data window with Variables, Data, Process etc on them:

- Click on Variables to check the information you have input, then click on Close
- Click on Data to check the inputted data (same window)
- Click on Process to get to the data processing screen.

3. Data Processing

You are now in the main screen and can undertake various tasks. For now:

a. Check the data:

- Type LIST RC RPDI
- Click on Close

b. Compute variables:

- Compute the savings ratio type: $S = (RPDI - RC) / RPDI$
Then click Go
- Compute a constant type: $C = 1$
Then click Go
- Take logs of variables type: $LRPDI = \text{LOG}(RPDI);$
 $LRC = \text{LOG}(RC);$
 $LS = \text{LOG}(S);$

Then click Go.

The ; allows you to run more than one command at a time.

You can also compute other transformations in the same way. For example first differences for DC would require $DRC = RC - RC(-1)$.

c. Plot variables over time: Type:

PLOT RPDI

PLOT RC

PLOT S

PLOT RPDI RC

Click on Go after each of these and on Close in the graphics Window

d. Plot variables against each other: Type

XPLOT RPDI RC

Click on Go

Click on Close

e. Get simple descriptive statistics and correlations: Type

COR RPDI RC

Click on Go

(You should get correlation coefficient of 0.9676)

Click on Close

After you have done all of these type click on the Single icon, which will give you the Linear regression - Ordinary Least Squares screen.

4. Running a Regression

Click on the empty window and type in the dependent variable a constant and the independent variable as follows:

RC C RPDI

and then click on the Start icon.

This will give you regression results and various statistics. They should be equivalent to:

$$\begin{array}{lcl} \text{RC} = & -52.21 + & 1.13 \text{ RPDI} \\ & (-2.4) & (11.5) \\ \\ R^2 = & 0.94 & \text{DW} = 0.596 \end{array}$$

You can print this out or save to

Further possible statistics are offered when you click on the Close icon. For the moment choose no. 3 (List/plot/save residuals and fitted values) and then click on OK.

5. Analysing the Residuals

Choose the option no. 3 Plot residuals and click on Ok

You will now see a plot of the residuals

It should be clear that there are problems with this regression!

You can print this graph out or save to a file using icons at the top left.

- Click on Close to return to the menu
- Accept option 0, Return to the Post Regression Menu
- Choose option 0, Return to Backtracking Menu
- Choose option 1, Return to Single Equation Estimation Window

6. Saving Data and Variables

- Click on File menu
- Choose Save As option
- Give the filename MAEG1.FIT
- Specify a directory and drive or floppy disk
- Accept the first and last observations offered by clicking on OK

- Exit from Microfit:

Either go to the File menu and choose Exit.

Or click on the X in the top right hand corner. Click on OK when you receive the warning about data being lost as you have already saved it.

7. Using saved FIT files

- Start Microfit again.
- Click on the File menu and choose Open
- Give the filename MAEG1.FIT

Note that you may have to specify a drive or directory, depending on where you saved the file.

You are now back with your data and all of the variables you created above are still there.

Check that this is the case by using the icons and then rerun the regression

You can now either exit or move on to exercise three, by clicking on the File menu and choosing the option Open

EXERCISE 2

The steps below only provide instructions. You will need to go through the same procedures as in Exercise 1 to complete the tasks.

1. Enter Microfit
2. Click on the File menu and choose the Open option. Give the filename as MAEG2.FIT with the directory/disk details. This file contains data for 1959-87 on consumption and income
3. Using OLS, estimate the linear model: $RC = a + b \text{RPDI}$
4. Estimate a log-linear model: $\text{LRC} = a + b \text{LRPDI}$
where $\text{LRC} = \text{LOG}(\text{RC})$ and $\text{LRPDI} = \text{LOG}(\text{RPDI})$
5. Estimate an extended model introducing inflation: $\text{LRC} = a + b \text{LRPDI} + c \text{DLPC}$
Where the inflation term DLPC is constructed using:
 $\text{LPC} = \text{LOG}(\text{PC})$
 $\text{DLPC} = \text{LPC} - \text{LPC}(-1)$
6. Consider the results for each of these regressions and why each one improves on the previous one.
7. To consider how to interpret multiple regression.
 - Make a note of the results of the extended model (parameter estimates/ t ratios/ DW/ Rsq)
 - Estimate $\text{LRC} = a_1 + b_1 \text{DLPC}$
 - Save the residuals. Give them the name RES1
 - Estimate $\text{LRPDI} = a_2 + b_2 \text{DLPC}$
 - Save the residuals as RES2
 - Estimate $\text{RES1} = a_3 + b_3 \text{RES2}$

You will see that b_3 is the same as b (the estimate in the extended model). Consider what this tells you about the interpretation of parameter estimates in multiple regression analysis.

EXERCISE 3: Capital Asset Pricing Model

This exercise is based upon those at the end of Chapter 2 in Berndt. The data is the same except that it has been collected in a Microfit file.

1. Start Microfit 4.0
2. Read in the file CHAP2.FIT, which contains monthly share return data.
3. Have a look at the descriptions of the variables.
4. Plot MARKET from Jan 78 to Dec 87 and then IBM over the same period.
5. What do the plots tell you?
6. Construct the risk premium measures $r_p - r_f$ and $r_m - r_f$, using:

$RIBM = IBM - RKFREE$

$RMARKET = MARKET - RKFREE$

Plot these and look at what happened October 1987.

