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)
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 prerequisite 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)

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<thead>
<tr>
<th>Course Assessment</th>
<th>Percent</th>
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<tbody>
<tr>
<td>Student Projects</td>
<td>40</td>
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<tr>
<td>Class tests</td>
<td>20</td>
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<tr>
<td>Final Examination</td>
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<td><strong>Total</strong></td>
<td><strong>100</strong></td>
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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.)
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

Required Textbooks

Free Open Source Ph.D. Econometrics Textbooks

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

Other Books
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


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:

Free Open Source Ph.D. Econometrics Textbooks
Hansen, B. (2020), Econometrics
https://www.ssc.wisc.edu/~bhansen/econometrics/Econometrics.pdf

Required Textbooks
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.

Other Books:

**General journal articles**

**Selected Journal articles on Africa**

**Relevant AERC Research Papers**

Available at [https://aercafrica.org/publications/](https://aercafrica.org/publications/)

**Links to other free open source resources:**