



THE UNIVERSITY OF HULL

Business School

Module Handbook 2006/07

Module Code: 56268

Module Title: Advanced Economic Theory

Level: 7

Semester: 2

Credits: 20

Module Leader: Dr. Keshab R Bhattarai

**This handbook is available in alternative
formats on request from the department**

Contents

1. Welcome note and introduction
2. Disability
3. Key contacts
4. Postal address
5. Using your University email address
6. Teaching sessions
7. Student support
8. Attendance
9. Blackboard
10. Personal development planning
11. Study programme
12. Plagiarism
13. Coursework submission – dates and times
14. Coursework submission – procedure
15. Assessment criteria for coursework
16. Examinations
17. Group work
18. Mitigating circumstances
19. Module specification
20. Reading and resources list
21. Module evaluation
22. Module review
23. Module changes
24. Health and safety
25. Notes

1. Welcome note and introduction

The main aim of the module is to develop theoretical and quantitative foundations required for the PhD degree in economics. After completing this module, students should be able to follow advanced textbooks or standard journal articles that apply advanced economic theories including both optimizing and econometric techniques. Students will be encouraged to develop some of their own ideas for the coursework assignments and will be required to achieve operational understanding of appropriate optimization and econometrics software packages.

Students are advised to read this handbook alongside the Business School's study skills handbook and to pay particular attention to the section on plagiarism in both handbooks.

2. Disability

If you have a disability it is imperative that you contact the Business School Disability Officer. In Hull and for distance taught students this is Graeme Reid, g.c.reid@hull.ac.uk, Wharfe building, room 106. You should also contact your module leader, especially if your disability impacts upon your ability to cope in lectures e.g. hearing/visual impairment

When you've made us aware of your disability the module leader will make every effort to meet your needs, wherever possible.

Students with a disability are also reminded to ensure that they have registered with the University Disability office.

3. Key contacts

Postgraduate office (Hull)	Derwent 20/21	01482 466659	businessmasters@hull.ac.uk
External business unit (Hull)	Esk 219	01482 63140	executiveprogrammes@hull.ac.uk
Dr. Keshab Bhattarai	125 Wharfe	01482- 463207	K.R.Bhattarai@hull.ac.uk

4. Postal address

The Business School, University of Hull, Hull, HU6 7RX

5. Using your University email address

Any of the staff listed above may try and contact you via your University email address. As a result **all** students should check their University email address on a regular basis. Failure to do so will mean you miss out on important information.

6. Teaching sessions

Economic Theory

- Optimization theory. Single and multivariate optimization. Constrained optimization.
- Production theory with Cobb Douglas, CES and Leontief technologies. Duality.
- Consumption theory with Cobb-Douglas, CES and Lancaster characteristic based preference relations.
- General equilibrium and welfare.
- Public goods and optimal taxation principles.
- Agency theory: introduction to cooperative and non-cooperative game theory and applications in economics.
- Key topics in macroeconomics and growth theory such as the derivation, use and limitations of the Taylor Rule in the context of economic policy.

Econometrics

- Basics of regression analysis, simultaneous equation and VAR models
- Co-integration and error correction models.
- Cross-section analysis.
- Qualitative Dependent Variable models (probit and ordered probit; binary and multinomial logit). Censored and truncated distributions. The Tobit model (censored regression). Truncated regression.
- The Poisson regression model. Heckman's procedure for selection bias.
- Panel data. Fixed effects models. Random effects models and dynamic panel data models.
- Duration models, Bayesian analysis and GMM estimators

7. Student support

If you require additional module support outside of lecture/seminar/tutorial times you may make an appointment to see your tutor.

Enquiries of a general educational nature, which may range over a number of modules, should be addressed to the programme leader of your registered degree.

If you are experiencing any other problems please see your personal supervisor who may direct you to a specialist University service.

8. Attendance

The University has an Attendance Policy, which requires all students to attend all timetabled sessions for their programme of study. An attendance register will be kept for tutorial sessions and students with unauthorised absence will be subject to School and University disciplinary procedures. You are reminded that unauthorised absence may affect your course progress and if applicable your LEA grant entitlement.

It is important that you have read and understood the section entitled 'General Attendance' in your Business School Programme handbook.

9. Blackboard

Resources supporting your independent learning will be provided through the Blackboard 6 learning environment. It is essential that you become familiar with Blackboard and specifically the Advanced Economic Theory. You are advised to check regularly for announcements and new material.

10. Personal development planning

The module begins with a review session, which will revise major essential concepts for the module. This is expected to refresh students' memory for various concepts used in economic theory.

Each week student will be assigned one or two articles for reading from the list of selected articles and asked to summarise and critically assess it in the class for about five minutes. Appendix of this handbook contains list to tutorial problems and tentative plans for these tutorials. Students are expected to solve them before coming to the lectures using background knowledge for solving problems. Students also should reveal their own interest and give feedback so that problems could be formulated according to their own interest specifically to their areas of dissertation.

11. Study programme

Advanced Economic Theory: Study Programme
Lectures: Monday 14:15-16:05 Derwent Lecture Theatre 3
Tuesday 17:15 --18:05 SR3

Week	Topic	Readings
Jan 29	1. Optimisation: Linear programming and duality and nonlinear programming and constrained optimisation and dynamic programming	Myles (2-5); Sargent (1-2) Jehle and Reny (1-3)
Feb 5	2. Theoretical distributions, estimation and regression analysis	Greene, Hendry, Burke and Hunter, Hull-Cuthbertson and Taylor
Feb 12	3. Macroeconomic Models: growth, fluctuations and policy rules, Macroeconometric simulations and forecasting	Ramey, Romer, Parente Wallis, Wickens, Shone
Feb 19	4. Time series analysis: unit root, cointegration, VAR and impulse response	Jonansen, Hendry, Harvey, Pesharan-Lee-Shin
Feb 26	5. Panel data models: fixed and random effects, dynamic panels	Pedroni, Pesaran-Smith, Baltagi, Woodridge
March 5	6. Input-output analysis using linear programming,	Leontief, ten Raa, Lecture notes; Chiang
March 12	7. Dynamic General Equilibrium and welfare analysis: Optimal Tax and public goods	Myles, Mirlees, Shoven and Whalley, Scarf, Rutherford, Perroni, Bhattarai
March 19	8. Game theory and its applications, Agency theory 9. Class Test	Rubienstien, Binmore, Nash, Harsanyi, Sutton, Machina, Kreps and Choi, Bhasker
EASTER Break March 24- April 15		
April 16	10. Cross section analysis: probit, logit, tobit, selection biases	Heckman, Hausman, Hsio, Greene,
April 23	11. Duration analysis,	Lancaster, Keifer, CGH
April 30	12. Bayesian analysis	Lancaster, Geweke
May 7	13. Asymptotic theory and GMM estimators	Hansen, Blundell and Smith Davidson J, Davidson R.

See details in the workbook for the Advanced Economic Theory.

Assessment:

This module will have three elements of assessment: one our in class mid-term test (20%), one research based essay (20%) and the final exam (60%). Mid-term exam will be held on **Tuesday 20th of March 2007**. The course work should be submitted on **Tuesday 1st of May 2007** at the post graduate office. Assessment is included at the end of this handbook. Students should check for the exam time table for the final exam.

