AFRICAN ECONOMIC RESEARCH CONSORTIUM (AERC)

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

JOINT FACILITY FOR ELECTIVES

LECTURE SERIES IN ECONOMETRICS

(Revised August 2020)

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Our mailing address is:
African Economic Research Consortium (AERC)
3rd Floor-Middle East Bank Towers Building, Jakaya Kikwete Road
P. O. Box 62882
00200 Nairobi
Kenya

1. Course Objectives

The objective of this two-semester PhD course is to provide advanced econometric tools for the applied and policy problems relevant to the African context, while striking a balance between theory and applications. A crucial aspect of the course is the provision of sound theoretical formulations, the rigorous application of techniques to applied contexts, including a variety of models that find application in the real world. Students will also learn to handle standard menu-driven econometric software, and high-level programming language developed for basic and advanced econometric studies.

2. Prerequisites

The pre-requisite for this course is a Masters degree in economics, in which the student has thorough grounding in calculus, basic mathematical statistics, and basic econometrics, from an accredited university. In addition, students are expected to have completed ECON 561 (Macroeconometrics) and ECON 562 (Microeconometrics) of the CMAP, or equivalent courses. Knowledge of mathematical statistics at the level of Mittelhammer (1996) or Cassela (2008) is crucial.

3. Overview of the Course

This course covers advanced topics in cross section, time series and panel data econometrics, with emphasis on specification, estimation and testing. The specific topics covered are stated below.

4. Teaching Arrangements

In the event that face-to-face offering is not possible, the course will be taught synchronously on one of the virtual platforms (e.g. Zoom, Microsoft Teams, Lifesize, etc.). The practical sessions will also be run virtually using screenshare. Students will be expected to submit their completed work via the class DropBox where important course resources (i.e., class notes, PowerPoint Slides, assignments, etc.) will also be posted. The exams will be in take-home format with strict time limits for the work to be completed and submitted via DropBox as well. The structure of examination questions will take into consideration the take home open book nature of the exam. Students will be expected to avail themselves for virtual meetings with the lecturer to discuss any submitted work. Office hours will be held virtually.

The course has two parts, each comprising 60 contact hours, including lectures and labs. At the end of each topic students are guided in estimating models preferably using data from African countries.

The ability to replicate relevant empirical work published in journals that make data available online constitutes an important aspect of this course. To this end, data from various archives (e.g., *Journal of Applied Econometrics* data archive http://qed.econ.queensu.ca/jae/, American Economic Association journals, etc.) will be used.

5. Grading

There will be at least one in class test in addition to empirical project(s)

Course Assessment	Percent
Student Projects	40
Class tests	20
Final Examination	40
Total	**100**

6. Software Packages

There are several software-packages that could be used for econometric analysis. These include: E-Views, STATA, GRETL and R. The students should master at least one menu-driven econometric software package (good for analyzing empirical data) and at least one programming environment (e.g. R, Gauss, MATLAB, Octave, RATS, STATA, EViews, etc.), which is good for new material which is not yet incorporated into canned econometric software packages. One may note that R is open source and free, which could be helpful when planning future research or teaching at a financially constrained organization.

7. Required Textbooks:

Experience has shown that basing a course of this nature on several alternative texts may help improve understanding. However, more often than not, it can easily confuse the average student because of inevitable differences in notations. Hence, following most common practice, the course will be based on a few major textbooks as main readings. (Supplementary textbooks will be pointed out, which should encourage students for further study.)

COURSE OUTLINE

PART I-ECON 661: ECONOMETRICS I (MACRO-ECONOMETRICS and ECONOMETRIC FOUNDATIONS)

LECTURE 1: Review of Econometrics and Statistics Fundamentals (10 Hours)

1.1 Linear regression models
1.2 Asymptotic distribution theory
1.3 Maximum Likelihood Estimation
1.4 Generalized Method of Moments
1.5 Linear systems of simultaneous equations
1.6 Lag operators
1.7 Difference Equations

Readings: Hamilton Ch. 1,2,7,8,9; Hayashi Ch. 1, 2, 3; Martin, Hurn and Harris Appendix B.

