

Queen's University
Department of Economics

ECONOMICS 452* -- Winter Term 2009

APPLIED ECONOMETRICS

Winter Term 2009

M.G. Abbott

Instructor: Mike Abbott

Office: Room A521 Mackintosh-Corry Hall

Tel: 613-533-2298

Fax: 613-533-6668

E-mail: abbott@econ.queensu.ca

Web Site: <http://www.econ.queensu.ca/pub/faculty/abbott/econ452/>

Time Slot 52: Mondays, 4:00 p.m. – 5:20 p.m.
Wednesdays, 2:30 p.m. – 3:50 p.m.

Office Hours -- Winter Term 2009:

- ♦ Tuesdays 2:30 p.m. – 4:00 p.m.
- ♦ Thursdays 2:30 p.m. – 4:00 p.m.

Secretary: Brittany Lovelock

Office: Room 209 Dunning Hall

Tel: 613-533-2522

Fax: 613-533-6668

Email: lovelock@econ.queensu.ca

ECONOMICS 452* -- Winter Term 2009**APPLIED ECONOMETRICS****Purpose and Organization**

The purpose of the course is to help students **learn to use econometric methods in empirical economic research**. The course focuses exclusively on econometric models and methods designed for analysis of *cross-sectional data*. It emphasizes problems that arise in actually conducting applied econometric research on cross-sectional data, and modern methods and practices for dealing with these problems. Empirical examples – many drawn from recent literature in applied economics – are presented to illustrate the application of all econometric methods covered in the course.

Course material is presented in both scalar and matrix terms. Extensive use is made of **matrix algebra** in the presentation of econometric methods and results.

Learning Objectives

Upon completion of the course, students should have acquired the methodological, operational and expository skills required **to design and conduct a small-scale econometric investigation** and **to write an accurate, complete and coherent report** of its methods and findings. They should also have developed the **capacity to comprehend and critically assess applied econometric studies** based on cross-sectional data.

Course Format

The course is based on *two 80-minute lectures per week*. In addition, *hands-on tutorials* are scheduled in the Department of Economics Computer Classroom (Dunning Hall 350) at times to be arranged. The tutorials are designed to familiarize students with those features of the statistical software program *Stata* they will need for the assignments in the course.

Course Work and Assessment

❑ Assignments: Two Research Projects

Two assignments will be given during the term. These assignments will require students to perform small econometric research projects that apply the various econometric methods and practices covered in the course.

The assignments will be *goal-specific* rather than *task-specific* in nature. That is, they will specify broad research objectives, a general empirical framework, and a dataset for each project, but will not specify in detail how the objectives are to be achieved or how the empirical framework is to be implemented.

Students will therefore be responsible for formulating a specific research design for achieving the research objectives of each project, for deciding what specific empirical results are reported and how they are presented and interpreted, and for writing a complete, coherent and well-documented project report. The **required format** for each project report is that of a short economics journal article.

Students are permitted to work in pairs in researching, writing and submitting the two assignments. However, students have the option of doing assignments individually if they wish to do so.

❑ Mid-Term Exam

A **mid-term exam** will be given in class during the tenth week of the term, on a date to be arranged. The exam will test students' knowledge and understanding of the important econometric principles, methods and practices covered in the course.

Note: There will be NO final exam in the course.

❑ Final Course Grade

Each student's **final course grade** will be computed using the following weights for the three course components:

Assignment 1	40 %
Assignment 2	40 %
Mid-term Test	20 %

Textbooks: Required and Recommended***Required Textbook***

The required textbook for the course is the fourth (2009) or third (2006) edition of the introductory textbook by Jeffrey Wooldridge:

Jeffrey M. Wooldridge, *Introductory Econometrics: A Modern Approach*, Fourth Edition. South-Western Cengage Learning, 2009. ISBN13: 978-0-324-58162-1. ISBN10: 0-324-58162-9.