Background Problem
Matrix for Econometrics

1. Find the determinant of the following matrix.

a) $A = \begin{bmatrix} 50 & 40 \\ 70 & 80 \end{bmatrix}$ b) $A = \begin{bmatrix} 2 & 1 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}$ c) $B = \begin{bmatrix} -7 & 0 & 3 \\ 9 & 1 & 4 \\ 0 & 6 & 5 \end{bmatrix}$

2. Find the inverse of the following matrix

$$A = \begin{bmatrix} 4 & 1 & -1 \\ 0 & 3 & 2 \\ 3 & 0 & 7 \end{bmatrix}$$

3. Prove that following matrix is a positive definite matrix

$$A = \begin{bmatrix} 3 & 1 & -3 \\ -4 & 2 & 2 \\ 6 & -4 & 7 \end{bmatrix}$$

4. Solve following equations system using Cramer's rule

$$x_1 + 2x_2 + 2x_3 = 1 \quad (1)$$

$$2x_1 + 2x_2 + 3x_3 = 3 \quad (2)$$

$$x_1 - x_2 + 3x_3 = 5 \quad (3)$$

5. Find the characteristic root of the following matrix and calculate the characteristic vectors.

$$A = \begin{bmatrix} 4 & 2 & 2 \\ 2 & 1 & 1 \\ 3 & -4 & 4 \end{bmatrix}$$

6. Define and provide examples of:

- a) Idempotent matrix
- b) Trace of a matrix
- c) Rank of matrix
- d) Kronecker products
- e) Jacobian matrix.

Tutorial Problem 1
Linear programming and optimisation

1. A producer wants to maximise revenues producing two goods x_1 and x_2 in the market. Market prices of goods are 10 and 5 respectively. Production of x_1 and x_2 requires 25 and 10 units of skilled labour and total endowment of skilled labour is 1000. Similarly production of x_1 and x_2 also requires 20 and 50 units of unskilled labour and whose total endowment is 1500. How much should this firm produce x_1 and x_2 in order to maximise the total revenue?

$$\text{Max } R = 10x_1 + 5x_2$$

Subject to:

$$\text{Skilled labour constraint: } 25x_1 + 10x_2 \leq 1000$$

$$\text{Unskilled labour constraint: } 20x_1 + 50x_2 \leq 1500$$

$$\text{Non-negativity constraints: } x_1 \geq 0 \quad x_2 \geq 0$$

Prove that the linear programming is a special case of the non-linear programming.

2. Inter-temporal Problem and Optimal Economic Growth

a. Inter temporal optimisation by each involves maximising utility subject to its life time budget constraint.

$$\text{Max } U(C_1^i, C_2^i, C_3^i) = \ln C_1^i + \beta_2^i \ln C_2^i + \beta_3^i \ln C_3^i \quad i = A, B, C \quad (7)$$

subject to:

$$C_1^i + b_1^i = \omega_1^i \quad \text{while young} \quad (8)$$

$$C_2^i + b_2^i = b_1^i(1+r) + \omega_2^i \quad \text{while adult} \quad (9)$$

$$C_3^i = b_2^i(1+r) + \omega_3^i \quad \text{while old} \quad (10)$$

where C_1^i , C_2^i and C_3^i are consumptions for periods 1, 2 and 3 for type i agent and β_2^i and β_3^i are subjective discount factors for period 2 and 3 consumptions with their values between 0 and 1. Endowment of agent i for time t is given by ω_t^i with endowments for agent A, B and C for periods 1, 2 and 3 are $\{\omega_1^A, \omega_2^A, \omega_3^A, \omega_1^B, \omega_2^B, \omega_3^B, \omega_1^C, \omega_2^C, \omega_3^C\}$. Again each household is allowed to borrow and lend at the interest rate r .

b. A benevolent social planner has the Ramsey model for his/her economy.

$$\text{Max } U_t = \sum_{t=0}^{\infty} \beta^t \ln(C_t) \quad 0 < \beta < 1 \quad (1)$$

Subject to:

Output and the technology constraint: $Y_t = AK_t^\alpha \quad 0 < \alpha < 1 \quad (2)$

Market clearing condition: $C_t + I_t = Y_t \quad (3)$

Capital formation: $K_{t+1} = I_t \quad (4) \quad (100 \text{ percent depreciation})$

Boundary (initial) condition $K_0 = K_0 \quad (5)$

where U_t is the utility, C_t is consumption, I_t is investment, Y_t is output K_t is the capital stock, A is technology. All of these variables are greater than zero. The parameter $0 < \beta < 1$ is preference for current rather than the future consumption and α is the elasticity of output with respect to the capital stock. Notice that the consumption is the control and the capital stock is the state variable in this model.

- a) Write the optimisation conditions of this social planner and find out the consumption, output and investment in the steady state.
- b) Provide a graphical illustration on how economy converges to the steady state if it is not in it in the beginning. What would happen to this economy if consumers eat all or invest all output in any one period?
- c) Now assume less than a 100 percent depreciation rate. The capital accumulation in this case is given by $K_{t+1} = K_t(1-\delta) + I_t$ or $K_{t+1} - K_t(1-\delta) = I_t$ where δ is the rate of depreciation of the capital stock and it is between zero and one, $0 < \delta < 1$. How much is the capital stock, consumption and investment in the steady state? How does this result compare to that in (a) above?
- d) Financial intermediaries take away a certain fraction of saving. Let ϕ represent the fraction of savings $0 < \phi < 1$ taken away (wasted) by them while channelling saving to investment. As such a higher value ϕ represents more inefficiency in the financial system. How does ϕ affect the saving and investment and capital accumulation in this economy?
- e) Study the impacts of capital income taxation in economic growth using Ramsey's model of optimal growth. Use GAMS program Captax.gms to compute the optimal growth.

Reading: Ramsey (1928), Coase (1937), Hicks (1937), Samuelson (1939)

Tutorial Problem 2

1. Consider the Keynesian model with the production function as following

Production function: $Y = F(K, N)$; $F_N > 0$; $F_K > 0$; $F_{NN} < 0$ $F_{KK} < 0$

Labour demand $\frac{W}{P} = F_N(N, K)$ Labour supply : $W = W_0 + W(N)$

where
$$W(N) = \begin{cases} 0 & \text{for } N \leq \bar{N} \\ + & \text{for } N > \bar{N} \end{cases}$$

Money market equilibrium $\frac{M}{P} = M(Y, r)$; $M_y > 0$, $M_r < 0$

Income: $Y = C + I + G + X - IM$

- (i) derive the income tax multiplier for this model and determine its sign.
- (ii) derive the income tax multiplier for this model when the money demand depends upon the disposable income and determine its sign.
- (iii) Linearise the model for comparative static analysis and determine the employment and output impacts of changes in the government spending, tax rates the fixed nominal wage rate.

2. Consider Brock-Mirman dynamic programming problem

$$\text{Max } U = \sum_t \beta^t \ln C_t \quad 0 < \beta < 1 \quad (1)$$

subject to

$$K_{t+1} + C_t = AK_t^\alpha \quad 0 < \alpha < 1 \quad (2)$$

- a. What are control and state variables in this model and why?
- b. Explain the meaning of value function (Bellman equation) and policy functions of this problem.
- c. Assume $V_0(K) = 0$. Demonstrate a recursive method of solving this problem by solving for policy and value functions for four iterations.
- d. Use limit theorem to find the explicit solution of the value function.
- e. Introduce a stochastic disturbance term for the state variable and show how it can be solved.

