



Bristol Business School

Module handbook 2007/8:

Module Code: UPEN3Q-15-M

APPLIED ECONOMETRICS

School of Economics, Bristol Business School, UWE

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1. Introduction

Module Aims and Objectives

The aim of this module is to build on the work covered in the Econometrics module and to provide a more advanced econometrics course, with the emphasis on the use of econometrics in applied economics and finance. It begins by introducing the linear model in matrix notation and then moves on to consider particular topics in applied econometrics. Exercises with computer packages to replicate published studies will be provided.

Specifically the aims are to:

- Provide an appreciation of the use of econometrics in economic analysis.
- Introduce the advanced tools required for applied econometric analysis.
- Provide a firm foundation for an understanding of the academic and professional literature.
- Prepare the student for research work as an economist in industry, government and possible academia.

By the end of the module you should:

- have developed your knowledge of econometric techniques beyond the Econometrics course in the first term
- be able to use the Microfit package in a more sophisticated manner and undertake empirical work with the Stata and/or Limdep packages.
- Have knowledge of the literature in a number of areas of applied econometrics and be able to replicate the results of the studies used in the classes.
- Be able to read and understand some of the applied articles published in academic and professional journals and monographs.
- be able to undertake independent applied econometric research: including data collection and analysis, using relevant econometric techniques, integrating economic theory and econometrics, understanding the problems and limitations.

Prerequisites

The prerequisite for this course is UPEN3P-15-M or an econometrics course of an equivalent level.

Note

This is a Master's level module. As you should now be aware, the level of the material may well be higher than anything you have encountered before. Certainly, the pace of the module will be faster than you are used to. Naturally, this will require considerable work, including, of course, much reading. This reading will be essential for you to be successful on the module. However, as always, we think the work will be rewarded by the enjoyment of a stimulating and essential module.

2. Learning Outcomes

At the end of the module the students should be able to:

- Have advanced knowledge of alternative methodologies in economics (component A, component B)
- Have a knowledge of survey methods (component A, component B)

- Carry out econometric analysis of cross section and panel economic data using Limpdep and Stata (component A, component B)
- Undertake a research project in applied econometrics (component B)

3. Organisation of the Module

3.1. Teaching and Learning Methods

Nominally, the module will be organised around a lecture-seminar model. This means that once a week, we meet and basically I lecture to you. As you will be aware, lectures provide core material and the framework for the module. **Lectures** also create the basis for seminars and for further reading. **Seminars** allow us to explore further the topics introduced in the lecture, clarify points of misunderstanding, and practice written and oral skills. The format of the seminar will vary according to the task at hand. The seminar will be aided by your own **private study**. A good seminar will deal quickly with the basic issues, without regurgitating lecture material, and it will encourage discussion and exploration of the topic. This will only be facilitated by private study on your part. You should read the required reading as listed in this handbook, but also I shall give you supplementary reading. Also, at postgraduate level, it is particularly important to find for yourself books and particularly articles to read.

3.2. Student responsibilities

Lectures

You should be aware that lectures are designed to provide a framework for discussion and analysis. Your responsibility therefore is to attend these lectures on a regular basis. **Failure to do so may seriously affect your ability to keep abreast of the course and hence impact on your final grade.**

Seminars

A seminar is designed to enable students to investigate an issue or theme in greater detail. The onus is on you to keep up to date with the reading on a weekly basis. **Seminars work well if everyone has done some preparatory reading, have thought about interesting questions to ask and come along prepared to discuss the theme in question.** Do not leave it to others to do the work. As you can see the reading lists for seminars are extensive. The purpose is two fold: to give an idea of what is available in our library; and to introduce various opinions expressed by a number of authors. This does not mean that just because a book is not listed here that it may not be relevant to the course. **We would encourage you from the outset to explore the wide variety of material contained in our library, which can be equally useful when preparing for a seminar or writing an essay.** Equally important, you are strongly encouraged to use journal articles, which publish the latest research. Articles are extremely useful because they concentrate on a specific issue or debate. They get to the heart of a debate and therefore provide insight into complex issues. So get into the habit of using the journals for all facets of your work.

Library

A final point concerns the library system. You are expected to use the full potential of the UWE library system. As a multi-campus institution, resources are scattered. Books and periodicals may be housed on only one site. So be prepared, especially when preparing essays, to use the inter-site loan system or (better still) travel to the other sites to obtain relevant material. UWE is well equipped with electronic media. Increasingly it is necessary for libraries to take journals in electronic form, and UWE does this well. Please take advantage of the resources available through the Library catalogue as well as internet-based research aids. Please be familiar with the University's inter-library loan (ILL) system: remember that ILLs always take a number of days to arrive, so you must plan ahead.

3.3. Staff responsibilities

Staff will endeavour to produce useful, interesting and thought provoking lectures, which are well informed by up-to-date secondary literature and, where appropriate, by visual aids. In seminars tutors will help to generate and sustain discussion while at the same time recognising the students' responsibility to stimulate debate. They will also try their best to return work, with detailed feedback, within the agreed timescale of the submission date. Staff will be available to discuss your work on a one-to-one basis at specified times. In addition, they will make time to discuss issues raised by the group in the regular weekly seminar slot.

3.4. Facilities and Resources

To be successful in the module, you will need to use a range of resources. Attend lectures and seminars, of course! However, as I have already indicated, you must take advantage of the Library and the electronic media available to you.

There is a wide reading list for the module. You will be given readings with each session but as a starting point:

This course will start off by going through matrix algebra and then the standard results for the linear model using matrix algebra. This is covered in most of the text books used in Methods of Economic Investigation (ECS4305) in semester 1. There are also some more advanced texts referenced below.