LECTURE 2: Stationary Time Series (5 Hours)

2.1 Stationary ARMA processes
2.2 Maximum Likelihood Estimation of Stationary ARMA Processes
2.3 Forecasting

Readings: Hamilton Ch. 3,4,5; Martin, Hurn and Harris Ch. 13.

LECTURE 3: Multivariate Time Series (7 Hours)

3.1 Covariance Stationary Vector Processes
3.2 Vector Autoregressions

Readings: Hamilton Ch. 10,11,18; Tsay Ch. 1, 2, 5: 5.5-5.11; Martin, Hurn and Harris Ch. 13, 14, 18; Lütkepohl Ch. 1-4.

LECTURE 4: Non-Stationary Time Series (18 Hours)

4.1 Models of Non-Stationary Time Series
4.2 Processes with Deterministic Time Trends
4.3 Univariate Processes with Unit Roots
4.4 Unit Roots in Multivariate Time Series
4.5 Cointegration

Readings: Hamilton Ch. 15,16,17,19,20; Martin, Hurn and Harris Ch. 16, 17; Tsay Ch. 5.

LECTURE 5: Review: Econometrics & Statistics Fundamentals-linear equations (5 Hours)

5.1 Asymptotic distributions in cross-section (iid) setting
5.2 Linear Regression and Ordinary Least Squares in cross-section (iid) setting
5.3 Linear Instrumental Variable estimation in cross-section (iid) setting

Readings: Wooldridge, Ch. 3, 4, 5; Cameron and Trivedi Ch. 4-6.

LECTURE 6: Statistics Fundamentals in non-linear parametrics (15 Hours)

6.1 M-Estimation in non-linear parametric settings, including asymptotic distribution and inference/testing
6.2 Bootstrap, simulation and resampling methods as alternative inference approaches
6.3 Generalized Method of Moments with unconditional moment restrictions
6.4 Generalized Method of Moments with conditional moment restrictions
6.5 Maximum Likelihood Estimation (optional)

Readings: Wooldridge, Ch. 12, 14 (and, optional, Chapter 13).

Main Textbook

Hamilton J.D. (1994) *Time Series Analysis*.Princeton, Princeton University Press.
Wooldridge (2010) *Econometric Analysis of Cross Section and Panel Data*: Second Edition

Required Textbooks

Tsay, R (2013) *Multivariate Time Series Analysis: With R and Financial Applications*, Wiley
Martin, V.,S. Hurn and D. Harris (2012) *Econometric Modelling with Time Series: Specification, Estimation and Testing*, Cambridge University Press.
Lütkepohl, H. (2005) *New Introduction to Multiple Time Series Analysis*, Springer Verlag
Ghysels, E. and M. Marcellino (2018), *Applied Economic Forecasting using Time Series Methods*, Oxford University Press.

Free Open Source Ph.D. Econometrics Textbooks

Diebold, F.X. (2019), *Time Series Econometrics: A Concise Course*
https://www.sas.upenn.edu/~fdiebold/Teaching706/TimeSeriesEconometrics.pdf

Hansen, B. (2020), *Econometrics*
https://www.ssc.wisc.edu/~bhansen/econometrics/Econometrics.pdf