(Reference: Sargent TJ (1987) *Dynamic Macroeconomic Theory*, Chapter 1; Ljungqvist L and T.J. Sargent (2000), *Recursive Macroeconomic theory*, MIT Press).

Readings: Plosser (1989), Wallis (1989), Wickens (1995), Hendry (1997), Sims (1980), Sargent and Wallace (1976), Blanchard and Qua (1989).

Problem 3
Regression Analysis

1. Consider the following model explaining the demand for money (M_t), as a function of the level of income (Y_t), the interest rate (R_t), exchange rate (E_t), and wealth (W_t)

$$M_t = \gamma_1 + \gamma_2 Y_t + \gamma_3 R_t + \gamma_4 E_t + \gamma_5 W_t + e_t$$

where e_t is a random error term with mean zero. The vector $e = \{e_t\}$ has the variance-covariance matrix:

$$Cov(e) = E(ee') = \begin{bmatrix} \text{var}(e_1) & Cov(e_1 e_2) & \cdot & \cdot & Cov(e_1 e_T) \\ Cov(e_1 e_2) & \text{var}(e_2) & \cdot & \cdot & Cov(e_2 e_T) \\ \cdot & \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot & \cdot \\ Cov(e_1 e_T) & Cov(e_2 e_T) & \cdot & \cdot & \text{var}(e_T) \end{bmatrix}$$

$$= \begin{bmatrix} \sigma_{11} & \sigma_{12} & \cdot & \cdot & \sigma_{1T} \\ \sigma_{21} & \sigma_{22} & \cdot & \cdot & \cdot \\ \cdot & \cdot & \sigma_{33} & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot & \cdot \\ \sigma_{T1} & \sigma_{T2} & \cdot & \cdot & \sigma_{TT} \end{bmatrix}$$

- (a) Outline the implications for the OLS estimators of $\gamma_1, \gamma_2, \gamma_3, \gamma_4$ and γ_5 when income and wealth are related to each other by the condition, $Y_t = 0.15W_t$. What would you do to correct the estimators?
- (b) The OLS method normally assumes that the condition $E(ee') = \sigma^2 I$ is satisfied. What does this imply for the values of $\sigma_{i,j}$ in the above matrix? Why may such an assumption not hold in many economic applications?
- (c) Suppose that all off-diagonal elements in the above matrix are zero ($\sigma_{i,j} = 0$, $i \neq j$), but the diagonal elements are different from each other ($\sigma_{i,j} \neq \sigma^2$, $i = j$). What kind of problem is this? How does it affect the properties of the OLS estimators of $\gamma_2, \gamma_3, \gamma_4$ and γ_5 ?
- (d) Assume that the variance-covariance matrix of the errors takes the form,

$$Cov(e) = \begin{bmatrix} \sigma^2 & \sigma_{12} & \cdot & \cdot & \sigma_{1T} \\ \sigma_{21} & \sigma^2 & \cdot & \cdot & \cdot \\ \cdot & \cdot & \sigma^2 & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot & \cdot \\ \sigma_{T1} & \sigma_{T2} & \cdot & \cdot & \sigma^2 \end{bmatrix}$$

where the diagonal elements are the same, but the off-diagonal elements are different.

- i. What sorts of problem can you identify in this model?
- ii. What kind of diagnostic test would you recommend?
- iii. What values of this test would indicate the presence or absence of the problems you are testing for?

1. Take a 3rd order dynamic autoregressive distributed lag model of consumption (C_t) on income (Y_t) and its own lagged values (C_{t-i}) (ARDL(3,3)) as following.

$$C_t = \alpha_0 + \alpha_1 C_{t-1} + \alpha_2 C_{t-2} + \alpha_3 C_{t-3} + \beta_0 Y_t + \beta_1 Y_{t-1} + \beta_2 Y_{t-2} + \beta_3 Y_{t-3} + e_t$$

Estimated values of parameters were $(\alpha_1, \alpha_2, \alpha_3) = (0.4, 0.2, 0.1)$
 $(\beta_0, \beta_1, \beta_2, \beta_3) = (0.6, 0.3, 0.1, 0.0)$ respectively.

- (a) What is the immediate impact of a 500 increase in income in this model?
- (b) What is the long run multiplier in it?
- (c) What criteria would you use to choose the optimal number of lags of dependent variables?
- (d) How would you compare predicted and actual series in such models?

3. Exchange rate and the interest rate in an economy are simultaneously related to each other as following

$$E_i = \alpha_{1,1} i_i + \alpha_{1,2} TB_i + e_{1,i} \quad (1)$$

$$i_i = \alpha_{2,1} E_i + \alpha_{2,2} MS_i + e_{2,i} \quad (2)$$

where E_i is the nominal exchange rate, i_i is the nominal interest rate, TB_i is the trade balance, MS_i is the money supply, $e_{1,i}$ and $e_{2,i}$ are the stochastic error terms, which are normally distributed with a zero mean and constant variance.

- (a) Provide a reduced form for this model and discuss briefly how you would estimate the reduced form.
- (b) Using the rank and order conditions determine whether each of the above equations are exactly, under or over identified. If identified show how you could retrieve the structural coefficients in this model.
- (c) Prove that application of the OLS in a single equation model like this generates a simultaneity bias.

4. Consider a market model for a particular product.

$$\text{Demand: } Q_t^d = \alpha_1 P_t + \alpha_2 I_t + u_{1,t} \quad (1)$$

$$\text{Supply: } Q_t^s = \beta_1 P_t + \beta_2 P_{t-1} + u_{2,t} \quad (2)$$

Here Q_t^d is quantity demanded and Q_t^s is quantity supplied, P_t is the price of commodity, P_{t-1} is price lagged by one period, I_t is income of an individual, $u_{1,t}$ and $u_{2,t}$ are independently and identically distributed (iid) error terms with a zero mean and a constant variance. Q_t and P_t are endogenous variables and P_{t-1} and I_t are exogenous variables, $\alpha_1, \alpha_2, \beta_1$ and β_2 are six parameters defining the system.

- (a) How can simultaneity bias occur if one tries to apply OLS to each of the above equations.
- (b) Use rank and order conditions to judge whether each of these two equations are over-, under- or exactly identified.
- (c) Write down the reduced form for this system.
- (d) How would you estimate the coefficients of the reduced form equations? Write down the estimator.
- (e) If equations are identified explain how you may retrieve the structural parameters, $\alpha_1, \alpha_2, \beta_1$ and β_2 from the coefficients of the reduced form equations.

Readings: Harsanyi (1967), Taylor (1987), Friedman (1968), Dickey and Fuller (1979).

Problem 4
Stationarity, Unit Root and Cointegration

1. The time series $\{c_t\}$ and $\{y_t\}$ represent the underlying data generating processes (DGP) of consumption and income. Answer the following questions regarding the properties these series.

- (a) What is meant by saying that $\{c_t\}$ and $\{y_t\}$ are stationary series? Why is it important that the series are stationary for a robust regression analysis?
- (b) How do you determine whether $\{c_t\}$ and $\{y_t\}$ are stationary series, or not?
- (c) Analyse the properties of these series when they follow a random walk, or have a unit root. What is the meaning of the order of integration in this respect? Discuss any three different methods of checking for stationarity.
- (d) What is the meaning of cointegration between the series $\{c_t\}$ and $\{y_t\}$? How would you decide whether these series are co-integrated, or not?
- (e) If the original series $\{c_t\}$ and $\{y_t\}$ are not co-integrated, what transformation can be applied to achieve co-integration? How do you decide the order of co-integration?
- (f) Study the test results given in the Appendix, where C is consumption and Y is the income. Comment on the stationarity and order of integration of each of these series, based on the test statistics.