Texts:

- Cameron, AC and PK Trivedi (2005) *Microeconometrics: Methods and Applications*, Cambridge University Press. Useful for panel data
- Deaton, Angus (1997) *The Analysis of Household Surveys: A Microeconomic approach to Development Policy*, Johns Hopkins University Press. Useful for panel data
- Greene, WH (2002) *Econometric Analysis*, Prentice Hall, 5th edn.
- Intriligator M, R Bodkin, C Hsiao (1996) *Econometric Models, Techniques and Applications*, Prentice Hall.
- Judge et al (1985) *The Theory and Practice of Econometrics*, Wiley.
- Patterson, K (2000) *An Introduction to Applied Econometrics*, Palgrave. Useful for time series
- Thomas RL (1993) *Introductory Econometrics: Theory and Applications*, Longman
- Wooldridge, Jeffrey (2002) *Econometric Analysis of Cross Section and Panel Data*, Massachusetts Institute of Technology.

Other useful texts are:

- Berndt ER (1991) *The Practice of Econometrics*, Addison Wesley.
- Charemza, WW and DF Deadman (1997) *New Directions in Econometric Practice*, Edward Elgar. Useful for cointegrating VARs
- Cuthbertson, K, SG Hall and MP Taylor (1992) *Applied Econometric Techniques*, Harvester Wheatsheaf.
- Darnell AC and JL Evans (1990) *The Limits of Econometrics*, Edward Elgar.
- Desai, M (1976) *Applied Econometrics*, Philip Allan.
- Hendry D (1995) *Dynamic Econometrics*, Oxford University Press.
- Griliches, Z and MD Intriligator (eds) (1993) *Handbook of Econometrics*, Elsevier.
- Mills T (1993) *Applied Financial Econometrics*
- Pesaran, M Hashem and Schmidt, Peter (eds) (1997) *Handbook of Applied Econometrics, Volume II: Microeconomics*, Blackwell.

- Stewart, J (1991) “Econometrics”, Philip Alan.
- Wallis, K (1979) “Topics in Applied Econometrics

Software:

We will be using

- Microfit 4.1: Pesaran MH and B Pesaran (1997) “Microfit 4.0 Manual”, OUP. Available in the library.
- LIMDEP 8.0: The manual is available in the library and a manual for version 7 on the internet
- Stata 9.0: The manuals are available in the library

4. Module Programme

The lecture course is designed as 12 1.5 or 2 hour lectures. These are followed by a 1 or 1.5 hour class. The first few weeks of lectures provide an introduction to matrix algebra and then go through the general linear model using matrix notation. The first class is in fact a lecture, dealing with the matrix algebra and an introduction on how to do the applied econometrics project. There is time for discussion. The second and third weeks classes are in the form of surgeries, where we will discuss individual students' ideas, how their work is developing and any problems they might be having. From the fourth week the lectures cover topics in applied economics and the classes will take the form of computer based workshops.

UWE Week	W/C	Class	Title
26	23-Jan	L1	Introduction & Matrix Algebra
		S0	Matrix Algebra
27	30-Jan	L2	General Linear Model 1
		S1	Project Surgery
28	6-Feb	L3	General Linear Model 2
		S2	Project Surgery
29	13-Feb	L4	General linear Model 3
		S3	Project Surgery
30	20-Feb	L5	Industry Growth and Size –sample selection
		S4	Applied exercise with Limdep
31	27-Feb	L6	Macromodelling, Cointegration and VARS
		S5	Applied exercise with Microfit
32	6-Mar	L7	Panel Data Models I
		S6	Applied exercise with Stata
33	13-Mar	L8	Dynamic Panel Data Models
		S7	Applied exercise with Stata
37	20-Mar	L9	Demand Analysis
		S8	Applied exercise with Microfit
38	17-Apr	L10	Student Presentations
		S9	Student Presentations
39	24-Apr	L11	Production Functions
		S10	Applied exercise with Stata

5. Lecture Details

1. Matrix Algebra

This lecture will introduce the basics of matrix algebra for use in the lectures in the next two weeks. You will need to go through the textbook section in your main text from last year, Maddala, although any other introduction to econometrics that has a section on matrices will do. You will need to read and do the exercises to familiarise yourself with the notation and the methods. This will allow you to follow the content of lectures 2 and 3.

Matrices and vectors; transposing a matrix; matrix addition; matrix and vector multiplication; identity matrices; determinant of a matrix; inverse of a matrix; orthogonality; rank of a matrix; trace of a matrix; quadratic form; matrix differentiation; eigenvalues and eigenvectors; idempotent matrices; kronecker products; systems of equations. This session should provide you with an overview of the necessary matrix algebra techniques to complete the following parts of this module.

Introduction to Project:

This session will consider how to choose a topic for your applied econometrics project and how to go about it. Section 2 of this handbook provides the notes and reading for this lecture. It is important that you keep referring to this as you go along.

2-4 General Linear Model

These lectures will deal with the general linear model using matrix algebra. It goes over what you have covered last semester, but using matrices. Topics covered: simple linear model; ML estimator; Ordinary Least Squares (OLS); OLS as BLUE; assumptions. This session should provide you with an understanding of the basic OLS model in matrix form; testing restrictions and hypotheses; small sample F tests; large sample tests; Lagrangian multiplier; Wald; Likelihood ratio tests. This session should provide you with an understanding of some more advanced aspects of the basic model in matrix form.

Project Surgeries

Will discuss general and individual problems with planning and implementing the project.

5. Industry: Growth and Size

This lecture will look at the part of industrial economics that studies the growth of firms and concentration. It will provide an overview of the literature and consider the ways in which Gibrat's law has been tested, the econometric problems involved and how they have been overcome. This lecture and the reading should enable you to achieve an understanding of the issues and techniques involved in modelling firm growth and survival.

Computer class

You will use data on the major international defence companies to test Gibrat's law and consider changes in concentration over time. This will require the use of the Limdep package and the probit and sample selection procedures.

6. Macromodelling/VARs

The lecture will consider macroeconometric modelling and the use of vector autoregression (VAR) methods. It will discuss how to set up a VAR and the criticisms of the approach before linking it to cointegration. The Johansen procedure will be outlined briefly and application of Granger causality tests discussed. This lecture and the reading should enable you to achieve an understanding of the issues and techniques of macroeconometric modelling.

Computer Class

You will be given long data series on military spending and unemployment for the UK and the US and use them to replicate published results for a simple two variable VAR.

