

<b>COURSE TITLE:</b>	<b>QUANTITATIVE METHODS</b>
<b>Course Co-ordinator:</b>	Gwilym Pryce
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<b>Location:</b>	Department of Urban Studies, 27 Bute Gardens

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### Course Delivery:

<b>Semester:</b>	1 & 2
<b>Time and Location of Lectures:</b>	Monday 5.30pm – 7.00pm, Lecture Theatre B, Boyd Orr Building (except for the first lecture of Module I which will take place on <i>Tues 27<sup>th</sup> Sept in Boyd Orr Lecture Theatre A at 10am</i> ).
<b>Time and Location of Labs:</b>	Monday 3pm to 5pm, Adam Smith Building, or Monday 7pm to 9pm, Adam Smith Building (students will allocated to the afternoon or evening lab).

### Course Aims:

The aims of this course are to: (1) provide tools and skills to help students produce valid inferences about economic, social and political life; and (2) enhance student's ability to evaluate and consider published research. Knowledge of fundamental statistical concepts is a prerequisite to achieving either of these aims.

### Learning Outcomes

By the end of the course, students should be able to:

1. Understand the purpose and potential of statistics in social science;
2. Distinguish between different types of variables;
3. Understand and apply basic methods of data description using SPSS;
4. Understand the principles of inference and apply them to practical problems;
5. Understand the logic and application of hypothesis testing and confidence intervals;
6. Understand the intuition behind regression analysis and be able to construct models using SPSS;
7. Outline the basic assumptions of regression analysis and the implications of their violation;
8. Test for infringements of the OLS assumptions and apply appropriate remedies;
9. Understand and apply logistic regression analysis using SPSS;
10. Interpret odds ratios from logistic regression output.

### Assessment

100% of the assessment will be in the form of two equally weighted projects (one for Module I and one for Module II). Submission dates are Tues, 20<sup>th</sup> Dec 05 for Module I and Thursday, 11<sup>th</sup> May 06 for Module II.

### Teaching Staff

The course is taught and co-ordinated by Dr Gwilym Pryce. Labs will be run by lab assistants. Gwilym will take the lectures for Module II.

### Course Summary

The first part of the course (**Module I**) introduces issues such as measurement of variables, describing properties of variables, visualisation of data, examining relationships between variables, the process of inference from samples to populations, the role of research design in

the interplay between theory and empirical data, and the logic of hypotheses testing. The second part of the course (**Module II**) focuses on statistical inference and hypothesis testing in the context of the basic linear regression model.

Our goals are primarily practical. We will emphasise how to use quantitative methods to analyse empirical data and how to substantively interpret and use the results of such analyses rather than the formal foundations of statistics. The course assumes no prior knowledge of statistics or knowledge of mathematics beyond a secondary school level.

*To understand statistics, you must use statistics.* Much of this material is difficult to grasp first time round, and very few will be able to master the subject from lectures and course notes alone. Although it is a compulsory requirement of the course that you attend the course lectures, you cannot expect to learn this material simply by showing up to classes. The key to success in this course is practice, and gaining hands-on experience through the practical exercises is an essential part of the course. Attendance at both labs and lectures is mandatory for all students and registers will be taken at both.

### **Reading: Module I**

#### **Books Recommended for Purchase:**

Essential reading for Module I is the following text:

Pryce, G. (2005) *Inference and Statistics in SPSS*, Geebeeje Publishing.

Because SPSS does not have built-in procedures for the most basic classical statistical tests (no shortage of advanced ones!) most courses teach theory and practice in a disjointed way. This text makes use of a series of macro commands which allow you to tackle questions where only summary data is provided (such as the mean, standard deviation, sample size), as well as those problems that provide you with tables of original data. Without these macros, SPSS will only allow you to run statistical tests if you have the original data; SPSS is impotent if you only have summary statistics and so these custom built commands will also prove useful in reading other peoples work where the original data is rarely presented. For example, if a periodical or newspaper reports that *17% of people voted for "The Bard" as the greatest Briton of all time, based on a sample size of 2000*, you could use the macros to run a confidence interval or hypothesis test using that information alone.

#### **Other Books and Papers for consultation:**

We will be using the statistical package SPSS for this course. Although we will review and gain practice in SPSS during the computer workshops, you will need to work individually outside class to familiarise yourself with the program. You might find it helpful to buy/borrow a book on SPSS. Various texts are available. A popular one is,

Field, A. (2005) "*Discovering statistics using SPSS for Windows : advanced techniques for the beginner*" 2<sup>nd</sup> Ed. (London : Sage)

an earlier version of which is in the library but definitely worth purchasing (particularly since it is useful for much of Module II also).