Other Books

Brockwell, P.J. and R.A. Davis (2009), *Time Series: Theory and Methods 2nd Edition*. New-York, Springer.
Brooks, C. (2019), *Introductory Econometrics for Finance, 4th edition*. Cambridge University Press.
Canova F. (2006), *Methods for Applied Macroeconomic Research*. Princeton University Press.
Chipman, J. (2011), *Advanced Econometric Theory*. Routledge.
Chan, J., Koop G., D. Poirier and J. Tobias (2020), *Bayesian Econometric Methods*, 2nd Edition, Cambridge University Press.
Commandeur, J. and S. Koopman (2007), *An introduction to State Space Time Series Analysis*. Oxford University Press.
Davidson, R. (2000), *Econometric Theory*, Wiley-Blackwell.
Durbin, J. and S. Koopman (2001), *Time Series Analysis by State Space Models*. Oxford University Press.
Enders, W. (2014*), Applied Econometric Time Series 4thEdition*. Wiley.
Francq, C. and J. Zakoian (2010), *GARCH Models: Structure, Statistical Inference and Financial Applications*. Wiley.
Franses, P.H. and D. van Dijk (2004), *Non-Linear Time Series Models in Empirical Finance*. Cambridge University Press.
Greenberg, E. (2012), *Introduction to Bayesian Econometrics, 2nd Edition*. Cambridge University Press.
Greene W. (2018), *Econometric Analysis 8th Edition*. Pearson.
Harris, R. and R. Sollis (2003), *Applied Time Series Modelling and Forecasting*. Wiley.
Johnston, J. and J. DiNardo (1997), *Econometric Methods 4thEdition*McGraw-Hill.
Lancaster T. (2004), *An Introduction to Modern Bayesian Econometrics*. Wiley.
Linton, O. (2019), *Financial Econometrics Models and Methods*, Cambridge University Press.
Lütkepohl, H. and M. Krätzig (ed.), (2009), *Applied Time Series Econometrics*. Cambridge University Press.
Lütkepohl, H. (2005), *New Introduction to Multiple time series Analysis*. Springer.
Madsen, H. (2007), *Time Series Analysis*. Chapman & Hall/CRC Texts.
Mills, T. and R. Markellos (2008), *The Econometric Modelling of Financial Time Series, 3rd edition*. Cambridge University Press.
Neusser, K. (2016) *Time Series Econometrics*, Springer
Shumway, R. H. and D.S. Stoffer (2010), *Time series and Its Applications: With R examples 3rdedition*. Springer Texts in Statistics.
Stock, J. and M. Watson (2020), *Introduction to Econometrics 4th Edition.* Pearson.
Taniguchi M and Kakizawa Y (2012), *Asymptotic Theory of Statistical Inference for Time Series*. New-York, Springer Verlag.
Woodward, W., H. Gray and A. Elliott (2017), *Applied Time Series Analysis*. CRC Press Taylor & Francis Group, LLC.
Wooldridge, J. (2019), *Econometrics: A Modern Approach, 7th Edition.* South-Western College Publishers.

PART II-ECON 662: ECONOMETRICS II (MICRO-ECONOMETRICS)

This part of the course is sub-divided in two parts. The first part introduces the concept of Causal Inference. The second part covers structural and parametric econometrics. The first part (causal inference) starts with randomized experiments and counterfactual outcomes, subsequently introducing matching methods and other methods with nonparametric identification. Since causal inference heavily uses nonparametric tools, one may consider starting with nonparametric topics.

LECTURE 7: Nonparametric and Semiparametric Methods (8 Hours)

7.1 Nonparametric Density Estimation
7.2 Nonparametric Regression

Readings: Greene Ch.7; Li and Racine Ch. 1, 2, 3, 7, 8; Cameron and Trivedi Ch. 9.

LECTURE 8: Causal Inference and Impact Evaluation (30 hours)

8.1 Definition of average treatment effects, potential outcomes, selection bias
8.2 Nonparametric identification
8.3 Randomized Controlled Trials (RCT)
8.4 Directed Acyclic Graphs, Matching and Propensity score matching
8.5 Difference in Difference estimation
8.6 Instrumental variables estimation (nonparametric methods)
8.7 Regression Discontinuity Design

Readings: Frölich and Sperlich (2019).

LECTURE 9: Issues in Panel Data Analysis (10 Hours)

9.1 Fixed and Random Effects (Specification, Estimation, Testing)
9.2 Dynamic Panels (Specification and Estimation)
9.3 Other topics in Panel Data

Readings: Use either Arellano Ch. 1, 2, 3; or Wooldridge Chapter 10 and 11.