7. Panel Data Models

The lecture will go through the issues involved in moving to panels of data –where time series and cross sectional data are combined. An overview of the available estimation methods and the problems involved in using them will then be outlined. This lecture and the reading should enable you to achieve an understanding of the issues and techniques of static panel data analysis.

Computer Class

You will be given a panel of data (time series data for a cross section of industries) for South Africa and asked to replicate the result of a study of the impact of government procurement on industrial output.

8. Dynamic Panel Data Models

The lecture will go through the issues involved in dealing with dynamic within panels of data. An overview of the available estimation methods and the problems involved in using them will then be outlined. This lecture and the reading should enable you to achieve some understanding of the issues and techniques of dynamic panel data analysis.

Computer Class

You will be given a panel of data (time series data for a cross section of industries) for South Africa and asked to replicate the result of a study of the impact of government procurement on industrial output.

9. Demand Analysis

The lecture will provide an overview of demand analysis from its important historical roots to come of the more recent developments. This lecture and the reading should enable you to achieve an understanding of the issues and problems.

Computer class

You will estimate an Almost Ideal Demand System using data on government consumption expenditure in the UK.

10. Student Project presentations

Students will prepare presentations of their applied econometrics project proposal, any progress they have made and problems they have come across. This session will allow you the chance to present your proposal and receive feedback from staff and students.

11. Production Functions

The lecture will provide an overview of the different empirical analyses of production function. It will start from the basic theory of Cobb Douglas and CES functions and their problems. The problems of applying the models will then be considered for cross section and time series data and some of the past applications and developments discussed. This lecture and the reading should enable you to achieve an understanding of the issues and problems of estimating production functions.

Computer Class

You will be given South African data and will estimate production functions and growth models and replicate a study of the economic effects of military spending. It will continue the analysis using panel data.

6. Seminar Details

This section presents details of the seminars to be undertaken in the module. It provides the learning outcomes for each seminar, the reading to be undertaken and the questions to be dealt

with in class. Where the books are those listed above, only the name of the author and the chapters to be read (if applicable) are listed. For new references, the whole reference is listed the first time. For all seminars, these reading lists are not exhaustive: for example, please read other relevant literature. In some seminars, there are long lists of questions. It might not be possible to cover all of these questions in class, so you should use them for revision and study purposes. **For every seminar, additional questions and any accompanying reading (where necessary) will be distributed either in class and/or via the module webpage**

7. Assessment Offences – Cheating, Collusion and Plagiarism

Please read carefully the following definitions of cheating, collusion and plagiarism. These are serious offences and it is very important that you know how to avoid them. The University procedures for dealing with allegations of assessment offences are laid out in the **UWE Student Handbook**, and in the Academic Regulations (E12a).

7.1. Definitions

- 7.1.1 Cheating (in the widest sense of the word) is the use of unfair means of presenting work for assessment. It is a serious academic offence as it prevents examiners from being able to make a realistic judgement of a student's knowledge, understanding, ability and/or creativity.
- 7.1.2 Cheating in an examination includes:
- taking aids (eg notes, books, mobile phones, equipment) into an examination room which are not authorised for use in that examination
 - copying another student's work
 - seeking or obtaining help from another person
 - assisting another student with an examination
- 7.1.3 Collusion includes:
- presenting work as one's own which is derived from unauthorised collaboration with others
 - assisting another person by giving substantial help with ideas or with text which are not then acknowledged.
- 7.1.4 Plagiarism is a form of theft. It includes:
- the quotation of another person's words without quotation marks
 - the quotation of another person's words or ideas without acknowledgement
 - the use of another person's ideas without acknowledgement
 - the use of another person's facts or experimental results without acknowledgment.
- 7.1.5 It is also an assessment offence to prevent another student from being able to be examined properly.

7.2. Avoiding Cheating in Examinations

- 7.2.1 Students can ensure that they do not unwittingly cheat in examinations if they
- take into an examination only those items which have been authorised. Particular care must be taken with programmable calculators and dictionaries which can only be used if specifically authorised.
 - follow carefully the "Instructions to Candidates" (Examination Regulation 2) and communicate with no-one except an invigilator during an examination.

7.3. Avoiding Collusion

- 7.3.1 Most collusion is unintentional. Students are often required to work on a topic or activity in groups and then to produce individual work for assessment. They must be careful to follow the instructions regarding the assessment. Some assessments may require the group to produce joint ideas or proposals, whereas others might assign this initiative to the individual. Unless the instructions specifically require a group report, students must produce their own written work without the help of other people.
- 7.3.2 It is a normal part of the learning process for students to discuss ideas for written work with each other. However, students should be cautious about lending essays, computer files or laboratory reports to other students in order to avoid the danger of the second student producing an essay or laboratory report similar to that of the first student.
- 7.3.3 Discussion between students can be a good way of learning: however, students should be careful to ensure that they think out and write the detail of their essays/assignments by themselves.

7.4. Avoiding Assessment Offences

- 7.4.1. In order to produce good essays, assignments, etc, it is expected that students will base their ideas on several sources and will quote from them. Plagiarism is often a result of poor academic practice rather than a deliberate attempt to cheat. Good academic standards require that -
 - a) any phrase or longer text which is taken from another author must be quoted precisely using quotation marks and the bibliographical reference
 - b) where an author's text is summarised the summary must be in the student's own words. Merely changing the order of words or using synonyms does not form an acceptable summary
 - c) any facts, tables, diagrams or experimental results taken from another person must be acknowledged and referenced
 - d) any ideas or conclusions taken from another person must be duly acknowledged and referenced.

8. Assessment

8.1. Regulations

In order to pass this module you need to obtain an overall mark of 50% or above. In addition you need to obtain at least 40% in both assessment components.

If you do not get 50% or more in the **module**, you will be referred in each **component** for which your mark is below 50%.

If you do get 50% or more in the module but one of your components is below 40% you will be referred in that component.

If the minimum mark of 40% is not achieved in both required components of assessment (and the other is passed) at the first assessment opportunity the mark for the referred component will be limited to 50%. This is described as a capped mark. The mark for the other component will not be capped nor will the overall module mark. Where a component of assessment is not passed at the second assessment opportunity and a student makes another attempt at the module, the overall module mark achieved at the second attempt will be capped at 50%.