Jeffrey M. Wooldridge, *Introductory Econometrics: A Modern Approach*, Third Edition. South-Western College Publishing, 2006. ISBN 0-324-28978-2.

This book provides excellent modern treatments of all topics included in the course. It also contains plenty of real applications of econometric methods. Copies of Wooldridge (2009) can be purchased in the Campus Bookstore, and copies of Wooldridge (2006) are on reserve in Stauffer Library Reserve Room.

Note that the *third (2006) edition* of this textbook (ISBN 0-324-28978-2) is also completely adequate for purposes of this course.

Recommended Textbooks

The following three textbooks are recommended for supplementary reading.

Damodar N. Gujarati, *Basic Econometrics*, Fourth Edition. New York: McGraw-Hill, 2003. ISBN 0-07-233542-4.

A standard textbook in introductory econometrics, Gujarati (2003) provides clear expositions of many of the topics covered in the course.

William E. Griffiths, R. Carter Hill, and George G. Judge, *Learning and Practicing Econometrics*. Toronto: John Wiley & Sons, 1993. ISBN 0-471-51364-4.

The Griffiths, Hill and Judge (1993) book provides accessible, user-friendly and moderately advanced treatments of most of the topics included in the course.

Ernst R. Berndt, *The Practice of Econometrics: Classic and Contemporary*. Don Mills, ON: Addison-Wesley Publishing Company, 1991. ISBN 0-201-17628-9.

Berndt (1991) is an excellent "hands-on" textbook in applied econometrics; it emphasizes the implementation of econometric techniques in real empirical applications.

Computer Software

The required econometric software package for the course is *Stata*. The current release of *Stata for Windows* is Release 10 (*Stata 10*), but Release 9 (*Stata 9*) is perfectly adequate for purposes of this course.

The *Stata* web site is at: www.stata.com.

Stata tutorials distributed during the term on the course web site will give students hands-on instruction in those features of *Stata* required to implement the econometric methods covered in the course and to do the two research assignments. In addition, **scheduled computing labs** in the Department of Economics Computer Classroom (Dunning Hall 350) will give students the opportunity to obtain individual assistance with both the computer tutorials and the research assignments.

Stata 10 for Windows will run under Windows Vista, Windows XP and Windows 2000. Students with their own PCs may wish to acquire a PC version of *Stata* suitable to their hardware.

Two basic versions of *Stata 10* are available:

Small Stata – *Stata 10* for small computers

- Datasets are restricted to a maximum of 99 variables and approximately 1000 observations.
- Matrices may be up to 40 x 40.
- String variables up to 80 characters.
- Computer should have at least 512 MB of RAM and 80 MB of disk space.

Stata/IC -- the standard professional version of *Stata 10*

- A maximum of 2,047 variables; the only limit on observations is the amount of RAM on your computer.
- Very fast.
- Matrices may be up to 800 x 800.
- 64-bit version available.
- Maximum number of right-hand variables = 798
- String variables up to 80 characters.
- Computer should have at least 512 MB of RAM and 80 MB of disk space.

Stata/IC is the required version of *Stata 10* for this course. Small Stata's restrictions on dataset size would prove to be binding for the research assignments in the course. Note that ***Intercooled Stata for Windows Release 9 (Intercooled Stata 9)*** is also perfectly adequate for this course.

Documentation for Stata 10

Core hard copy documentation for **Stata 10 for Windows** consists of five manuals (approximate prices in US dollars):

- ***Getting Started with Stata for Windows*** (\$25.00);
- ***User's Guide*** (\$45.00);
- ***Base Reference Manual*** (3 volumes, \$150.00);
- ***Graphics Reference Manual*** (\$65.00);
- ***Data Management Reference Manual*** (\$50.00).

The first two manuals are particularly useful for relatively new *Stata* users.

Complete information on Stata 10 documentation is available from the Stata web site at <http://www.stata.com/bookstore/documentation.html>.