2. Suppose that the data generating process of a certain economic series follows a second order autoregressive process,

$$Y_t = \delta + \theta_1 Y_{t-1} + \theta_2 Y_{t-2} + e_t$$

where e_t represents an independently and identically distributed error term, and Y_{t-1} and Y_{t-2} are lagged values of Y_t

- (a) What is the mean value of Y_t in terms of δ , θ_1 and θ_2 ? What constraints on θ_1 and θ_2 are required to make this series weakly stationary?
- (b) What is the variance of the Y_t process?
- (c) Write down the expression for the autocorrelation function in terms of the variance and covariance of Y_t . How can this autocorrelation function help in determining whether or not the series is stationary?
- (d) Study the following output of an AR(6) process on the output series for the UK from macroseriesuk_gw.xls and comment on the statistical significance of the parameters and the autocorrelation coefficients of this series.

3. Consider a simultaneous equation model with two endogenous and two exogenous variables as following.

$$a_{11}y_{1i} + a_{12}y_{2i} + b_{11}x_{1i} + b_{12}x_{2i} = e_{1i}$$

$$a_{21}y_{1i} + a_{22}y_{2i} + b_{21}x_{1i} + b_{22}x_{2i} = e_{2i}$$

where $y_{1,i}$ and $y_{2,i}$ are endogenous variables and $x_{1,i}$ and $x_{2,i}$ are exogenous variables.

Errors of each equation, $e_{1,i}$ and $e_{2,i}$, are identically and independently distributed with zero mean and constant variance and covariance between $e_{1,i}$ and $e_{2,i}$ is assumed zero.

- Why it is wrong to use a single equation method to estimate each of above equations?
- Show how a simultaneous equation model (OLS, 2SLS or 3SLS) can be applied to estimate unknown parameters $a_{1,1}, a_{1,2}, a_{2,1}, a_{2,2}, b_{1,1}, b_{1,2}, b_{2,1}$ and $b_{2,2}$.
- Derive the reduced form coefficients for both equations in the above model.
- How do the shocks $e_{1,i}$ and $e_{2,i}$ affect the values of endogenous variables $y_{1,i}$ and $y_{2,i}$?

4. Consider a vector autoregressive model of order 2, VAR(2) given below.

$$y_t = a_{10} + a_{11}y_{1,t-1} + a_{12}y_{2,t-2} + b_{11}x_{t-1} + b_{12}x_{t-2} + e_{1t}$$

$$x_t = a_{20} + a_{21}y_{1,t-1} + a_{22}y_{2,t-2} + b_{21}x_{1,t-1} + b_{22}x_{t-2} + e_{2t}$$

where y_t and x_t are two variables for time t range from 1 ... T periods. Errors of each equation, $e_{1,t}$ and $e_{2,t}$, are identically and independently distributed with zero mean and constant variance and covariance between $e_{1,t}$ and $e_{2,t}$ is assumed zero.

- Evaluate the relationship between y_t and x_t in the long run.
- Provide impulse response analysis for y_t and x_t of a unit shock in $e_{1,t}$ and $e_{2,t}$.
- Suggest criteria to determine the order of VAR model like this.
- What extra information is needed to make h period ahead forecast using the above model?
- Show how the variance of the forecast error and the confidence interval of forecast are sensitive to the number of periods of forecast.

Readings: Engle and Granger (1987), Phillips (1987), Kydland and Prescott (1977), Johansen (1988).

Problem 6
Panel Data Analysis

1. Consider a panel data model of economic growth the form

$$y_{i,t} = \beta_0 + \beta_1 x_{i,t} + \beta_2 Z_i + \beta_3 S_t + e_{i,t}$$

where $y_{i,t}$ is the rate of growth of output for countries i for time t , with $i = 1 \dots N$ countries and $t = 1 \dots T$, $x_{i,t}$ denote determinants of economic growth by countries over time, Z_i denotes country specific factors influencing the growth rates, S_t captures the time specific effects and $e_{i,t}$ is a normally distributed error term with zero mean and constant variance.

- a. Discuss an efficient panel data estimator for this type of model.
- b. Rewrite this model to estimate only the fixed effects across countries that influence economic growth.
- c. Rewrite this model to estimate only the time effects influencing economic growth.
- d. Provide estimators when data is pulled over cross section and time series.
- e. Reformulate it as a dynamic panel data model.
- f. Comment on the estimates of determinants of per capita income across countries contained in the following table.

Determinants of Economic Growth in Newly Emerging Growth Miracle Economies.

2-step estimation using dynamic panel data model				
	Coefficient	Std.Error	t-value	t-prob
Gdpprcap(-1)	0.12036	0.01812	6.64000	0.00000
GDP60	-0.00159	0.00043	-3.73000	0.00000
China	0.00288	0.00137	2.11000	0.03700
Hkong	-0.00171	0.00077	-2.21000	0.02800
Ireland	0.00110	0.00128	0.86300	0.38900
Korea	0.00335	0.00074	4.53000	0.00000
Malta	-0.00197	0.00068	-2.90000	0.00400
Portugal	-0.00061	0.00096	-0.63700	0.52500
Singapore	0.00113	0.00027	4.21000	0.00000
Sy	0.15583	0.04257	3.66000	0.00000
Iy	0.18329	0.02995	6.12000	0.00000
Infl	-0.00510	0.00487	-1.05000	0.29700
Rint	-0.02795	0.06357	-0.44000	0.66100
Xmy	-0.00461	0.00097	-4.74000	0.00000
Japan	-0.00056	0.00086	-0.65300	0.51500
sigma	4.914753	sigma^2	24.1548	
RSS	3526.6004	TSS	2240.0576	
no. of observations	161	no. of parameters	15	

Definition of variables:

Gdpprcap(-1) : per capita GDP in the previous period

Sy: ratio of saving to GD

GDP60 : per capita GDP in 1960

Rint: real interest rate

Iy: ratio of investment to GDP

Xmy: ratio of trade to GDP

Infl: rate of inflation

Popg: growth rate of population

Govy: ratio of government expenditure of GDP

Txy: ratio of tax revenue to GDP

Readings: Mankiw Romer and Weil (1992), Pedroni (1999), Pesaran and Smith (1995), Islam (1995), Baltagi, Wooldrige

Problem 7
Limited Dependent Variable Model

A university teacher is interested to estimate a model that explains whether a certain student gets a first class marks in an exam. He/she uses observations on limited dependent variable Y_i which takes value 1 ($Y_i = 1$) if a student gets a first class mark, value 0 ($Y_i = 0$) otherwise. Probability of getting a first class mark in an exam is a function of student effort index denoted by Z_i

$$Z_i = \beta_1 + \beta_2 H + \beta_3 E + \beta_4 A + \beta_5 P + e_t$$

where H = hours of study; E = hours spent on exercises, A = number of right answers you were able to write in exams, and P = number of pages of papers written. e_t is an iid random error term.