All students referred in a component will have to do the same referral work.

Further information about assessment may be found in the University's Student Handbook.

8.2. First Assessment Opportunity

The assessment has two components: an Examination Component (Component A) and a Coursework Component (Component B). Component A comprises a 2-hour examination in the assessment period between terms.

Component B is an applied project. This will be a project in which you apply the material of the module to an issue in economics, banking or finance.

The word limit for this project is 3000 words. You will need to agree a title (and consider the execution of the project) with the module leader

8.3 Guidelines

Assessment criteria for component A

The criteria for assessment include: evidence of an understanding of relevant analytical techniques and theories; the ability to apply them effectively; the ability to gather, organise, analyse and present evidence and data in a coherent and concise fashion. Students will be expected to demonstrate their knowledge of economic concepts, theories and principles at Masters level.

Assessment criteria for Component B

The criteria for assessment include: evidence of an understanding of relevant analytical techniques and theories; the ability to apply them effectively; the ability to gather, organise, analyse and present evidence and data in a coherent and concise fashion, employing a range of appropriate and properly referenced material. Students will be expected to demonstrate their knowledge of economic concepts, principles and theories at Masters level. Particular emphasis will be placed on the effective use of statistical theories and techniques.

General Assessment Criteria:

The following section provides guidance on the criteria employed for assignments which receive a distinction, pass or fail award.

Distinction level (75%): For component 1, work which gains a distinction will demonstrate a standard of writing and critical analysis will be considered excellent. In other modules, excellence will be taken to mean that it could be considered for publication in that field. To be judged of distinction quality in specific assignments or in the overall performance for a module, assessed work will demonstrate all that is required for the PASS band and will also demonstrate a range of the following characteristics, as determined by the relevant subject specialists and programme team. Care must be taken to ensure that this process does not invite subject specialists to ignore or devalue these generic criteria:

- a) creativity in developing new approaches and interpretation to existing or new areas of knowledge and/or innovations in practice
- b) original critical analysis which reviews the validity of theoretical perspectives and methodologies
- c) critical understanding of an appropriate range of research methodologies as well as the ability to explore the limitations of existing research strategies
- d) creativity in exploring the limits of current knowledge and contributing to the development of theory, research and practice
- e) work supported throughout by appropriate evidence
- f) correct use of language, unambiguous expression and clear presentation

Pass (50%): To be judged as a pass in specific assignments or in the overall performance for a module, assessed work will demonstrate the following characteristics as determined by the relevant subject specialists and programme team. Care must be taken to ensure that this process does not invite subject specialists to ignore or devalue these generic criteria:

- a) a comprehensive understanding of existing areas of relevant knowledge and practice and an awareness of gaps and weaknesses of such knowledge
- b) a standard of objective critical analysis which demonstrates academic rigour using relevant concepts and knowledge
- c) a creative attempt to contribute to the ongoing development of theory, research and practice
- d) most substantive points are supported by appropriate evidence, with avoidance of unfounded generalisations
- e) an ability to structure and organise material in a broadly logical manner with a clear development of ideas
- f) clear evidence of thorough reading of core texts
- g) largely accurate and complete referencing using an appropriate citation system
- h) largely correct use of language, unambiguous expression and clear presentation

Fail: Assessed work which is judged to fail will demonstrate a significant number of the following characteristics, as determined by the subject specialists and programme team. Care must be taken to ensure that this process does not invite subject specialists to ignore or devalue these generic criteria:

- a) insufficient critical analysis of the topic
- b) limited critical review of existing areas of knowledge and/or practice
- c) disorganised structure with incorrect or inappropriate sequencing of content/ materials
- d) failure to develop a clear line of argument
- e) inadequate use of supportive evidence
- f) disproportionate reliance on unsupported generalisations
- g) evidence of insufficient appropriate reading and reflection
- h) inaccurate referencing
- i) poor use of an appropriate citation system
- j) inappropriate or poorly executed research methodologies
- k) unclear presentation

8.4 Second Assessment Opportunity (Referral)

The regulations for passing this module are expressed in section 8.1 above. All students referred in a component will have to do the same referral work. *Further information regarding assessment may be found in the University's Student Handbook. The deadline date for the submission of referral work will be posted on the Faculty notice board when it is known.*

The referral exam, component A (50%) will be in the same format as the exam in the first assessment period, with a similar balance and style of questions.

Re-assessment for the coursework, component B (50%)

Resubmit an applied project according to the instructions given in section 8.2 above.

Part 2 Doing An Applied Econometrics Project

These notes provide advice on how to undertake a piece of applied econometrics using the skills learnt in the Econometrics course. This can be complemented by Appendix A in Intriligator, Bodkin and Hsiao (1996).

1. Starting

By the end of the first semester's *Methods of Economic Investigation* course (ECS4305) you should be able to run regressions and interpret the results. The applied econometrics exercises you undertook were designed to provide you with the required skills.

You should give some thought to the topic you would like to do before the beginning of the second semester. Once the course starts you will be asked to provide a brief proposal, describing the topic, the general form of the model and the data to be used. Surgeries to provide advice and guidance will be given in the second and third weeks and you will be assigned a member of staff to provide supervision. You will be required to make a short presentation of your work in week seven.

2. Topic

You can choose any topic. Useful sources are:

- an interesting dataset
- your job if you are a part time student
- your optional subject if you are full time
- published articles
- members of staff
- overseas students might choose topics using data from their own country.

Do not put a lot of effort into the theory until you have the data and avoid choosing a topic that is too ambitious. Also, do not worry about whether the results you get are good or bad, you will be assessed on how well you analyse a problem, not on your final result.

An important way of developing your project is to replicate a published paper. Applying the researcher's model to the same data, updating the analysis, and then maybe attempting to improve upon the model. Alternatively, you could use the data for a different country, industry or time period. It is often very difficult to get exactly the same results as those published. See Dewald et al (1986).

Read empirical economics papers and try to copy their style. Have a look through some recent journals.

