AFRICAN ECONOMIC RESEARCH CONSORTIUM (AERC)

COLLABORATIVE PHD PROGRAMME (CPP) IN ECONOMICS FOR SUB-SAHARAN AFRICA

QUANTITATIVE METHODS

COURSE OUTLINE

(Revised: February, 2014)

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2.2.5 Time Series Analysis *(10 hours)*

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2.2.7 Panel Data Analysis *(10 hours)*

1. INTRODUCTION

1.1. Objectives

This course provides an advanced treatment of quantitative methods designed for Ph.D students in economics who have undertaken courses in mathematics and statistics for economists, and econometrics at the master's degree level. The aim is to prepare the students to pursue microeconomic and macroeconomic analysis at an advanced level. To ensure that the course is pitched at a high enough level for PhD, extensive use of matrix algebra is recommended. Further, to make the course relevant to economists, it is recommended that the course be taught using economics examples.

1.2. Prerequisites: Sound knowledge and understanding of quantitative methods or equivalent course at masters level.

1.3. Organization and mode of assessment:

The course is divided into two parts each running for one semester with 60 contact hours per semester. The assessment of the course will be through course work, project and final examination.

1.4 Main Reference Texts:

1.4.1. Mathematics and Statistics for Economists

1.4.1.1. Main Texts

Casella G. and Berger R.L. (2002) *Statistical Inferences*, Duxbury USA

Simon, C.P., and L. Blume, (1994), *Mathematics for Economists*, Norton.

Sydsæter, K.; P. Hammond, Atle Seierstad and Arne Strøm (2005), *Further Mathematics for Economic Analysis*, Prentice Hall. **(SHSS)**

1.4.1.2. Supplementary Texts

Chiang, A. (1992) *Elements of Dynamic Optimisation*, McGraw-Hill

Chiang, A.C. and K. Wainwright (2005): *Fundamental Methods of Mathematical Economics,* (4th edition). McGraw-Hill. **(CW)**

Lambert P. J. (1985) *Advanced Mathematics for Economists: Static and Dynamic Optimization*, Basil Blackwell, Oxford, UK.

Pemberton, M. and N. Rau (2001), *Mathematics for Economists*, Manchester: University Press.

Sydsæter, K. and P. Hammond (2006), *Essential Mathematics* for *Economic Analysis,* Prentice Hall.

Supplementary Reading on Computer Intensive Methods

Johnston J. and J. DiNardo (1997), *Econometric Methods* (4th Edition), McGraw-Hill International Edition.

Spanos A. (1986), *Statistical Foundations of Econometric Modelling,* Cambridge University Press.

Mooney C.Z (1997) *Monte Carlo Simulation*, Sage publication

Mooney C.Z. and Duval, R.D (1993) *Bootstrapping: A Non-parametric Approach to Statistical Inference,* Sage publication

1.4.2 Econometrics

1.4.2.1. Main Texts

Greene W. H. (2011), *Econometric Analysis* (7th edition), Prentice Hall.

Verbeek, M. (2012) *A Guide to Modern Econometrics*, John Wiley and Sons Ltd, (4th Edition)

Wooldridge J.M (2010), *Econometric Analysis of Cross Section and Panel Data* (2nd Edition), MIT Press

1.4.2.2. Supplementary General Econometrics Texts

Creel, M (2008) *Econometrics*, Free online textbook

Davidson J and R. MacKinnon (1993), *Estimation and Inference in Econometrics*, Oxford.

Davidson J and R. MacKinnon (2004), *Econometric Theory and Methods*, Oxford University Press.

Enders W. (2010), *Applied Econometric Time Series* (3rd Edition)**,** John Wiley & Sons, Inc.

Griliches Z. and Intriligator (1983) *Handbook of Econometrics* Vol 1 to 5. North Holland

Hansen, B. (2014) *Econometrics*, Free online textbook

Hsiao C. (2003), *Analysis of Panel Data***,** Cambridge University Press, New York,

Johnston J. and J. DiNardo (1997), *Econometric Methods* (4th Edition), McGraw-Hill International Edition.

Maddala G. and Rao . (1993), *Handbook of Statistics*, North Holland

UIlah, A. and H. Vinod (2000) *Handbook of Applied Econometrics*, North Holland

1.4.2.2 Supplementary Reading on Topics in Time Series Analysis

Hamilton J. D. (1994), *Time Series Analysis***,** Princeton University Press, Princeton, New Jersey.