In a logit model the probability of getting a first class marks in an exam depends nonlinearly upon Z_i as $P_i(Y_i = 1) = \frac{1}{1 + e^{-Z_i}}$, where $0 \leq P_i(Y_i = 1) \leq 1$. The log of the ratio of odds

$\left[\frac{P_i}{1 - P_i} = \frac{1 + e^{Z_i}}{1 + e^{-Z_i}} = e^{Z_i} \right]$ is a linear function of the index Z_i

$$\ln\left(\frac{P_i}{1 - P_i}\right) = Z_i = \beta_1 + \beta_2 H + \beta_3 E + \beta_4 A + \beta_5 P + e_t$$

- a) Explain how you can test the contribution of any one of the explanatory variables to the probability of getting a first class mark in the exam using this logit model.
- b) Discuss the estimation method that you will apply to estimate the parameters of a non-linear function with a limited dependent variable like this.
- c) A probit model, like a logit model, gives a probability of getting a first class marks as a function of an index of variables, Z_i . Its functional form takes a normal distribution such as

$$\Pr(Y_i = 1) = \Pr(Z_i^* \leq Z_i) = F(Z_i) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{Z_i} e^{-\frac{t^2}{2}} dt$$

where $t \sim N(0,1)$ is a normally distributed variable.

Give a graphical explanation of how a variable included in index Z_i would affect the probability of getting a first class mark.

- d) How would you test whether a particular variable such as hours spent on study is statistically significant or not in logit and probit models?
- e) Compare and contrast probit and logit models to a linear probability model in explaining probability of occurrence of an event as above?

Readings: Heckman (1979), Lancaster (1979), Greene - LIMDEP

Problem 8
Economic Applications of Games

1. Consider an economy involving three players, the consumers, business sector and the government. The strategy contingent payoff functions for consumers $y_i^C(s, l, k)$ business $y_i^B(s, l, k)$ and the government $y_i^G(s, l, k)$. The probability of being in particular state like this is given by $\pi_i^C(s, l, k)$, $\pi_i^B(s, l, k)$ and $\pi_i^G(s, l, k)$ respectively. The consumers have s number of strategies, the business has l of them and the government has k of them.

- a. Show using a dynamic sequential game how the correct and consistent signalling and beliefs improve the objectives of these players over years.
- b. Show how lack of coordination among these players can lead to inferior position in terms of achieving their objectives.

Demonstrate how the cooperative solution is Pareto-optimal than non-cooperative solutions.

2. Non-cooperative two person zero sum games
3. Cooperative prisoner's dilemma
4. Spencer model of moral hazard and asymmetric information.
5. Hayasi's model on incomplete information
6. Rubinstein model on bargaining
7. Sutton on cooperative bargaining.
8. Signalling

Readings: Nash (1953), Mirlees (1971) Rubinstein (1982), Sutton (1986), Choi and Kreps (1987), Sen (1991), Binmore (1999), Rebelo (1991).

Tutorial 9 Two Sector General Equilibrium Tax Model

Consider an economy with two production sectors in which a representative household supplies labour and capital inputs to firms and receives wages and interest rates in return. Government imposes taxes on labour and capital income and transfers it back to the household.

Household's problem

$$\underset{X_1, X_2}{\text{Max}} \quad U_1 = X_1^\alpha X_2^\beta \quad 0 < \alpha < 1, 0 < \beta < 1, \alpha + \beta = 1$$

subject to

$$I = P_1(1+t_1)X_1 + P_2(1+t_2)X_2$$

$$I = (1-t_k)r(K_1 + K_2) + (1-t_w)w(L_1 + L_2)$$

Production takes places in two level nests. At the bottom producers use capital, labour input in producing value added . At the top level of the nest gross output is given by value added and intermediate inputs.

$$\underset{L_1, K_1}{\text{Max}} \quad \Pi_1 = P_1Y_1 - wL_1 - rK_1 \quad \text{Subject to: } Y_1 = K_1^{\gamma_1} L_1^{(1-\gamma_1)} \quad GY_1 = F(Y_1, X_{i,1}), 0 < \gamma_1 < 1$$

$$\underset{L_2, K_2}{\text{Max}} \quad \Pi_2 = P_2Y_2 - wL_2 - rK_2 \quad \text{subj. to: } Y_2 = K_2^{\gamma_2} L_2^{(1-\gamma_2)} \quad GY_2 = F(Y_2, X_{i,2}), 0 < \gamma_2 < 1$$

Revenue of the government equals its spending

$$R = t_k r(K_1 + K_2) + t_w w(L_1 + L_2) + t_1 P_1 X_1 + t_2 P_2 X_2 = G$$

$$X_1 \geq 0 \quad X_2 \geq 0 \quad Y_1 \geq 0 \quad Y_2 \geq 0 \quad I \geq 0 \quad P_1 \geq 0 \quad P_2 \geq 0 \quad w > 0 \quad r > 0 \quad \Pi_1 \geq 0 \quad \Pi_2 \geq 0$$

A simple input-output table for this economy summarises all these transactions.

	Primary	Secondary	C	I	G	X	M	Total
Primary	x_{11}	x_{12}	C_1	I_1	G_1	X_1	M_1	GY_1
Secondary	x_{21}	x_{22}	C_2	I_2	G_2	X_2	M_2	GY_2
Labour	L_1	L_2						wL
Lab-tax	$T_{l,k}$	$T_{l,k}$						TL
Capital	K_1	K_2						rK
Cap taxes	$T_{1,k}$	$T_{2,k}$						TK
Total	GY_1	GY_2	C	I	G	X	M	

The base year data set for this economy us given in the following table.

Benchmark Data Set for a Two Sector Economy

	Sector 1	Sector 2	C	I	G	GY
Sector 1	15	15	40	10	20	100
Sector 2	10	20	30	10	30	100
Labour	30	24				54
Labour income tax	20	16				36
Capital	15	20				35
Capital income tax	10	5				15
Total	100	100	70	20	50	

- a. Define precisely the competitive equilibrium for this economy.
- b. Provide an analytical solution of this model.
- c. Check the micro-consistency of the data set on both production and consumption sides of the economy.
- d. Write a MPSGE program to replicate the benchmark equilibrium by calibrating the model to this benchmark data set.
- e. Test the sensitivity of the model to five different values (1, 2, 3, 4 and 5) of the elasticity of substitution production and consumption.
- f. Evaluate the welfare gains from eliminating the labour income taxes without equal yield constraint.
- g. Evaluate the welfare impacts of eliminating labour income taxes with equal yield constraint.
- h. Take the sixteen sector static model of the UK economy (as given by ptax.gms and uk16.gms files). Report the change in output, employment, capital stock and consumers' welfare when labour income taxes are replaced by value added taxes.