- American Economic Review
- Economic Journal
- National Institute Review
- International Review of Applied Economics
- Applied Economics

are good places to look for empirical papers. Appendix A in Intriligator, Bodkin and Hsiao (1996) gives more. If you want to find a paper or book on a particular topic look in the Journal of Economic Literature, which classifies them by subject.

Do not agonise for too long over choosing a topic and once you have chosen a topic and collected the data do not be tempted to change.

The topics should involve explaining at least one variable by some others. Some examples might be standard economic relationships:

- explaining a countries imports by the level of demand, GDP; domestic process; import prices; tariffs; exchange rates.
- explaining consumption by income, inflation and wealth.
- explaining money demand by income and interest rates.

Or non-economic relationships:

- explaining attendance at football matches by ticket process, the quality of the teams, hooliganism, and the weather.
- explaining carbon dioxide concentrations by industrial production and sea temperature
- explaining crime rates by unemployment and economic factors.

3.Data

Finding the appropriate data can be the most difficult part of the project. You should check that the data is available before deciding on a topic and make sure you are clear what the data is. You can use time series data, cross section data (observations at one moment in time over countries, regions, families, etc...), or panel data which combines time series and cross section.

Make sure there are enough observations and variables. The sample size can be important in determining the techniques you can use and the precision of our results. Aim to have at least 30 observations for annual or cross section data; more for quarterly or monthly data. Unless you have experience of large data sets, or can get help in handling them, do not go much above 100 observations.

Make sure you know the exact definition of your data and what they are measuring. Terms like income and prices are not acceptable as they give little information. The sort of questions you should consider are:

Are the data current or constant price?

What is the base year?

What is the coverage (Net or Gross, Domestic UK or GB)?

Are they seasonally adjusted?

Have the definitions changed over the sample period?

If it is constructed data, how was this done?

Is the data based on a sample?

You may have to do a lot of work to make the data useable or comparable. If so provide information on this work, possibly in the form of a data appendix, so that you can be given credit.

You may have to adjust the data in various ways to deal with missing observations, to splice series on different bases, or to convert them into a different currency. Published data are not infallible, so always be on the look out for possible mistakes.

You should know something about the relevant history and institutions, such as important events, like strikes, wars, or changes of government.

Once you have loaded the data onto the computer, you should conduct a descriptive analysis. Print the data out and check carefully for typing errors. Plot the data and note the distinctive features such as trends, temporal dependencies, seasonality, unusual observation, etc. Calculate the means variances of your variables and their correlations.

Repeat this process after you transform the data in any way:

-growth rates or ratios (the savings rate, the velocity of circulation, the share of profits) are often more informative because they are not dominated by trends.

-logarithmic transformations are often used in economic models as the coefficients can then be interpreted as elasticities; the change in the logarithm is approximately equal to the growth rate; variances are more likely to be constant; and many interesting economic hypotheses can be expressed as linear restrictions in logarithmic models.

The introduction to the article by Hendry on house prices in Hendry and Wallis (1984) is a good model for this descriptive analysis. As part of the data description for time series you should check the order of integration of the variables and whether they are co-integrated.

Where there are a number of possible measures for a series use all of them and try to decide which is best. You can report this in the project. e.g. Do wages respond more to the consumer price index or the retail price index? Do not decide a priori, test and find out.

Keep detailed notes on the sources of data and anything you do to them. Its easy to forget at a later stage. You might end up with some adjustments you made and forgot about dominating your results.

Keep at least two backed up copies of your data on separate discs, stored separately. There are many ways of losing or corrupting disks and it can be a lot of work typing the data in again.

Sources

For UK data:

- Economic Trends Annual Supplement: is the best single source
- The Blue Book (National Income and Expenditure)
- The Annual Abstract of Statistics
- Financial Statistics
- Employment Gazette
- Family Expenditure Survey
- Census of Production
- Key Data a CSO publication provides a good introduction to what data is available and will give the relevant specialist publication.

For international data:

- World Development Report: published by the World Bank
- OECD Main Economic Indicators
- International Financial Statistics: Published by IMF

For the US:

Economic Report of the President: has an appendix giving the main economic aggregates.

Financial data:

Datastream: provides various financial and company accounts information and is available in the library. It also has some coverage of international macroeconomic and financial data. Similar but more limited data sources are available in the Hendon library.

There are also a number of publications which present data, such as:

- Maddison (1982) which gives long runs of historical data for the main capitalist countries.
- Berndt (1991) provides data on a floppy disc.

NB CSO, OECD and Eurostat data are available on disk if required. It is still a good idea to study the publications to make sure the data is what you think it is and to check on any idiosyncrasies

4. Analysis

Conduct your research with the final written project in mind. Make sure you can answer all the questions posed in the next section. Write fairly detailed notes of what you are doing and what your results are as you go along. It is very easy to forget what you did and be left with a vast pile of incomprehensible printout.

Try and organise your investigations around a few central questions. This will allow you to structure your specification search. The implicit methodology in these notes is broadly the Hendry/Spanos approach. This is not the only way to structure the analysis but it does provide a convenient framework.

5. Writing Up

Leave plenty of time for writing up, this tends to be the weakest link. In exercises like this students who can do all the rest, often fail to describe what they have done and what it all means. It should read like a good empirical paper in an economics journal, not a piece of autobiography. Read some more empirical papers and copy their style.

You are expected to type the project before submitting it, though equations can be handwritten. **Do not submit computer print outs.** You should process and digest the relevant information from them and report it in the project. Do not just transcribe the results of running dozens of regressions. Try to structure the interpretation of the results; pose questions and explain how the regressions provide

answers to them. As you write up you are bound to think of something else you need to do. So start writing up early, don't leave it till the last minute.

Write about all the things the reader does not know and will need to know to understand what you have done. Do not copy large chunks of econometrics textbooks. The reader will know most of that, just give a reference.

Attempt the impossible: try to make it lively and interesting.

Introduction: Don't jump in at the middle. Introduce the subject, give some background information and refer to any relevant literature. Then explain the questions you are going to try to answer, or the problems you are going to solve and why they are interesting. Say how your project differs from other work.