Harris R. and Sollis, R. (2003), *Applied Time Series Modeling and Forecasting*, John Wiley.

Hendry F.D. (1995), *Dynamic Econometrics*, Oxford University Press.

Maddala, G.S., and In-Moo Kim (1998), *Unit Roots, Cointegration, and Structural Change*, Cambridge University Press.

Pfaff B. (2006), *Analysis of Integrated and Cointegrated Time Series with R*, Springer

Lutkepohl H. (2005), *New Introduction to Multiple Time Series*, Springer

Vance M, Hurn, S and Harris, D. (2013), *Econometric Modelling with Time Series*, Cambridge University Press

Woodward, W. A, H. L. Grey and A. C. Elliott (2011), *Applied Time Series Analysis*, CBC Press

1.4.2.3. Supplementary Reading on Topics in the Limited and Categorical Dependent Variables

Cameron, A. C, and P. K. Trivedi (2010), *Applied Microeconometrics Using Stata*, Stata Press

Cameron, A.C. and P. K. Trivedi (2005), *Microeconometrics Methods and Applications*, Cambridge University Press

Deaton A. (1997), *The Analysis of Household Surveys*, World Bank.

Long S. J. (1997), *Regression Models for Categorical and Limited Dependent Variables*, SAGE Publications Inc.

1.4.2.4. Supplementary Reading on Topics in Panel Data Analysis

Baltagi B. H. (2013), *Econometrics Analysis of Panel Data*. John Wiley & Sons, New York.
Baum C. C. (2006), *Introduction to Modern Econometrics Using STATA*, Stata Press
Hsiao C. (2003), *Analysis of Panel Data***,** Cambridge University Press, New York,
Matyas, L. and P. Sevestre (2008), *The Econometrics of Panel Data* (3rd Edition), Springer
Wooldridge J.M (2010), *Econometric Analysis of Cross Section and Panel Data*, MIT Press.

Additional econometrics resources are available at http://econometricslinks.com. and http://www.economicsnetwork.ac.uk/

1.5 Software

Since the course requires computer-assisted laboratory sessions, it is recommended that students be trained in software packages that lend themselves well, not only for econometric applications, but also for modern data analysis (using graphical methods).

Mathematics for economists software: MATHEMATICA, MAXIMA (Open Source available at http://maxima.sourceforge.net/).

Econometrics software: STATA *and* EViews are *highly* recommended statistical packages which are excellent for modern data analysis as well as for standard econometric applications (including time series analysis). Open source alternatives are GRETL (http://gretl.sourceforge.net/), R (http://www.r-project.org/), and OCTAVE (https://www.gnu.org/software/octave/). Other recommended commercial statistical packages include RATS, LIMDEP, MICROFIT, MATLAB,GAUSS and SHAZAM. Note that, at the start of the course, students need to be given an introduction to the relevant software package.

DETAILED COURSE OUTLINE

2.1 MATHEMATICS AND STATISTICS FOR ECONOMISTS

2.1.1. Matrix Algebra — 8 hours

Brief review of Determinants, Inverses, Cramer's Rule

Partitioned Matrices, Matrix Differentiation, Ranks and Determinants, Eigenvalues and Eigenvectors, Quadratic Form, Generalized Inverses (Moore-Penrose), Kronecker Products, diagonalisation of matrices, idempotent matrices and spectral decomposing matrices, Matrix operators and Matrix Applications

Readings:

SHSS Chapter 1

Simon and Blume, Chapters 7, 16, and 23

Pemberton and Rau, Chapters 12 and 25

Greene, Appendix A

2.1.2. Set Theory — 4 hours

Boundary, interior, openness and closure, convexity, compactness, sequences

Readings:

Simon and Blume, Chapter 12

2.1.3. Real Analysis — 8 hours

Continuity of functions, Implicit Functions, Homogeneous Functions, Concave and Quasiconcave Functions, pseudo concavity, Convex and Quasiconvex Functions

Fixed point theorem

Readings:

Simon and Blume, Chapters, 15, 20 and 21

Pemberton and Rau, Chapters 8, 16 and 17

SHSS, Chapters 2 and 14

2.1.4. Static Optimization **6 hours**

Unconstrained and Constrained Optimization, Linear and Nonlinear Programming, and Envelope Theorem

Readings:

Simon and Blume, Chapters 17, 18 and 19.