7. Get the sample means using:

COR IBM MARKET RKFREE RIBM RMARKET

Work out the values you would expect for β if you estimated

$$(r_j - r_f) = \alpha_j + \beta_j (r_m - r_f) + e_j$$

8. Estimate β for IBM using $RIBM = \alpha_j + \beta_j RMARKET + e_j$
9. Are the results what you would expect?. Look at the residuals and consider any outliers.
10. Choose two companies, a highly risky one and a relatively safe one and estimate their values of β . Are they what you would expect?
11. Look at the plots over time and the plots of the residuals. Are there any outliers? How would you interpret them?
12. Test the null hypothesis that $\alpha = 0$ and the hypothesis that $\beta = 1$. What are the implications of these results?
13. If you wish follow the rest of the Exercises in Berndt Chapter 2.

EXERCISE 4

This exercise will extend the previous two, both in terms of the data coverage and the techniques used.

Part 1

A Microfit file named CONS95.FIT contains the data.

Run Microfit 4.0 and access this file.

The data consist of:

CE: Consumers Expenditure in current prices

RCE: Consumers Expenditure in 1995 prices

RDE: Expenditure on Durables in 1995 prices

PDI: Personal Disposable Income in current prices

RPDI: Real Personal Disposable Income in 1995 prices

C: A variable with the value one for each observation

When you have read in the data, check the data definitions using TITLE.

Then:

Explain what RPDI measures and how it differs from personal income.

Plot RCE and RPDI and comment on the main features

Generate:

$S = \log((PDI - CE)/PDI)$

$RS = \log((RPDI - RCE)/RPDI)$

Plot these two series and comment on their meaning and the difference between them.

Generate:

$LC = \log(RCE - RDE)$

$GC = LC - LC(-1)$

$LY = \log(RPDI)$

$GY = LY - LY(-1)$

$LP = \log(CE/RCE)$

$GP = LP - LP(-1)$

$Z = LC - LY$

What do these series measure?

Use the following commands and explain the output you get:

PLOT LC LY

PLOT GC GY

COR LC

COR LC LY GC GY

LIST C LC LY GC GY

XPLOT LC LY

Run a regression with RCE as the dependent variable and C and RPDI as the independent variables, **using sample 1950 to 1980**. Note and interpret the regression results.

Save your dataset in a special Microfit file with a different name to the original (eg consnew.fit). Use this file from now on.

Part 2

Run the following regressions using OLS, on **sample 1950 1980**, the first variable is the dependent variable, the rest the independent ones. In each case interpret and comment on the main features of the regression results, diagnostic tests A to D, the plot of actual and predicted values and the plot of the residuals.

1. $LC = C + LY$

Test whether the coefficient of LY is significantly different from zero and then from one, at the 5% level.

2. $GC = C + GY$

After estimating the equation go to the hypothesis testing menu and conduct a variable addition test to see whether $LC(-1)$ and $LY(-1)$ are jointly significant using the F statistic and individually significant using the t statistics

3. $GC = C + GY + GP$

Repeat as for 2 and comment on the significance of the lagged values.

4. $LC = C + LY + LY(-1) + LC(-1)$

5. $GC = C + GY + LY(-1) + LC(-1)$

Compare the results for 4 and 5 in terms of coefficients, standard errors, log-likelihoods, and the sum of squared residuals. What is the relationship between them.

6. $GC = C + GY + LY + LY(-1) + LC(-1)$

Explain what happens when LY is added to 5

7. $GC = C + GY + LY(-1) + GP + LP(-1) + LC(-1)$

Calculate the long run elasticities of consumption with respect to the price level and income. What does economic theory predict about the coefficient of $LP(-1)$. Test this prediction.

8. $GC = C + GY + GP + Z(-1)$

Test 8 against 7. Is this a well specified equation. Explain the economic interpretation of 8. What is the long run elasticity of consumption with respect to prices and incomes in this model.

9. $GC = C$

Interpret this model and carry out a variable addition test for the significance of $LY(-1)$ and $GY(-1)$. Interpret the result.

Part 3

Run equation 8 for the samples 1950 to 1965 and 1966 to 1980. Test whether the variances are equal in the two periods and whether the coefficients are equal.

Use the equation to forecast 1980 to 1985. Interpret your results.
Estimate equation 8 for 1980 to 1985. Note the results.

Construct dummy variables for 1986, 1987, 1988 and 1989 using the following commands:

```
SAMPLE 1948 1989
```

```
D86=0
```

```
D87=0
```

```
D88=0
```

```
D89=0
```

```
SAMPLE 1986 1986
```

```
D86=1
```

```
SAMPLE 1987 1987
```

```
D87=1
```

```
SAMPLE 1988 1988
```

```
D88=1
```

```
SAMPLE 1989 1989
```

```
D89=1
```

```
SAMPLE 1948 1989
```

Run the following regression for 1950 to 1989:

```
GC C GY GP Z(-1) D86 D87 D88 D89
```

Compare the results from this equation with the ones obtained when equation 8 was run over 1950 to 1985. Interpret the coefficients and standard errors of the dummy variables.