Theory: Set out the economic theory and use it to specify a model. Wallis (1979) and Berndt (1991) are good on the process of moving from economic theory to econometric models. Discuss the economic interpretations of the parameters (elasticities, marginal propensities, long and short run effects, etc). Set out any a priori expectations about signs and magnitudes of the parameters. Set out any hypotheses to be tested: constant returns to scale; homogeneity; unit elasticities. Note any identities linking the data. Discuss any identification problems.

It is often useful to think of economic theory as specifying: a long run equilibrium relationship; an adjustment process; an expectations formation process. Discuss each of these separately. Think about the time series structure of the data. You will get into trouble if you try to explain a stationary variable just by a single, highly trended, variable. Check that orders of integration match.

Remember that some theories imply that variables should follow random walks, so the basic theoretical model is that the change in the variable is a 'white noise' error, unpredictable from earlier information.

Data: Discuss the sources of the data, the exact definitions of the variables, the sample used for estimation, the correspondence of the data to the relevant theoretical concepts, the possible measurement errors etc. Describe the main features of the series, with graphs if necessary, and point out any peculiarities or outliers. Ask whether the series are stationary in levels or first differences.

Credit is given for data collection but you need to give information about it. If you have done a lot of work developing a new or unusual data set make sure you describe what you have done.

Statistical Model: Use the theoretical and the probabilistic structure of the data to choose a statistical model; linear regression model; dynamic linear regression; multivariate regression; vector autoregression; simultaneous equations model; etc. Discuss your choice of statistical model in terms of the assumptions it involves. You need to convince the reader that you have made an appropriate choice. It pays to start by trying both a simple model using just levels of the main variables (which you may want to treat as a cointegrating regression) and a fairly general model with lots of lags and variables.

Estimation and Misspecification Testing: Estimate the statistical parameters of interest and test the validity of the assumptions underlying the statistical model (no serial correlation, linear functional form, homoscedasticity, normality, constant parameters, etc). If any of the assumptions are rejected you should respecify the model and try again. With luck you should get a "well defined statistical model" that passes all the misspecification tests. Report the results briefly. How you lay out and present the results is very important. Try to copy articles in the literature.

Specification Testing and Interpretation: When you have a "well defined statistical model", then you can proceed to reparameterise/restrict the statistical model in order to construct an empirical econometric model. This involves testing economic hypotheses (eg homogeneity in prices, constant returns to scale), calculating the economic parameters of interest (eg long run solutions, elasticities), and interpreting the adjustment process (eg error correction, common factors).

Finally, evaluate your chosen empirical econometric model in the light of the original theoretical model, the estimated theoretical parameters of interest, and how your results compare with other published estimates. If you were unable to find a well defined statistical model go through this stage anyway, but point out that your results may be less reliable because of the possible misspecifications.

Conclusions: Explain the significance of the results and how they relate to the original questions or problems posed in the introduction. What is their relevance for practical questions of policy, forecasting, business? Are they consistent with theory and with institutional and historical information you might have? Is the model statistically adequate in representing the data.

References: Provide a list of works cited at the end, with references in the text of the form Berndt (1991).

References:

- Berndt ER (1991) "The Practice of Econometrics", Addison-Wesley.
- Dewald WG , Thursby JG and RG Anderson (1986) Replication in Empirical Economics, American Economic Review, September, p587-603.
- Hendry DF and Wallis KF (eds) (1984) Econometrics and Quantitative Economics, Basil Blackwell.
- Intriligator, Bodkin and Hsiao (1996) "Econometric Models, Techniques and Applications"
- Maddison A (1982) Phases of Capitalist Development, Oxford.
- Wallis KF (1979) Topics in Applied Econometrics, Basil Blackwell.

Part 3 Specific Information

NB: Not all of the topics are covered in the course

Industry: Growth and Size

Growth and Firm Size: Limited Dependent Variables, Heteroscedasticity and Sample Selection

General Background

- Sawyer M (1985) "The Economics of Industries and Firms", Routledge.
- Caves RE (1998) "Industrial Organisation and New Findings on the Turnover and Mobility of Firms", Journal of Economic Literature, Vol. XXXVI, December, pp1947-1982.
- Sutton J (1997) "Gibrat's Legacy" Journal of Economic Literature, Vol. XXXV, December, pp 40-59.

General Texts

- Intriligator M, R Bodkin, C Hsiao (1996) "Econometric Models, Techniques and Applications", Prentice Hall. Chapter 7.
- Judge et al (19) "The Theory and Practice of Econometrics", Wiley.
- Maddala GS (1992) Introduction to Econometrics, Prentice Hall, 2nd edn. Chapters 5 and 8.
- Maddala GS (1983) Limited Dependent and Qualitative Variables in Economics", CUP.
- Berndt (1991) "The Practice of Econometrics", Addison Wesley. Chapter on labour supply particularly relevant.

Specific:

It is worthwhile going back to the original articles which are referenced in the text.

- Dunne P and A Hughes (1993) "Age, Size, Growth and Survival: UK Companies in the 1990s", Journal of Industrial Economics Vol XLII, No 2, June, pp 115-40.
- Evans, DS (1987) "The Relation Between Firm Growth, Size and Age", Journal of Industrial Economics, Vol 35, June.
- Kumar MS (1985) "Growth, Acquisition Activity...", Journal of Industrial Economics, Vol 35, March
- Cheshire A (1979) "Testing the Law of Proportionate Effects", Journal of Industrial Economics, Vol 27, June.
- Singh A and G Whittington (1975) "The Size and Growth of Firms", Review of Economics Studies, XLII, Jan, pp 15-26.

LIMDEP 7.0 Manual especially chapters 21, 24, 28,

Is available on the internet and a link to this resource can be found at:

STATA 9 Manuals

Macromodelling/VARs: Vector Autoregressions, Cointegration and Causality

General reading:

- J Stewart and L Gill (1998) "Econometrics", Prentice Hall. Ch 9.
- Intriligator, Bodkin and Hsiao (1996) "Econometric Models, Techniques and Applications", Chapter 6,9,11
- W Charemza and M Deadman (1997) "New Directions in Econometric Practice", Edward Elgar. Ch 6.
- J Stewart and L Gill (1998) "Econometrics", Prentice Hall. Ch 9.
- R Harris and Sollis (2003) "Applied Time series Modelling and \Forecasting", Prentice Hall. Useful exposition of co integration. R Harris (1995) version "Using Cointegration Analysis in Econometric Modelling" is still useful.