Purchasing your own copy of the Stata 10 statistical software

The course instructor has set up a plan – called a *Stata* course GradPlan – whereby students can purchase their own copies of the *Stata 10* statistical software and documentation at special student discount prices. Students who wish to take advantage of this GradPlan should send an e-mail message to the instructor, who will send them instructions on how to proceed.

Background Preparation for ECON 452*

It is assumed that students have successfully completed an introductory undergraduate econometrics course such as ECON 351*, and an introductory university-level calculus course such as MATH 126 or MATH 121.

Since extensive use is made of matrix algebra, a selective review of basic concepts in matrix algebra may be advisable. For *a brief review of matrix algebra*, see either Wooldridge (2009), Appendix D, pp. 788-797 or Wooldridge (2006), Appendix D, pp. 808-818.

COURSE OUTLINE AND READINGS

NOTE: All readings in Wooldridge (2009, 2006) are required. In addition, lecture notes for several sections of the course are posted on the course web site in PDF format.

1. SPECIFICATION ISSUES IN LINEAR REGRESSION MODELS

A. Theoretical Specification of the Classical Linear Regression Model

NOTE 1: Formulation and Specification of the Multiple Linear Regression Model in Vector-Matrix Notation.

Wooldridge (2009). Ch. 3, Sec. 3.3, pp. 84-88; Appendix D, pp. 788-798; Appendix E, Sec. E.2, pp. 801-805.

Wooldridge (2006). Ch. 3, Sec. 3.3, pp. 89-94; Appendix D, pp. 808-818; Appendix E, Sec. E.2, pp. 822-825.

B. Selection of Regressors

NOTE 2: Specification Errors in the Selection of Regressors.

Wooldridge (2009). Ch. 3, Sec. 3.3, pp. 89-94.

Wooldridge (2006). Ch. 3, Sec. 3.3, pp. 94-99.

1. Exclusion of Relevant Regressors: Omitted Variables Bias

2. Inclusion of Irrelevant Regressors

C. Functional Form of the Regression Function

Wooldridge (2009). Ch. 2, Sec. 2.4, pp. 41-46; Ch. 6, Sec. 6.2, pp. 189-199; Ch. 9, Sec. 9.1, pp. 300-306.

Wooldridge (2006). Ch. 2, Sec. 2.4, pp. 44-50; Ch. 6, Sec. 6.2, pp. 197-206; Ch. 9, Sec. 9.1, pp. 304-310.

C. Functional Form of the Regression Function (concluded)

1. Marginal Effects of Continuous Explanatory Variables: Constant or Variable?

NOTE 3: Marginal Effects of Continuous Explanatory Variables: Constant or Variable?

2. Functional Form in the Variables: Linear or Logarithmic?

NOTE 4: Functional Form in the Variables: Linear or Log?

D. Coefficient Differences and Dummy Variable Regressors

Wooldridge (2009). Ch. 7, Secs. 7.1-7.4, pp. 225-246.

Wooldridge (2006). Ch. 7, Secs. 7.1-7.4, pp. 230-252.

NOTE 5: Using Dummy Variable Regressors for Two-Category Categorical Variables.

NOTE 6: Using Dummy Variable Regressors for Multi-Category Categorical Variables.

NOTE 7: Dummy Variable Interaction Terms.

NOTE 8: A General Regression Model with Dummy Variable Interactions.

**2. OLS ESTIMATION OF THE LINEAR REGRESSION MODEL:
MATRIX FORMULATION**

NOTE 9: OLS Estimation of the Classical Linear Regression Model: Matrix Notation and Derivations.

Wooldridge (2009). Ch. 3, Sec. 3.2, pp. 73-83; Appendix E, Sec. E.1, pp. 799-801.

Wooldridge (2006). Ch. 3, Sec. 3.2, pp. 78-89; Appendix E, Sec. E.1, pp. 819-822.

3. INFERENCE (HYPOTHESIS TESTING) IN THE LINEAR REGRESSION MODEL: REVIEW AND EXTENSIONS

NOTE 10: Testing Linear Coefficient Restrictions in Linear Regression Models: The Fundamentals.