(Reference: Rutherford (1998) An Introduction to GAMS/MCP and GAMS/MPSGE; GAMS Corporation: <http://www.gams.com>; Shoven and Whalley (1992))

Readings: Shoven and Whalley (1984) Kehoe (1992), Scarf (1986)

Exercise 10
Exercise on a General Equilibrium Model of an Economy

1. Construct an input-output table for an economy from the available information.
2. Consider the structure of consumption, production, trade, tax and spending as included in the input output table for an economy (UK economy).
 1. Reduce this table to seven sectors agriculture, mining (extraction, other mining, chemicals, metals), engineering, manufacturing (food and drink, other manufacturing, utilities), construction, private service (distribution, transport, financial), public services (public admin, education, housing).
 2. Insure the micro-consistency of the data set both in this table
 - a. Zero profit conditions among production sectors
 - b. Income, consumption and saving
 - c. Government revenue and taxes
 - d. Exports imports and balance of payment condition
 - e. Backward and forward linkages of change in final demand in the engineering sector by 10 percent
 3. The government collects revenue from value added tax on final demand, labour and capital income taxes and tariffs and revenue balances with government spending. Households receive income from factor inputs and transfers from the government. Specify a static general equilibrium model with:
 - a. Cobb-Douglas (or CES) production function for each production sectors
 - b. Cobb-Douglas (or, CES) preference for the households
 - c. Armington specification for international trade
 - d. Market clearing conditions in goods and factors markets
 4. Define a competitive equilibrium for this economy. Calibrate the key parameters required in the model from the benchmark dataset.
 5. Write a GAMS/MPSGE program to compute the general equilibrium model presented in 2. Use the model to evaluate the impact of replacing taxes on consumption by taxes in labour income.
 6. Assume that household follows a Ramsey model in determining consumption and saving over an infinite horizon and producers maximise profit.
 - a. Specify a dynamic general equilibrium for this economy.
 - b. Calibrate the key benchmark parameters to compute the general equilibrium in this economy.
 - c. Write a GAMS/MPSGE programme to compute the dynamic general equilibrium for this economy.
 - d. Illustrate the role of inter-temporal elasticity of substitution in the model.

Readings: Harberger (1962), Atkinson and Stiglitz (1976), Sargent (1976) Hansen

12. Plagiarism

All work which is submitted for assessment must be your own work and appropriately referenced. Academic dishonesty is a very serious offence and will be penalised accordingly. Being found guilty of academic dishonesty may have a serious effect upon your academic progression, it may also result in a University Warning or it may result in your expulsion from the University.

If you are unsure about referencing or plagiarism please refer to the Business School Study Skills handbook or seek advice from your module or programme leader or the University Study Advice Centre.

It is important that you have read and thoroughly understood the section on 'Plagiarism' in your Business School Programme handbook and that you have read and understood the University Code of Practice on the Use of Unfair Means which is published on the University website.

The plagiarism declaration on the coursework submission sheet is your personal statement that the work which you are submitting for assessment is your own.

13. Coursework submission - dates and times

Mid-term exam will be held on **Tuesday 20th of March 2007**. The course work should be submitted on **Tuesday 1st of May 2007** at the post graduate office. A Business School Coursework Submission Sheet must be attached to all Coursework and must be completed legibly and in full. Coursework must be submitted by the date and time stipulated. Students submitting work which is late, and who do not have mitigating circumstances approved by the Mitigating Circumstances Sub-Committee, will be awarded a mark of 0 for that late work.

14. Coursework submission - procedure

A Business School coursework submission sheet must be attached to all coursework and must be completed legibly and in full. Coursework must be submitted by the date and time stipulated. Deadlines will be strictly adhered to. Students submitting work which is late, and who do not have mitigating circumstances approved by the Mitigating Circumstances Sub-Committee, may be awarded a mark of 0 for that late work.

The Plagiarism Declaration on the Coursework Submission sheet is your personal statement that the work which you are submitting for assessment is your own. If you need any advice on plagiarism or referencing please consult the graduate school documents at <http://www.hull.ac.uk/gri/> and the Business School Study Skills Handbook : http://www.hull.ac.uk/hubs/students/handbooks/Study_Skills_Manual_draft11.pdf

Please consult the Business School Study Skills Handbook carefully for advice on academic matters. The postal address of the Business School is:

The Business School, University of Hull, Hull, HU6 7RX

15. Assessment criteria for coursework

In general students are expected to demonstrate complete understanding of the model relevant to the question and assess it critically with proper attention to its application.

16. Examinations

Examination dates are determined by the University Examination office and not the Business School. It is your responsibility to be available throughout the stipulated university examination period. Draft exam timetable arrangements are **draft** and are subject to change. **Do not** make holiday, travel or work arrangements during the examination period.

17. Group work

Not applicable for this module.

18. Mitigating circumstances

If you have any mitigating circumstances (for example, illness, legal, social, economic or personal problems etc.) and you believe that these will, or have already, affected your academic performance then you are advised to complete a mitigating circumstances form (available from the support offices). It is very important to submit this form **before** the examination or assessment deadline and to provide as much documentary evidence as possible to support your case e.g. medical note, police case note etc

Please note that IT problems on personal computers will not be accepted as a mitigating circumstance. All students are strongly urged to back up their work as they go along.

19. Module specification

Module rationale:

The main aim of the module is to develop theoretical and quantitative foundations required for the PhD degree in economics. After completing this module, students should be able to follow advanced textbooks or standard journal articles that apply advanced economic theories including both optimizing and econometric techniques. Students will be encouraged to develop some of their own ideas for the coursework assignments and will be required to achieve operational understanding of appropriate optimization and econometrics software packages.

Aims and distinctive features:

This module builds on the M level modules in economics such as Economic Forecasting and aims to develop analytical and quantitative skills essential for PhD research in economics. Extra effort will be made in order to accommodate motivated students who may not have done required modules.

Learning outcomes:

The students upon completion of this module are expected:

1. to demonstrate descriptive and analytical skills required for scientific writing in economics.
2. to show expertise in formulation of optimization approaches to economic theory including application of Lagrangian in contexts of consumer theory and the theory of the firm.
3. to be familiar to cooperative and non-cooperative game theoretic concepts and economic applications in economics, particularly with the idea of agency relations and their application to the theory of the firm.
4. to be comfortable in using the standard techniques used within time series econometrics and interpretation of results of such analysis.
5. to develop an awareness of several econometric models and estimation methods associated with cross-section data.
6. to demonstrate the ability to draw parallels between theory and the results of practical application of econometric techniques.
7. to demonstrate, through competent use of appropriate computer software, the ability to apply the theory underlying econometric techniques.

Learning and teaching strategy:

The following teaching & learning strategies are used within this module:

Three contact hours per week including lectures, classes and computer based workshops making use of appropriate optimisation and econometric software packages - such as GAMS/SPSGE, GiveWin-PcGive-STAMP/OX, LIMDEP, MICROFIT, SHAZAM, STATA. The lectures sessions 1-22 and tutorials 1-10 will focus on achieving learning outcomes 1-7.

In addition students can consult the instructor during office hours.

Assessment strategy:

The academic performance in this module will be assessed using following three elements:

- A 2-hour unseen written examination in the standard exam period (60%).
- A 1-hour class test during a slot normally used for a lecture (20%).
- An in-semester computer based writing assignment (20%). An in-semester computer based written assignment (20%). This assignment involves application of optimisation technique to solve consumers and producers problems for analysing economic growth and time consistency problem in policy making using applied general equilibrium model for analysis of economic growth and income redistribution and for assessing the impacts tax and trade policy. Econometric part includes conducting unit root and cointegration tests and VAR impulse response analysis.

Alternative reassessment strategy:

The reassessment method for this module has been declared to differ from the original assessment mechanism as follows: A 2-hour (closed-book) written examination (100%).

Arrangements for revision and private study:

Students are required to undertake preparatory reading before all taught sessions, as well as undertaking technical and computer exercises in advance of workshops and tutorials. Further reading and private study are also required, to reinforce learning after taught sessions.

Module constraints: There are no specific constraints for this module.