Specific Articles:

- Granger CWJ (ed) (1991) "Modelling Economic Series", Clarendon Press, Oxford. This contains reprints of:
 - Sims CA (1980) "Macroeconomics and Reality", *Econometrica*, Vol 48, No 1, Jan, pp1-48.
 - Pagan A (1987) "The Econometric Methodologies: A Critical Appraisal", *Journal of Economic Surveys*, Vol 1, No 1, jan.
 - Leamer EE (1983) "Lets Take the Con Out of Econometrics", *American Economic Review*, Vol 23, no 1, March.

Applications:

- Dunne P and R Smith (1990) "Military Expenditure and Unemployment in the OECD", *Defence Economics*, Vol 1, pp 57-73. This article estimates the simplest form of VAR to test for Granger causality between military spending and unemployment.
- Smith, Ron, Paul Dunne and Eftychia Nikolaidou (2000) "The Econometrics of Arms Races", *Defence and Peace Economics*, Volume 11, Number 1, 2000, pp 31-43. Provides a useful exposition of VARs and cointegrating VARS in considering their use in analysing arms races.
- Dunne, Paul, Eftychia Nikolaidou and Ron Smith (2001) "Arms Race Models and Econometric Applications". Paul Levine and Ron Smith (eds) (2001) "*The Arms Trade, Security and Conflict*", Harwood Academic Publishers. Version available on websits. Provides some applications of the models in the previous paper.
- Birdi, Alvin and Paul Dunne (2001) "An Econometric Analysis of Military Spending and Economic Growth in South Africa". Chapter 9 in Jurgen Brauer and J Paul Dunne (eds) "*Arming the South: The Economics of Military Expenditures, Arms Production and Trade in Developing Countries*". Palgrave. Version available on the website. This considers how cointegrating VAR methods may improve upon the usual approach to estimating growth models.

Additional: Efficiency and Volatility

ARCH Modelling in Economics - Empirical Applications

The Autoregressive Conditional Heteroscedasticity (ARCH) developed by Engle (1982) can account for the difference between the unconditional and the conditional variance of a stochastic process. While conventional econometric models operate under the assumption of constant variance, the ARCH process allows the conditional variance to vary over time, leaving the unconditional variance constant. This has been developed through the Generalized ARCH (GARCH) family of models.

Some readings:

- Bollerslev, T., 1986, Generalised Autoregressive Conditional Heteroscedasticity, *Journal of Econometrics*, 31, pp. 307-327.
- Choudhry, T., 1996, Stock Market Volatility and the Crash of 1987: Evidence from Six Emerging Markets, *Journal of International Money and Finance*, vol. 15, no. 6, pp. 969-981.
- Engle, R.F. and Bollerslev, T., 1986, Modelling the Persistence of Conditional Variances, *Econometric Reviews*, 5, pp. 1-50, 81-87.
- Engle, R.F. and Ng V.K., 1993, Measuring and Testing the Impact of News on Volatility, *Journal of Finance*, vol. XLVIII, No.5, pp. 1749-1778.
- Pagan, A. and Schwert, W., 1990, Alternative models for conditional stock volatility, *Journal of Economics*, 45.

Panel Data Models

Analysing Panels of Data

This lecture looks at the estimation of static panel data models using the fixed effects and random effects approaches. Some diagnostic tests are also considered.

Introductory accounts

- Greene, W.H. (2002) *Econometric Analysis*, 5th edn., ch. 14. Prentice Hall. You need third edition or later as the second edition did not contain much material on panels.
- Johnston J and J Dinardo (1997) *Econometric Methods*, ch. 12. McGraw-Hill. 4th Edn. There is nothing on panel data in earlier editions.

More advanced treatments

- Cameron, AC and PK Trivedi (2005) *Microeconometrics: Methods and Applications*,
- Baltagi B.H. (1995) "Econometric Analysis of Panel Data", New York: Wiley
- Hsiao, C (1986) *Analysis of Panel Data*. Cambridge University Press.
- Griliches, Z and M Intriligator (eds) *Handbook of Econometrics Vol 2*. Chapter on Panel Data.
- The Limdep Manual version 7 is available on the internet and chapter 17 is particularly useful on this topic.
- Smith, Ron P (2000) "Estimation and inference with non-stationary panel time series data", Mimeo, Birkbeck College.

Data files

The data for the exercise can also be downloaded from the above internet page in a number of formats.

Applied articles:

Birdi, Alvin, Paul Dunne and David Saal (2000) "The Impact of Arms Production on the South African Manufacturing Industry", *Defence and Peace Economics* Volume 11, No. 6, 2000, pp 597-613. Uses industry level data for South Africa to estimate production functions.

Cambridge University Press. Useful for panel data

Deaton, Angus (1997) *The Analysis of Household Surveys: A Microeconomic approach to Development Policy*, Johns Hopkins University Press. Useful for panel data

Greene, WH (2002) "*Econometric Analysis*", Prentice Hall, 5th edn.

Intriligator M, R Bodkin, C Hsiao (1996) "*Econometric Models, Techniques and Applications*", Prentice Hall.

Judge et al (1985) *The Theory and Practice of Econometrics*", Wiley.

Patterson, K (2000) "*An Introduction to Applied Econometrics*", Palgrave. Useful for time series

Thomas RL (1993) "*Introductory Econometrics: Theory and Applications*", Longman

Wooldridge, Jeffrey (2002) *Econometric Analysis of Cross Section and Panel Data*, Massachusetts Institute of Technology.