On the theory side, I would recommend:

Moore, D.S. and McCabe, G.P. (2003) *Introduction to the Practice of Statistics* 4<sup>th</sup> Ed. (San Francisco: Freeman)

A useful alternative to Moore and McCabe is:

Moore, D.S. (2000) *The Basic Practice of Statistics*. (2<sup>nd</sup> Edition, San Francisco: Freeman)

or more recent versions.

Most of you will probably find reading about specific issues in more than one text helpful for this course. The below list outlines some suggested sources covering parts of the course material. I have tried to give some guidelines, but the important thing is that you find something that will work for you.

David S. Moore. (2001) *Statistics: Concepts and Controversies*. (5<sup>th</sup> Edition, New York: Freeman).

This is a thoughtful introductory text on the use of statistics in research and will help you get started. This is a very much an introductory text, however, and is less useful as a reference book for specific concepts and issues.

Daniel B. Wright's *Understanding Statistics: An Introduction for the Social Sciences* (London: Sage, 1997) is an introductory text on mathematical statistics for social scientists.

Edward R. Tufte. *Data Analysis for Politics and Policy* (Englewood Cliffs, NJ: Prentice Hall, 1974)

is a very insightful and readable introduction to applied analysis in social science research.

Christopher H. Achen *Interpreting and Using Regression* (Beverly Hills, CA: Sage, 1982)

is a very thoughtful monograph on regression.

Eric A. Hanushek and John E. Jackson. 1977 *Statistical Methods for Social Scientists* (Orlando, FL: Academic Press)

has a comprehensive discussion-based exposition of statistics that some may find appealing. Note that it is hard to look up single concepts without having to read the text extensively. Finally, a general guide to reading statistics and research is:

Huck, S. W. (2004) *Reading Statistics and Research* (Boston, USA: Pearson, 4<sup>th</sup> Edition)

which is nicely presented and fully revised.

### **Reading: Module II**

We will be using the statistical package SPSS for this course. Although we will review and gain practice in SPSS during the computer workshops, you will need to work individually outside class to familiarise yourself with the program. You might find it helpful to buy/borrow a book on SPSS. Various texts are available. A popular one is:

Field, A. (2005) "*Discovering statistics using SPSS for Windows : advanced techniques for the beginner*" 2<sup>nd</sup> Ed. (London : Sage)

which was also recommended for Module I.

### **Books Recommended for Purchase:**

For Module II I recommend Andy Field's book noted above and also:

Peter Kennedy (1994) *A Guide to Econometrics* (Cambridge, MA: MIT Press)

which provides an overview over issues and topics in applied regression analysis (though not in any great depth it has to be said).

**Key Books and Papers for consultation:**

Numerous introductory texts in econometrics will also cover these issues. Have a browse in the Economics and Statistics sections of the bookstore. One that's in the library is worth a particular mention is:

Michael, Lewis-Beck (ed.). 1993. *Regression Analysis*. Newbury Park, CA: Sage.

This volume is a collection of a number of short monographs on topics in regression analysis from the Sage Quantitative Methods in the Social Sciences series (sometimes referred to as "the green paper" series due to the green paperback design). The most important section is the Lewis-Beck monograph on Regression Analysis, which can also be purchased individually. If you plan to use regression analysis in your research, a very worthwhile investment is:

Greene, William, 2003. *Econometric Analysis*. 5<sup>th</sup> Edition, Prentice Hall, New Jersey.

This is an advanced text but an excellent book for reference, written by a respected statistician. Earlier editions are also very good and are available in the library.

**Course Outline:**

Below is a detailed structure of the course, with brief descriptions of the contents and reading for each session. Note that the timing of material may change depending on how well the class is progressing, student feedback etc. All lectures will be presented by Dr Gwilym Pryce.