Wooldridge (2009). Ch. 3, Secs. 3.4-3.5, pp. 94-104; Ch. 4, pp. 117-159; Appendix E, Sec. E.3, pp. 805-807.

Wooldridge (2006). Ch. 3, Secs. 3.4-3.5, pp. 99-109; Ch. 4, pp. 123-167; Appendix E, Sec. E.3, pp. 826-827.

4. LINEAR REGRESSION MODELS WITH HETEROSKEDASTIC ERRORS

A. Consequences of Heteroskedastic Errors for OLS Estimation and Inference

NOTE 11: Heteroskedasticity-Robust Inference in Linear Regression Models Estimated by OLS.

Wooldridge (2009). Ch. 8, Sec. 8.1, pp. 264-265.

Wooldridge (2006). Ch. 8, Sec. 8.1, pp. 271-272.

B. OLS With Heteroskedasticity-Robust Inference

NOTE 11: Heteroskedasticity-Robust Inference in Linear Regression Models Estimated by OLS.

Wooldridge (2009). Ch. 8, Sec. 8.2, pp. 265-271.

Wooldridge (2006). Ch. 8, Sec. 8.2, pp. 272-276.

C. Tests for Heteroskedastic Errors

NOTE 12: Testing for Heteroskedasticity in Linear Regression Models.

Wooldridge (2009). Ch. 8, Sec. 8.3, pp. 271-276.

Wooldridge (2006). Ch. 8, Sec. 8.3, pp. 278-284.

D. GLS Estimation of Heteroskedastic Errors Models

Wooldridge (2009). Ch. 8, Sec. 8.4, pp. 276-290.

Wooldridge (2006). Ch. 8, Sec. 8.4, pp. 284-295.

5. MAXIMUM LIKELIHOOD ESTIMATION OF LINEAR REGRESSION MODELS

A. Fundamentals of Maximum Likelihood Estimation

Wooldridge (2009). Appendix C, Sec. C.4, pp. 761-762.

Wooldridge (2006). Appendix C, Sec. C.4, pp. 778-779.

B. ML Estimation of the Classical Normal Linear Regression Model

NOTE 13: Maximum Likelihood Estimation of the Classical Normal Linear Regression Model.

6. BINARY DEPENDENT VARIABLES MODELS

A. OLS Estimation: The Linear Probability Model

Wooldridge (2009). Ch. 7, Sec. 7.5, pp. 246-251; Ch. 8, Sec. 8.5, pp. 290-293.

Wooldridge (2006). Ch. 7, Sec. 7.5, pp. 252-257; Ch. 8, Sec. 8.5, pp. 295-297.

B. Probit and Logit Models: Basic Features

NOTE 14: Maximum Likelihood Estimation of Binary Dependent Variables Models: Probit and Logit.

Wooldridge (2009). Ch. 17, Sec. 17.1, pp. 575-578.

Wooldridge (2006). Ch. 17, Sec. 17.1, pp. 583-586.

C. ML Estimation of Probit and Logit Models

NOTE 14: Maximum Likelihood Estimation of Binary Dependent Variables Models: Probit and Logit.

Wooldridge (2009). Ch. 17, Sec. 17.1, pp. 578-579.

Wooldridge (2006). Ch. 17, Sec. 17.1, pp. 586-587.

D. Interpreting Probit and Logit Coefficient Estimates

NOTE 15: Marginal Effects in Probit Models: Interpretation and Testing.

Wooldridge (2009). Ch. 17, Sec. 17.1, pp. 580-587.

Wooldridge (2006). Ch. 17, Sec. 17.1, pp. 588-595.

E. Statistical Inference in Probit and Logit Models

NOTE 16: Testing Linear Coefficient Restrictions in Probit Models.

Wooldridge (2009). Ch. 17, Sec. 17.1, pp. 579-580.

Wooldridge (2006). Ch. 17, Sec. 17.1, pp. 587-588.

