**Managerial Econometrics (MM)**
**Elective for PGP and PGP (ABM)**

Instructors: Sanket Mohapatra (SM) and Abhiman Das (AD)

## Course Overview

Econometric applications have become an integral part of training in modern economics and business management. Modern managers in a number of sectors are increasingly incorporating econometric applications into their businesses to establish sound economic strategies, to develop insight, create value, and outperform competition. Econometric applications provide organisations with a potent set of tools to unlock the power of information and in effective decision making. Therefore, it is imperative that management students have basic grounding on Econometric analysis before handling real life problems.

In PGP 1, under Quantitative Methods (Part 1 and 2), students are introduced to the basic concepts of probability and its applications, notions of sampling, point and interval estimation, testing of hypotheses, analysis of variance, basic framework of regression, etc. Building over this foundation, the main objective of the course is to introduce Econometrics as a decision making tool purely from application point of view. Towards this, the course aims at developing adequate understanding of regression methodology and showcases various applications to real life problems. Beginning with the very nature of Econometrics and economic data, we highlight some important real life problems upfront so as to ignite the problem solving ability of young managers through Econometrics. Following two sessions (Module 1) aim at recapitulating some of the basics concepts of regression from a more applied context. Subsequent sessions take regression methodology forward by questioning some of the fundamental assumptions, without going into the detailed technical stuff of regression methodology. What happens when basic assumptions like linearity, homoscedastic errors, causality, etc., are violated and what are the various tweaks to the data that enable us to overcome such issues forms the crux of Modules 2 and 3. Again all these issues are covered through various examples. The discussion in Modules 1 – 3 is typically restricted to cross-sectional data and an introduction to regression is not complete without discussing time series data in a greater detail. Time series data comes with additional issues like stationarity, trend, seasonality, cyclicality, etc. Module 4 is aimed at providing greater understanding of how to deal with such data. We conclude in Module 5 by discussing panel data where the data is both cross-sectional as well as time series in nature.

In the process of teaching, we will introduce various data sets. The primary idea is to understand the power of data analysis and to demonstrate some of the concepts which are covered in the class. They will cover wide range of topics including finance, marketing, politics, policy evaluation and HR. On top of that, we shall encourage students to come up with examples of application of regression in areas of their interest. There is a software component to this course. We will use Excel as well as more advanced statistical software like STATA and EViews for the course. So students will have benefit to learn the basics of STATA and EViews as well. Prerequisite for this course is the understanding of basic statistics. However, the desire to learn a technical tool which is increasingly used in today's world to address real life problems is essential.

**Pedagogy** – Lectures, Econometric case studies discussions, project presentations

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## Textbooks

**The main textbook for the course is:**
"Introductory Econometrics - A Modern Approach", by Jeffrey Wooldridge, 5th Edition, 2015 (W).
"Econometrics for Dummies", by Roberto Predace, June 2013 (P).

**Other useful books:**
"Basic Econometrics", by Damodar Gujarati and Sangeetha, TMH, 2007 (DG)

Mostly Harmless Econometrics: An Empiricist's Companion, by J. Angrist and J. Prischke, Princeton University Press, 2009.

## Additional readings:


Card, David and Alan Krueger (1994). Minimum Wages and Employment: A Case Study of the Fast-Food Industry in New Jersey and Pennsylvania, *American Economic Review*, 84(4), 772-793.

Chintagunta, P. K., T. Erdem, P. Rossi, M. Wedel. (2006). Structural modeling in marketing: Review and assessment. *Marketing Science*, 25(6) 604–616.

Mazzeo, M. J. (2002). Product choice and oligopoly market structure. *Rand Journal of Economics*, 33(2) 221–242.

Duflo E. (2001). "Schooling and Labor Market Consequences of School Construction in Indonesia: Evidence from an Unusual Policy Experiment", *American Economic Review*, 91(4), 795-813.

Eissa, Nada and Jeffrey Liebman (1996). "Labour Supply Response to the Earned Income Tax Credit," *Quarterly Journal of Economics*, May, 1996

Lieberman, Marvin (1990). "Exit from Declining Industries: Shakeout or Stakeout," *Rand Journal of Economics*, Vol. 21, No. 4.

Iyer, Lakshmi (2010). "Direct versus Indirect Colonial Rule in India: Long Term Consequences," *Review of Economics and Statistics*, November.

Angrist, Joshua and Alan Krueger (1994). "Why do World War II Veterans Earn More than Non-Veterans?" *Journal of Labour Economics*, January.

Levitt, Steven (1997). "Using Electoral Cycles in Police Hiring to Estimate the Effects of Police on Crime," *American Economic Review*, June.