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**Module I***Induction / Week 1: Introduction to Quantitative Methods in Social Science*

Course overview and organisation  
Review of basic Concepts and Mathematical Notation  
Translating social phenomena to data  
Types of data/levels of measurement  
Summarising data using tables, graphs and statistics

*Week 2: Introduction to Inference*

Review of Measures of Central Tendency and Dispersion  
Normal distribution  
Distribution of means from repeated samples  
Problems with the CLT  
Student's t-distribution  
Proportions

*Week 3: Calculating z-Scores*

Calculating the Probabilities Associated with z-scores  
Calculating z for a normally distributed variable,  $x$   
Distribution of Sample Means

*Week 4: Confidence Intervals*

Three steps of Confidence Interval calculation  
Large Sample Confidence Interval for the mean  
Small Sample Confidence intervals for the Population mean

*Week 5: Confidence Intervals*

Small Independent Samples CI for 2 means  
Small sample Matched Pairs  
Large Sample Confidence Intervals for Proportions

Calculating Confidence Intervals for Original Data  
Graphical Representation of Confidence Intervals for Data  
Sample size determination

*Week 6: Introduction to hypothesis testing*

Significance

The 4 steps of hypothesis testing

P-Values for one and two tailed tests

Large Sample Significance Test on One Mean

Small Sample Hypothesis test on one mean

*Week 7: Hypothesis Tests for All Occasions*

Large and Small sample significance tests on one mean

Small Independent Samples significance test for 2 means

Small Sample Matched Pairs significance test for 2 means

Large Sample significance test on one proportion

Large Sample significance test on two proportions

*Week 8: Relationships between Categorical Variables*

Contingency Tables

Chi-Square Test for Independence

*Week 9: Regression I: OLS and Interpreting Output*

Ordinary Least Squares And Related Terminology

OLS Estimates are BLUE

Doing Regression analysis in SPSS

Confidence Intervals for regression coefficients

OLS Assumptions (also called the Gauss-Markov theorem)

*Week 10: Regression II: Dealing with Categorical Variables*

Dummy explanatory variables

Categorical dependent variable regression: logit

*Weeks 11 & 12 Catch-up and Review*

Finishing off core material

Summary of material covered

Guide to further study: other techniques

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**Module II**

*Week 1: Correlation And Inference From Regression*

Covariance and the Simple Correlation Coefficient

Multiple Regression

Interpreting coefficients

Inference from regression

Confidence Intervals

Hypothesis tests on slope coefficients

*Week 2: Prediction And Analysis Of Variance*

Prediction and Error

Errors

ANOVA in regression

The F-Test

Regression assumptions

*Week 3: Non-Linearities And Dummy Variables*

Non-linearities

Visual inspection of Scatter plots

Testing for non-linearities using t-statistics

Using dummy variables

*Week 4: F-Tests*

Doing F-tests with the aide of a computer

Testing a set of linear Restrictions when the Restrictions are Homogenous

Testing for the existence of a relationship

Testing for Structural Breaks

*Week 5: Omitted And Irrelevant Variables*

Causes & Consequences

Diagnostic Tests:

(i) Adjusted  $R^2$

(ii) t-values

(iii) Ramsey's Regression Specification Error Test (RESET)

Inclusion of Irrelevant Variables

Consequences

Diagnostic tests

(i) t-tests

(ii) F-tests

(iii) Adjusted  $R^2$

(iv) Sequential regression

Solutions

*Week 6: Errors in variables*

Causes & Consequences

Diagnostic Tests & Solutions

Non-normal & Nonzero Mean Errors

Consequences & Diagnostic Tests

*Week 7: Heteroscedasticity*

Causes & Consequences

Detection:

(i) Specific Tests/Methods

(ii) General Tests

Solutions:

(i) Weighted Least Squares

(ii) Whites Standard Errors

*Week 8: Multicollinearity and Modelling Strategies*

Causes & Consequences of Perfect Multicollinearity

Causes & Consequences of Near Multicollinearity

Diagnosis

Solutions

Modelling Strategies

A Salutary Tale

General to Specific

*Week 9: Categorical/Limited Dependent Variables and Logistic Regression*

Choosing the Appropriate Statistical Models

Linear Probability Model & its Problems

Logit

Interpreting Odds Ratios

**Problems**

If you have any problems or queries relating to the course, you should contact Dr Gwilym Pryce:

Office location: 27, Bute Gardens, Department of Urban Studies.  
Consultation time: available 12.00pm to 2.00pm most Mondays in term time (worth ringing beforehand to confirm his availability and that secretaries will be on duty to allow you into the building) and at other times by appointment.  
Tel. for appointment: 0141 330 5048 or 330 4693.  
E-mail: [g.pryce@socsci.gla.ac.uk](mailto:g.pryce@socsci.gla.ac.uk)