20. Reading and resources list

Pre-requisite reading

Advanced Micro

- 1 Binmore K (1999) Why Experiment in Economics? *The Economic Journal* Vol. 109, No. 453, Features Feb. pp. F16-F24
2. Caminal R. (1990) A Dynamic Duopoly Model with Asymmetric Information *Journal of Industrial Economics* Vol. 38, No. 3 (Mar., 1990), pp. 315-333
3. Cho I.K. and D.M. Kreps (1987) Signalling games and stable equilibria, the *Quarterly Journal of Economics*, May 179-221.
4. Coase R. H. (1937) The Nature of the Firm, *Economica*, 386-405, November.
5. Debreu, G. (1954) *The Theory of Value*, Yale University Press, New Haven.
6. Harsanyi J.C. (1967) Games with incomplete information played by Bayesian Players, *Management Science*, 14:3:159-182.

7. Jin J. Y. (1994) Information Sharing through Sales Report *Journal of Industrial Economics* Vol. 42, No. 3 (Sep., 1994), pp. 323-333
8. Lockwood B. A. Philippopoulos and A. Snell (1996) Fiscal Policy, Public Debt Stabilisation and Politics: Theory and UK Evidence *Economic Journal* Vol. 106, No. 437 (Jul., 1996), pp. 894-911
9. Machina M. (1987) Choice under uncertainty: problems solved and unsolved, *Journal of Economic Perspective*, 1:1:121-154.
10. Mailath G. J. (1989), Simultaneous Signaling in an Oligopoly Model *Quarterly Journal of Economics* Vol. 104, No. 2 (May, 1989), pp. 417-427
11. McCormick B. (1990) A Theory of Signalling During Job Search, Employment Efficiency, and "Stigmatised" Jobs *Review of Economic Studies* Vol. 57, No. 2 (Apr., 1990), pp. 299-313
12. Milgrom P., J. Roberts (1986) Price and Advertising Signals of Product Quality *Journal of Political Economy* Vol. 94, No. 4 (Aug., 1986), pp. 796-821
13. Nash J. (1953) Two person cooperative games, *Econometrica*, 21:1:128-140.
14. Rodrik D. (1989) Promises, Promises: Credible Policy Reform via Signalling *Economic Journal* Vol. 99, No. 397 (Sep., 1989), pp. 756-772
15. Rogerson W.P. (1988) Price Advertising and the Deterioration of Product Quality *Review of Economic Studies* Vol. 55, No. 2 (Apr., 1988), pp. 215-229
16. Riley J.P. (1979) Noncooperative Equilibrium and Market Signalling *American Economic Review* Vol. 69, No. 2, Papers and Proceedings of the Ninety-First Annual Meeting of the American Economic Association (May, 1979), pp. 303-307
17. Rubinstein A (1982) Perfect equilibrium in a bargaining model, *Econometrica*, 50:1:97-109.
18. Sobel J. (1985) A Theory of Credibility *Review of Economic Studies* Vol. 52, No. 4 (Oct., 1985), pp. 557-573
19. Sutton J. (1986) Non-Cooperative Bargaining Theory: An Introduction *The Review of Economic Studies*, Vol. 53, No. 5., pp. 709-724
20. Spence M. (1977) Consumer Misperceptions, Product Failure and Producer Liability *Review of Economic Studies* Vol. 44, No. 3 (Oct., 1977), pp. 561-572

Advanced Macro

1. Blanchard O.J. and Kiyotaki (1987) Monopolistic competition and the effects of aggregate demand, *American Economic Review*, 77: September, pp 647-66/
2. Barro and Gordon (1983) A Positive Theory of Monetary Policy in a Natural Rate Model, *Journal of Political Economy*, 91:4: 589-610.
3. Friedman, M. (1968), The Role of Monetary Policy, *American Economic Review*, No.1 vol. LVIII March
4. Hicks, J. R. (1937) Mr. Keynes and the "Classics"; A Suggested Interpretations, *Econometrica* 5:147-159.
5. Prescott, E.C. (1986), Theory Ahead of Business Cycle Measurement, Federal Reserve Bank of Minneapolis, *Quarterly Review*; Fall.
6. Kydland F.E and E.C. Prescott (1977) Rules rather than discretion: the Inconsistency of Optimal Plans, *Journal of Political Economy*, 85:3: 473-491.
7. Lucas R.E. (1988) "On the Mechanics of Economic Development", *Journal of Monetary Economics*, 22, 3-42
8. King R.G. and Plosser C.I. (1984) Money Credit and Prices in a Real Business Cycle, *American Economic Review*, 64 (June) 263-380.
11. Pissarides C A (2000) *Equilibrium Unemployment Theory*, MIT Press.
12. Romer P. (1990) Endogenous Technological Change, *Journal of Political Economy*, 98:5:2, pp.s71-s102.
13. Samuelson P. A. (1939) Interaction Between the Multiplier Analysis and the Principle of Acceleration, *Review of Economics and Statistics*, 75-78.
14. Ramsey, F.P. (1928) "A Mathematical Theory of Saving," *Economic Journal* 38, 543-559.
15. Sargent, T.J. and N. Wallace (1975) "Rational" Expectations, the Optimal Monetary Instrument, and the Optimal Money Supply Rule, *Journal of Political Economy*, pp. 241-254.
17. Taylor M P (1987) *On the long run solution to dynamic econometric equations under rational expectation*, *Economic Journal*, 97:385:215-218.

18. Wickens M. (1995) Real Business Cycle Analysis: A Needed Revolution in Macroeconometrics (in Controversy: Business Cycle Empirics) *The Economic Journal*, Vol. 105, No. 433., pp. 1637-1648.
19. Plosser Charles I (1989) Understanding Real Business Cycle, *Journal of Economic Perspectives*, vol. 3, no. 3 pp. 51-77.
20. Wallis K.F. (1989) Macroeconomic Forecasting: A Survey , *The Economic Journal*, Vol. 99, No. 394., pp. 28-61
21. Sims Christopher A (1980) Macroeconomics and Reality, *Econometrica*, 48:1 January, pp. 1-45.