Borenstein, Severin and Nancy Rose, "Competition and Price Dispersion in the U.S. Airline Industry," *Journal of Political Economy*, Vol. 102, No. 4

Varian, H. and H. Choi (2011): Predicting the Present with Google Trends, http://people.ischool.berkeley.edu/~hal/Papers/2011/ptp.pdf

**Session Plan**

**Module 1: Introduction to Econometrics and Basic Linear Regression Methodology**

Session 1: ***Introduction: Nature of Econometrics and Economic Data (W, P)***

- What is Econometrics?
- Goals of Econometric Analysis
- Economic models and Econometric models
- Variables: quantitative and qualitative
- Various kinds of economic data sets
    - Cross-sectional data
    - Time series data
    - Pooled cross-sectional data
    - Panel/Longitudinal data
    - Examples of various data
- Introduction to the simple linear regression model
- Practical applications in Econometrics
- Readings: W (Chapter 1 and 2)

Sessions 2 and 3: ***Classical multiple linear regression model***

- Sample vs. population estimates
- Discussion of assumptions in a regression model
- Ordinary least squares estimate
- Degrees of freedom and hypothesis testing; standard errors
- Goodness of fit – $R^2$, adjusted $R^2$
- Prediction and issues
- **In class exercise:** Wage rate equation. Understanding a standard software (STATA) output
- Readings: W (Chapters 3 and 4 (sec. 4.1-4.4)
- Additional readings: Borenstein and Rose (1994)

Sessions 4: ***Further issues in classical linear regression model***

- Choice of functional form (logarithmic, quadratic)
- Interaction terms in regression models
- Testing general model restrictions
- **In class exercise:** Pollution and housing prices
- Readings: W (Chapters 4 (sec. 4.5-4.6) and 5)

Sessions 5 and 6: ***Regression models with binary independent variables***

- Dummy variable regression: intercept and slope dummy
- Dummy variables when there are more than two classifications

- Difference – in – difference estimation
- **In class exercise:** wage rate vs. gender; municipal bonds
- Readings: W (Chapter 7)
- Additional readings: Eiss and Liebman (1996), Card and Krueger (1994)

**Module 2: Nonlinear regression methods**

Sessions 7 and 8: ***Limited dependent variable models***

- Basic Logit and Probit models
- Multinomial logit/ probit models
- Discrete choice models and application to marketing
- Basics of nested logit model
- Tobit regression models
- **In class exercise**: GPA of a student, demand for cars
- Readings: W (Chapter 17)
- Additional readings: Lieberman (1990)

**Module 3: Violation of basic assumptions of classical linear regression**

Sessions 9 and 10: ***Multicollinearity, heteroscedasticity and non-normality***

- Problems with multicollinearity, detection and some cures
- Homoscedasticity vs. heteroscedasticity
- Detection (BP test and White test)
- Some common cures for heteroscedasticity
- Issues of non-normality assumption
- **In class exercise:** House price determinants, wage rate determinants
- Readings: DG (Chapter 10), W (Chapter 8)

Sessions 11 and 12: ***Endogeneity, instrumental variables, simultaneous equations***

- Omitted variables and subsequent bias
- Two way causality and issues
- Demand supply paradigm and basic identification problem
- Instrumental variable regression (2SLS)
- Estimating structural equations
- **In class exercise:** wage equation, crime vs. police force
- Readings: W (Chapter 15)
- Additional readings: Iyer (2010), Angrist and Krueger (1994) and Levitt (1997)

**Module 4: Time series regressions**

Sessions 13 and 14: ***Basic regression with time series data***

- Nature and scope of time series regressions
- Classical assumptions and time series data

- Trends and seasonality
- **In class exercise:** GDP growth rates vs. inflation in India
- Readings: W (Chapter 10)

Session 15-16: ***Further issues in time series data***

- Issues of stationarity and weakly dependent time series
- Impact of these issues on estimates
- Dynamically complete time series data
- Differencing and time series regressions
- Forecasting – basic Box-Jenkins ARIMA modelling
- Granger's causality
- **In class exercise**: t-bill exercise
- Readings: W (Chapter 11)

Sessions 17: ***Serial correlation and heteroscedasticity***

- Problems with serial correlation
- Testing and correcting for serial correlation
- Heteroscedasticity in time series data and how to rectify the problem
- **In class exercise**: unemployment in Puerto Rico, CAPM model
- Readings: W (Chapter 12)

**Module 5: Time series with cross-sectional data – Basic Panel Data Models**

Sessions 18-19: ***Basic panel data regressions***

- Pooled cross-sectional data analysis
- Simple fixed effects regression
- Mean differencing regression
- **In class exercise**: return to education
- Readings: : W (Chapters 13 and 14)
- Ten common mistakes in Applied Econometrics

Session 20: ***Student project presentations***

**Evaluation**

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|---|---|
| Class preparedness | 10% |
| Problem sets | 20% |
| Project | 30% |
| Final | 40% |

There would be two problem sets, with equal weightage. Problem sets and projects can be done in groups of three/four students (to be assigned by the instructors). For the project, students are expected to identify a hypothesis, and formulate a regression model to test the hypothesis and take it forward to interpret correctly the estimated regression coefficients.