Demand Analysis

General Texts

- Intriligator M, R Bodkin, C Hsiao (1996) "Econometric Models, Techniques and Applications", Prentice Hall. Chapter 7.
- Thomas RL (1993) "Introductory Econometrics: Theory and Applications", Longman. Chapter 9. A very good comprehensive survey.
- Desai, M (1976) "Applied Econometrics", Philip Allan. Chapter 3. A bit dated but useful exposition
- Deaton A and J Muellbauer (1980) "Economics and Consumer Behaviour", Cambridge University Press. Chapters 1,2,3. Very good background, particularly for theory, though terse
- Deaton A (1993) "Demand Analysis", Chapter 30, Vol 3, Griliches, Z and MD Intriligator (eds) (1993) "Handbook of Econometrics", Elsevier. Valuable survey of developments in the field

Specific:

It is worthwhile going back to the original articles on demand analysis, which are referenced in the texts. Articles that are particularly useful for the demand systems being estimated in the computer class are:

- Deaton A and J Muellbauer (1980) "An Almost Ideal Demand System", American Economic Review, Vol 70, No 3, pp 312-26. -classic article essential reading
- Dunne JP and RP Smith (1983) "The Allocative Efficiency of Government Expenditure: Some Comparative Tests", European Economic review, Vol 20, pp 381-94.
-an application of the above
- Anderson G and R Blundell (1982) "Estimation and Hypothesis Testing in Dynamic Singular Equation Systems", Econometrica, 50, pp1559-76.
-specify a general dynamic form of the model with the dynamics coming from the empirical specification rather than the data
- Dunne JP, P Pashardes and RP Smith (1984) "Needs, Costs and Bureaucracy: The Allocation of Public Consumption in the UK", Economic Journal, March, pp 1-15.
-provide a dynamic model that is based upon a dynamising of the theoretical model
- Ng S (1995) "Testing for Homogeneity in Demand Systems when the Regressors are Non-stationary", Journal of Applied Econometrics, Vol 10, pp 147-63.

Production Functions

Econometric Estimation of Production Functions

General Texts

- Thomas RL (1993) "Introductory Econometrics", Longman Ch 11
- Intriligator, Bodkin and Hsiao (1996) "Econometric Models, Techniques and Applications", Chapter 8
- Berndt ER (1991) "The Practice of Econometrics", Addison Wesley. Chapter 9.

Other useful:

- Wallis KF (1979) "Topics in Applied Econometrics", Blackwell. Chapter II
- Desai M (1976) "Applied Econometrics", Philip Alan. Chapters 5 and 6
- Hebden J (1983) "Applications of Econometrics" Philip Allen. Chapters 4 and 5.

Applied Articles:

- Batchelor, P, Dunne, P and D Saal (1999) "Military Spending and Economic Growth in South Africa", *Defence and Peace Economics* Volume 11, No. 6, 2000, pp 553-571. Applies a Feder-Ram growth model to South African data.
- McCombie and Dixon (1991) "Estimating Technical Change in Aggregate Production Functions: A Critique", *International Review of Applied Econometrics*. Provides a valuable critique of studies estimating aggregate production functions.
- Crafts N (1992) "Productivity Growth Reconsidered", *Economic Policy*, CEPR. Useful survey of issues and literature.
- Articles by Dowrick and Shaw (1992) "Policy Forum: The Determinants of Economic Growth", *Economic Journal*, 598-621.

Consumption

Consumption Analysis

We consider the development of econometric analyses of the consumption function from early Keynesian studies through the celebrated DHSY study and random walk type models. We also look at some recent problems with estimating consumption from the 1990s onwards. The best reference is Thomas (1993) below.

General Reading

- W Charemza and M Deadman (1997) "New Directions in Econometric Practice", Edward Elgar. Ch3,4,5.
- Deaton, A.S (1994) Understanding Consumption, Oxford: Clarendon Press.
- Deaton, A and J. Muellbauer (1980) Economics and Consumer Behaviour. Cambridge University Press.
- Thomas, R.L. (1993) Introductory Econometrics, 2nd edn., ch. 10. Longman.
- Wallis, K (1979) Topics in Applied Econometrics, ch. 1. Blackwell.

Original Papers

- Berg, G.L. and R Bergstrom (1995) "Housing and financial wealth, financial deregulation and consumption - the swedish case" Scandinavian Journal Of Economics 97 No.3, pp.421- 439.
- Branson, W.H. and A.K. Klevorick (1969) "Money illusion and the aggregate consumption function", American Economic Review, 59, 832-49.
- Campbell, J and A. Deaton (1989) "Why is consumption so smooth?" Review of Economic Studies, 56, 357-74.
- Carruth, A. and A. Henley (1990) "Can existing consumption functions forecast consumer spending in the late 1980s?", Oxford Bulletin of Economics and Statistics.
- Carruth, A. and A. Henley (1990) "The housing market and consumer spending", Fiscal Studies, August.
- Davidson, J.E.H., D.F. Hendry, F. Srba and S. Yeo (1978) "Econometric Modelling of the Aggregate Time Series Relation between Consumer's Expenditure and Income in the UK", Economic Journal, 88, 661-9.
- Deaton, A.S (1974) "The analysis of consumer demand in the UK 1900-1970" Econometrica, 42, 341-67.
- Hall, R.E. (1978) "Stochastic Implications of the life cycle permanent income hypothesis: theory and evidence", Journal of Political Economy, 86, 339-57.
- Hendry, D.F and Urgan-Sternberg, T von (1980) "Liquidity and inflation effects on consumer's expenditure" in A.S. Deaton (ed) Essays in the Theory and Measurement of Consumer's Behaviour, Cambridge University Press.
- Molana, H. (1991) "The time series consumption function: error correction, random walk and the steady state", Economic Journal, 101, 382-403.

- Pesaran, M.H. and R.A. Evans (1983) "Inflation, capital gains and UK personal savings: 1953-81", *Economic Journal*, 94, 237-57. Reprinted in the Microfit manual.
- Song, H Y, P Romilly and X.M. Liu (1998) "The UK consumption function and structural instability: improving forecasting performance using a time-varying parameter approach", *Applied Economics* 30, No.7, pp.975-983.
- Stewart, C (1998) "Reinterpreting the DHSY (1978) consumption function with hindsight" *Applied Economics*, 30 No.4, pp.477-489.
- Stone, J.R.N (1964) "Private saving in Britain, past present and future, Manchester School, 32, 79-112.