Advanced Econometrics

1. Arulampalam W., Booth A.L., (1998), "Learning and Earning: Do Multiple Training Events Pay?", *Journal of Economic Literature*
2. Blanchard O and D Quah (1989) The dynamic effects of aggregate demand and supply disturbances, *American Economic Review*, 79, 655-673.
3. Blundell R W and R J. Smith (1989) Estimation in a class of simultaneous equation limited dependent variable models, *Review of Economic Studies*, 56:37-38.
4. Chesher A (1984) Improving the efficiency of Probit estimators, *Review of Economic Studies*, 66:3:523-527.
5. Dickey D.A. and W.A. Fuller (1979) Distribution of the Estimator for Autoregressive Time Series with a Unit Root, *Journal of the American Statistical Association*, June.
6. Engle R E and C.W.J. Granger (1987) Co-integration and Error Correction: Representation, Estimation and Testing. *Econometrica*, vol. 55, No. 2, pp. 251-276.
7. Hansen L.P. (1982) Large sample properties of generalized method of moment estimators, *Econometrica*, 50:4:1029-1054.
8. Hausman J.A., (1978), "Specification Tests in Econometrics", *Econometrica*, Vol. 46, No. 6, pp.1251-1271.
9. Heckman J. J., (1979), Sample Selection Bias as a Specification Error, *Econometrica*, Vol. 47, No. 1, pp153-161.
10. Imbens G. W. and T Lancaster (1994) Combining Micro and Macro Data in Microeconomic Models, *Review of Economic Studies*, 61:4:655-680.
11. Keifer N (1988) Economic duration data and hazard functions, *Journal of Economic Literature*, 26:647-679.
12. Hendry D.F. (1997) The Econometrics of Macroeconomic Forecasting , *The Economic Journal*, Vol. 107, No. 444., pp. 1330-1357
13. Pedroni, P. (1999): "Critical values for cointegration tests in heterogeneous panels with multiple regressors", *Oxford Bulletin of Economics and Statistics*, 61, p.653-670.
14. Pesaran, M.H. and R. Smith (1995): "Estimating long-run relationships from dynamic heterogeneous panels", *Journal of Econometrics*, 68, p.79-113
15. Phillips P.C.B. (1987) Time Series Regression with an Unit Root, *Econometrica*, vol. 55, No. 2, 277-301.
16. Johansen Soren (1988) Statistical analysis of cointegration vectors, *Journal of Economic Dynamics and Control*, 12:231-254, North Holland.
17. Johansen Soren (1988) Estimation and Hypothesis Testing of Cointegration Vectors in Gaussian Vector Autoregressive Models, *Econometrica*, 59:6, 1551-1580.
18. Staigler D., Stock J. H., (1997), "Instrumental Variables Regression with Weak Instruments", *Econometrica*, Vol. 65, No. 3, pp.557-586.
19. Lancaster T (1979) Econometric Methods for Duration of Unemployment, *Econometrica*, 47:4:939-56.
20. Lancaster T and A Chesher (1983) The Estimation of Models of Labour Market Behaviour *Review of Economic Studies*, 50:4:609-624.
21. Zellner A. (1985) Bayesian Econometrics, *Econometrica*, 53:2:253-270

Advanced Public Economics

1. Atkinson A.B. and J. E. Stiglitz (1976) "The design of the tax structure: direct versus indirect taxation", *Journal of Public Economics*, 6:1-2:55-75.
 2. Bhattarai (1999) A Forward-Looking Dynamic Multisectoral General Equilibrium Model of the UK Economy, Hull Economics Research Paper no. 269.
 3. Harberger A.C. (1962), The Incidence of the Corporation Income Tax, *Journal of Political Economy* 70, 215-40.
 4. Mirlees, J.A. (1971) "An exploration in the theory of optimum income taxation", *Review of Economic Studies*, 38:175-208.
 5. Pechman J A (1987) Tax reform: theory and practice, *Journal of Economic Perspective*, 1:1:11-28.
 6. Perroni, C. (1995), Assessing the Dynamic Efficiency Gains of Tax Reform When Human Capital is Endogenous, *International Economic Review* 36, 907-925.
 7. Scarf, H. E. (1986) The Computation of Equilibrium Prices, in Scarf H. E and Shoven John B. ed. *Applied General Equilibrium Analysis*, Cambridge University Press.
 8. Shoven, J.B. and J.Whalley (1984) "Applied General-Equilibrium Models of Taxation and International Trade: An Introduction and Survey", *Journal of Economic Literature*, vol. XXII, Sept, pp.1007-1051.
1. Rebelo, S. (1991) Long-run Policy Analysis and Long-run Growth *Journal of Political Economy* 99:500-521.
 2. Sen A. (1976) Poverty: An Ordinal Approach to Measurement, *Econometrica*, 44:2:219-231.

Core text(s)

- Mailath G. J. and L. Samuelson (2006) Repeated Games and Reputations: long run relationship, Oxford.
- MasColell A, M.D.Whinston and J.R.Green (1995) Microeconomic Theory, Oxford University Press.
- Romer D. (1996) Advanced Macroeconomic Theory, McGraw Hill.
- Holly S and M Weale Eds.(2000) Econometric Modelling: Techniques and Applications, pp.69-93, the Cambridge University Press.
- K. Kuthberson , S. Hall and M Taylor (1992) Applied time series analysis , Michigan University Press.
- Burke S. P. and J. Hunter (2005) Modelling non-stationary economic time series, Palgrave.
- Greene W. (2000) Econometric Analysis, Prentice Hall.
- Myles G.D. (1995) Public Economics, Cambridge University Press.
- Sargent T. J. (1987) Dynamic Macroeconomic Theory, Harvard University Press.

Equivalent reading

- Osborne M.J. and A. Rubinstein (1994) A course in game theory, MIT Press.
- Cornwall R R (1984) Introduction to the use of general equilibrium analysis, North-Holland.
- Jehle G A and P.J. Reny (2005) Advanced Microeconomic Theory, Pearson Education.
- Varian H. R. (1992) Microeconomic Analysis, Norton.
- Hillman Arye (2005) Public Finance, Cambridge University Press.
- Harvey A.C. (1990) The Econometric Analysis of Time Series, Phillip Allan, 2nd edition.
- Hendry (1995) Dynamic Econometric Theory, Oxford.
- Lancaster T (1990) Econometric Analysis of Transition Data, Blackwell
- Sargent and Ljungqvists (2000) Recursive Macroeconomic Theory, MIT Press.

Further reading

- Baltagi (2005) Econometric analysis of panel data,
- Lancaster T (2004) An Introduction to Modern Bayesian Econometrics, Blackwell
- MasColell A, M.D.Whinston and J.R.Green (1995) Microeconomic Theory, Oxford University Press.

Journal list

13 key economics Journals in JOSTOR and other journals in Econlit.

Websites

- <http://www.eswc2005.com>; <http://www.hull.ac.uk/php/ecskrb>; www.eswc2005.com;
- <http://www.eea-esem.com/EEA-ESEM/2006/Prog/>; <http://www.econometricsociety.org>;
- <http://www.vanderbilt.edu/AEA/>; <http://www.helsinki.fi/WebEc/webec8d.html>
- http://www.elsevier.com/wps/find/homepage.cws_home; <http://www.ecomod.net/conferences.htm>;

Other Sources: To be mentioned at relevant time.

21. Module evaluation

This module will be evaluated by means of the Business School module evaluation questionnaire (MEQ), which all students are required to complete at the end of the module. The results of this formal evaluation will be forwarded to student-staff committees and programme group meetings and will be used to make alterations and improvements to the delivery and content of the module next year, if these are deemed to be necessary. Additional module evaluation techniques are also employed. Issues concerning the module can be forwarded directly to the module leader or to staff student committees. You may also have the opportunity to make informal comments and suggestions concerning the module in tutorial sessions.

Module evaluation is an integral part of the School's annual reporting process, therefore, your input is highly valued and, as such, much appreciated.

22. Module review

This is a brand new module and has not been taught before.

23. Module changes

Wherever possible, the module timetables and content will be delivered as outlined in this module handbook. However, at times changes do have to be made. In the event of such changes occurring, every effort will be made to re-schedule the activity, or replace it with work of an equivalent nature. You are advised to consult regularly the 'Blackboard' website and to read the programme notice boards for post graduate students. It is your responsibility to keep abreast of the current information.

24. Health and safety

You are responsible for your own health and safety at all times. It is vitally important that you act sensibly and safely for both indoor and outdoor activities. You are required to follow all safety instructions and guidelines as laid down in your Business School Programme handbook.

25. Notes

e.g. Change of programme schedule, tutor group, location etc.

The module staffs hope that you enjoy studying this module and that it makes a valuable educational contribution to your chosen programme.