LECTURE 10: Qualitative Response and Related Models (6 Hours)

10.1 Probit/Logit
10.2 Bivariate Probit/Logit
10.3 Random Effects Probit
10.4 Binary Response Models for Panel Data
10.5 Multinomial Probit/Logit
10.6 Ordered Logit/Probit

Readings: Wooldridge Ch. 15, 16; Cameron and Trivedi Ch. 14, 15.

LECTURE 11: Truncated, Censored Regression and Sample Selection Models (6 Hours)

11.1 Censored and Truncated models
11.2 Tobit models
11.3 Heckman Two-Step Estimation
11.4 Roy Model

Readings: Wooldridge Ch. 17, 19; Cameron and Trivedi Ch. 16.

Main Textbooks:

Frölich and Sperlich (2019), *Impact Evaluation*, Cambridge University Press
Wooldridge, J. (2010), *Econometric Analysis of Cross Section and Panel Data, 2nd Edition*. MIT

Free Open Source Ph.D. Econometrics Textbooks

Hansen, B. (2020), *Econometrics*
https://www.ssc.wisc.edu/~bhansen/econometrics/Econometrics.pdf

Required Textbooks

Arellano, M. (2003), *Panel Data Econometrics*. Oxford University Press.
Cameron, A.C. and P. K. Trivedi (2005), *Microeconometrics: Methods and Applications*. Cambridge University Press.
Cameron, A.C. and P. K. Trivedi (2010), *Microeconometrics using STATA*. Stata Press.
Li, Q. and J. Racine J. (2007), *Nonparametric Econometrics: Theory and Practice*. Princeton University Press.
Racine, J. (2019), *An Introduction to the Advanced Theory and Practice of Nonparametric Econometrics: A Replicable Approach Using R* , Cambridge University Press
Henderson, D. J. and C. F. Parmeter (2015), *Applied Nonparametrics*, Cambridge University Press.

Other Books:

Chan, J., Koop G., D. Poirier and J. Tobias (2020), *Bayesian Econometric Methods*. 2nd Edition, Cambridge University Press.
Deaton, A, (1997), *The Analysis of Household Surveys: A Microeconometric Approach to Development Policy*, Johns Hopkins University Press.
Greene W. (2018), *Econometric Analysis 8th Edition*. Pearson.
Greene W. and D. Hensher (2010), *Modelling Ordered Choices, A Primer*. Cambridge University Press.
Hsiao, C. (2014), *Analysis of Panel Data, 3rd Edition*, Cambridge University Press.
Pagan, A. and A. Ullah (1999), *Nonparametric Econometrics*. Cambridge University Press.
Silverman, B.W. (1986), *Density Estimation for Statistics and Data Analysis*. New York, Chapman and Hall.
Stock, J. and M. Watson (2018), *Introduction to Econometrics 4th Edition*. Pearson.

Verbeek (2017), *A Guide to Modern Econometrics, 5th Edition*, Wiley.
Winkelmann, R. (2008), *Econometric Analysis of Count Data, 5th Edition*. Springer.
Wooldridge, J. (2019), *Econometrics: A Modern Approach, 7th Edition.* South-Western College Publishers

General journal articles

Arrelano, M. and S. Bond (1991) "Some Tests of Specification for Panel Data: Monte Carlo Evidence and Application to Employment Equations," *Review of Economic Studies,*58,277-297.
Arellano, M. and O. Bover (1995) "Another Look at the Instrumental Variable estimation of Error-Components Models," *Journal of Econometrics,* 68, 29-51.