Pemberton and Rau, Chapters 16, 17 and 18

SHSS, Chapter 3

2.1.5. Dynamic Analysis **8 hours**

a) Review of Difference and Differential Equations of the 1st and 2nd order

b) Systems of Difference and Differential Equations

Readings:

Simon and Blume, Chapters 23, 24 and 25.

Pemberton and Rau, Chapters 21, 24 and 26

SHSS, Chapters, 5, 6, 7 and 11

CW, Chapters 15-19

2.1.6. Dynamic Optimization **10 hours**

Calculus of Variation, Optimal Control Theory and Dynamic Programming

Readings:

SHSS, Chapters, 8, 9, 10 and 12

Chiang

CW, Chapter 20

2.1.7. Distribution Theory and Statistical Inference **12 hours**

a) Review of Probability Theory

b) Univariate and multivariate distributions

c) Moment generating functions and characteristics functions

d) Sampling distributions, large-sample distribution theory, point and interval estimation, maximum likelihood, methods of moments, restricted and robust estimation, and hypothesis testing

e) Bayesian theory

Readings:

Casella and Berger, Chapters 1, 2 and 5 - 10

Verbeek, Appendix B

Greene, Chapter 16 and Appendices B, C, and D

2.1.8. Computer Intensive Methods: 4 hours

Monte Carlo simulation

Re-sampling techniques including bootstrapping, jackknife and other methods

Readings:

Davidson and Mackinnon (1993), Chapter 21

Johnston and DiNardo, Chapter 11

Cameron and Trivedi, Chapters 11 and 12

Greene, Chapter 15

2.2. ECONOMETRICS

2.2.1. Specification and Estimation of the Classical Linear Regression Model (Matrix Approach) 8 hours

Assumptions of the classical linear regression model, least squares regression, goodness of fit and the analysis of variance, statistical properties of OLS in finite samples, multicollinearity problem, missing observations, diagnostics and outliers, testing restrictions, tests of structural change, testing non-linear restrictions, prediction. Dummy variables, non-linearity in the variables, specification analysis and model selection, biased estimators.

Readings:

Greene, Chapters 1 - 7

Johnston and DiNardo, Chapters 3 and 4

Verbeek, Chapters 2, 3 and 5

2.2.2. Extensions 10 hours

Stochastic regressors, instrumental variable estimation and measurement error, non-normal disturbances and their asymptotic properties. Consequences for least square estimation, efficient estimation, feasible generalized least squares, testing for heteroscedasticity and autocorrelation, HAC estimator. Nonlinear least squares estimators and testing hypotheses

Readings:

Greene, Chapters 8, 9, 12 and 20

Cameron and Trivedi, Appendix A

Verbeek, Chapters 4 - 6

2.2.3. Simultaneous Equation Models: 6 hours

Problem of identification, methods of estimation: single equation and system methods,

Readings:

Greene, Chapter 10

Verbeek, Chapter 5

Johnston and DiNardo, Chapter 5.5

2.2.4. Maximum Likelihood and GMM 8 hours

Maximum likelihood estimation and hypothesis testing, and generalized method of moments (GMM)

Readings:

Greene, Chapters 13 and 14

Johnston and DiNardo, Chapters 5 and 10

Verbeek, Chapter 6

2.2.5. Time Series Analysis 10 hours

Stationarity and unit roots, ARDL models, vector autoregression analysis and its extensions, cointegration analysis, structural breaks, autoregressive conditional heteroscedasticity (ARCH), generalized autoregressive conditional heteroscedasticity (GARCH) and extensions, forecasting.

Main Readings:

Greene, Chapter 21

Verbeek, Chapters 8 and 9

Johnston and DiNardo, Chapters 7 and 9

Lutkepohl, Chapters 1, 2 and 4

2.2.8. Microeconometrics 8 hours

Limited dependent variables models, multinominal logit models, ordered discrete dependent variables, models for count data, truncation, Tobit models, duration models.

Readings:

Greene, Chapters 17 - 19

Wooldridge, Chapters 15-19, and 22

Johnston and DiNardo, Chapter 13

Verbeek, Chapter 7

Cameron and Trivedi, Chapters 14-20

2.2.9 Panel Data Analysis **10 hours**

Static and dynamic panel data analysis

Readings:

Greene, Chapter 11

Wooldridge, Chapter 10

Johnston and DiNardo, Chapter 12

Verbeek, Chapter 10

Cameron and Trivedi, Chapters 21 and 22