Major Steps in an Econometric Research Project

Step 1: Formulate a methodologically sound *research design*, or *research plan*, that effectively utilizes the available sample data to provide ***credible and complete empirical evidence*** on the empirical question(s) you are investigating.

Requires knowledge and understanding of both

- (1) the **principles of econometric model specification**, and
- (2) the **methods of estimation and inference** in econometric models.

Step 2: Execute the research plan in accordance with good econometric practice – i.e., conduct the econometric analysis required to assemble ***credible and complete empirical evidence*** on the empirical question(s) you were asked to investigate.

Requires a good working knowledge of both econometric methods and econometric software.

Step 3: Write an accurate, complete, and logically coherent *research report* in which you fully and accurately explain *what you did*, *how you did it*, and *what you found*.

Explaining *what you did* and *how you did it* involves:

- Describing the sample data you used;
- Specifying the econometric models you estimated;
- Identifying the estimation methods you used;
- Specifying the hypothesis tests you performed on each model.

Reporting *what you found* involves:

- Tabulating the results of your econometric analysis, including the coefficient estimates of all reported models and the results of all hypothesis tests performed on these models;
- Interpreting and explaining the results of your econometric analysis;
- Assessing the strength of the evidence you obtained on the empirical questions you were asked to investigate;
- Identifying limitations of your analysis and suggestions for further research.

Requires excellent organizational and technical writing skills.

A Template of an Econometric Research Paper

Kalena E. Cortes, "Are Refugees Different from Economic Immigrants? Some Empirical Evidence on the Heterogeneity of Immigrant Groups in the United States." Berkeley, CA: Center for Labor Economics, University of California, Berkeley, Working Paper No. 41 (September 2001), 41 pp.

Body of Paper

Title Page

1. Introduction
2. Literature Review
3. Conceptual Framework: A Model of Human Capital Investment
4. Empirical Methodology and Data Description
5. Characteristics of Refugees and Economic Immigrants
6. Empirical Results
 - 6.1 Model Specification and Regression Analysis
 - 6.2 Robustness Tests: Illusion or Reality
 - 6.3 The Effects of Improving English Fluency
7. Conclusion

Back Matter

References

Figures

Tables

Appendix

□ Cortes' Econometric Model: A Linear Regression Model

Regression Model:

$$\begin{aligned} \text{Ln}(\text{annearn})_{i,t} = & \alpha_0 + \alpha_1 D^{1990} + \alpha_2 D^{\text{Refugee}} + \alpha_3 D^{1990} D^{\text{Refugee}} + X_{i,t} \gamma + \beta_0 \text{Low_Eng} \\ & + \beta_1 \text{Low_Eng}^{1990} + \text{Educ}_{i,t} \theta + u_{it} \end{aligned} \quad (7)$$

Variable Names and Definitions:

$\text{Ln}(\text{annearn})_{i,t}$ = the natural log of annual wage and salary earnings for person i in year t;

D^{1990} = a dummy variable indicating the 1990 census year;

D^{Refugee} = a dummy variable indicating a refugee immigrant;

$D^{1990} D^{\text{Refugee}}$ = an interaction of refugee status and the 1990 census dummy;

$X_{i,t}$ = a vector of control variables (age, age², age³, age⁴, region, marital status);

Low _ Eng = a dummy variable indicating low English ability;

Low _ Eng¹⁹⁹⁰ = a dummy variable indicating low English ability in 1990;

Educ_{i,t} = a vector of educational attainment dummy variables (kindergarten, 1st-4th grade, 5th-8th grade, 9th grade, 10th grade, 11th grade, 12th grade 1 to 3 years of college, 4 plus years of college);

u_{it} = a random error term.

Mini-Assignment 1 on Cortes (2001) Paper

In no more than two sentences, answer the following question:

Question: What is the primary *empirical* question addressed in the Cortes (2001) paper?

Due Date: Wednesday January 14, 2009 (not marked)