Selected Journal articles on Africa

- Abdulai, A. and D. Aubert (2004) "Nonparametric and Parametric Analysis of Calorie Consumption in Tanzania," Food Policy, 29, 113-129.
- Adjasi, C.K.D. and N. Biekpe (2009) "Do Stock Markets Matter in Investment Growth in Africa?" Journal of Developing Areas, 43, 109-120.
- Ben Hammouda, H., S. Karingi, A. E. Njuguna, and M. Sadni-Jallab (2009) "Why doesn't regional Integration Improve Income Convergence in Africa?" African Development Review, 21(2), pp 291-330.
- Boopen, S. (2009) "The Economic Importance of Education: Evidence From Africa Using Dynamic Panel Data Analysis," Journal of Applied Economics, XII, 137-157.
- Cichello, P.L., G.S. Fields and M. Leibbrandt (2005) "Earnings and Employment Dynamics for Africans in Post-apartheid South Africa: A Panel Study of Kwazulu-Natal," Journal of African Economies, 14, 143-190.
- Diiro, G.M. and A.G. Sam (2015) "Agricultural Technology Adoption and Non-Farm Earnings in Uganda: A Semiparametric Analysis," Journal of Developing Areas, 49, 145-162.
- Jaunky, V.C. (2008) "Divergence in Per Capita Electric Power Consumption: An African Perspective," Applied Econometrics and International Development, 8, 137-150. Available at: http://www.usc.es/~economet/aeid.htm
- Jaunky, V.C. (2013) "Democracy and Economic Growth in Sub-Saharan Africa: A Panel Data Approach," Empirical Economics, 45, 987-1008.
- Juselus, Katarina, N.F. Moller and F. Tarp (2014) "The Long-Run Impact of Foreign Aid in 36 African Countries: Insights from Multivariate Time Series Analysis," Oxford Bulletin of Economics and Statistics, 76, 153-184.
- Kassie, G., A Abdulai and C. Wollny (2010) "Implicit Prices of Indigenous Bull Traits in Crop-Livestock Mixed Production Systems of Ethiopia," African Development Review, 22, 482-494.
- Kassie, M., S. Ndiritu, and J. Stage (2014) "What determines gender inequality in household food security in Kenya? Application of Exogenous Switching Treatment Regression", World Development Vol. 56, pp 153-171.
- Kerr, A. and F. Teal (2015) "The Determinants of Earnings Inequalities: Panel Evidence from KwaZulu-Natal, South Africa," Journal of African Economies, 24, 530-538.
- Khadaroo, J. and S. Boopen (2007) "The Role of Transport Infrastructure in FDI Evidence from Africa Using GMM Estimates," Journal of Transport Economics and Policy, 43, 365-384.

- Leibbrandt, M. and J. Levinsohn (2011) "Fifteen Years On: Household Incomes in South Africa, National Bureau of Economic Research, Inc, NBER Working Papers, 16661. Available at: http://www.nber.org/papers/w16661.pdf
- Mariotti, M. and J. Meinecke (2015) "Partial Identification and Bound Estimation of the Average Treatment Effect of Education on Earnings for South Africa," Oxford Bulletin of Economics and Statistics, 77, 210-233.
- Mesnard, A. and M. Ravallion (2006) "The Wealth Effect of New Business Startups in a Developing Country," Economica, 73, 367-392.
- Naude, W.A. (2004) "The Effects of Policy, Institutions and Geography on Economic Growth in Africa: An Econometric Study Based on Cross-Section and Panel Data," Journal of International Development, 16, 821-849.
- Naude, W. and W.F. Krugell (2007) "Investigating Geography and Institutions as Determinants of Foreign Direct Investment in Africa Using Panel Data," Applied Economics, 39, 1223-1233.
- Novignon, J., J. Novignon and E. Arthur (2015) "Health Status and Labor Force Participation in Sub-Saharan Africa: A Dynamic Panel Data Analysis," African Development Review, 27, 14-26.
- Oyekale, A. (2014) "Factors Explaining Child Survival in Ethiopia: Application of Two-Stage Probit Model," African Development Review, 26, 237-249.
- Walle, Y. (2014) "Revisiting the Finance-Growth Nexus in Sub-Saharan Africa: Results from Error Correction-Based Panel Cointegration Tests," African Development Review, 26, 310-321.

Relevant AERC Research Papers

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Links to other free open source resources:
https://ocw.mit.edu/courses/economics/14-382-econometrics-spring-2017/lecture-notes/