

# ECOM20001

## Econometrics 1

### Lecture Note 11

#### Subject Review and Next Steps

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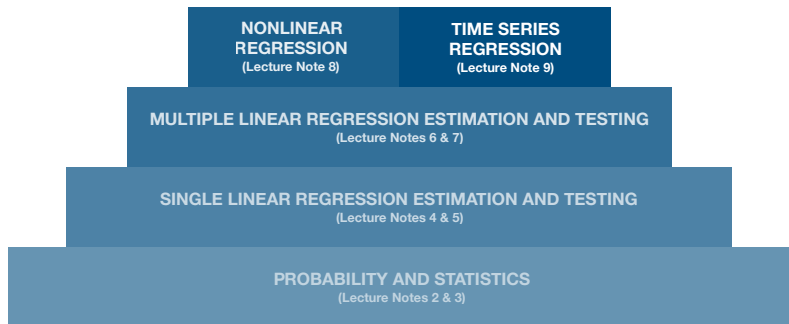
# Summary of Key Concepts

- ▶ Subject review
- ▶ Feedback
- ▶ Final exam
- ▶ Next subjects
- ▶ Careers in economics and econometrics

# What I Have Tried to Do with ECOM20001

- ▶ Get students interested in exploring important, real-world issues using data
- ▶ Provide foundational tools for econometric analysis
  - ▶ empirically **estimate** economic relationships
  - ▶ **test** economic theories
  - ▶ **predict** and **evaluate** the impact of government and business policy
- ▶ Training in R, a modern, open-source, statistical program
  - ▶ R is emerging everywhere in business and government as the leading program for econometric analysis
  - ▶ also the leading program for data science and Big Data
  - ▶ developing the skill of learning how to learn a programming language

# ECOM 20001 in a Picture



# Lecture Note 2: Probability

- ▶ Motivating example: pokies and income
- ▶ One Random Variable
  - ▶ Random processes and probabilities
  - ▶ Discrete and continuous random variables
  - ▶ Probability density functions
  - ▶ Cumulative density functions
  - ▶ Describing distributions: mean, variance, skewness, kurtosis
- ▶ Two Random Variables
  - ▶ Joint, marginal, and conditional distributions
  - ▶ Covariance, correlation, and independence
- ▶ Distributions: Normal, Chi-Squared, Student t, F Distributions
- ▶ Random Sampling
  - ▶ Sample averages and population means
  - ▶ Law of Large Numbers, Central Limit Theorem

# Lecture Note 3: Statistics

- ▶ Estimators and sample averages
- ▶ Hypothesis tests of means and p-values
- ▶ Sample variance, sample standard deviation, standard error
- ▶ One-sided alternatives
- ▶ Confidence intervals
- ▶ Comparing means from different populations
- ▶ t-statistics with small sample sizes
- ▶ Scatterplots, sample covariance and correlation

# Lecture Note 4: Single Linear Regression Estimation

- ▶ Motivating example: class size and test scores
- ▶ Single linear regression model
- ▶ Population true values
  - ▶ population regression line, slope, intercept, errors
- ▶ Ordinary Least Squares Estimator
  - ▶ sample regression line, slope estimate, intercept estimate, residuals, predicted values
- ▶ Model fit
  - ▶  $R^2$  and Standard Error of the Regression
- ▶ 3 Least Squares Assumptions
  - ▶ independence, IID, no outliers
- ▶ Sampling distribution of the OLS estimator

# Lecture Note 5: Single Linear Regression Testing

- ▶ Visual evidence
- ▶ Hypothesis testing with the regression model
  - ▶ 3 steps to hypothesis tests, testing and statistical software, class size and test score example
- ▶ Confidence intervals for regression model slope  $\beta_1$  and intercept  $\beta_0$
- ▶ Dummy variables
- ▶ Heteroskedasticity and Homoskedasticity



# Lecture Note 6: Multiple Linear Regression Estimation

- ▶ Omitted Variable Bias
- ▶ Population Multiple Linear Regression Model
- ▶ Control Variables
- ▶ Heteroskedasticity
- ▶ OLS Estimator with Multiple Linear Regression
- ▶ Measures of Model Fit
- ▶ Least Squares Assumption in Multiple Linear Regression
- ▶ Perfect Multicollinearity
- ▶ Imperfect Multicollinearity

# Lecture Note 7: Multiple Linear Regression Testing

- ▶ Standard errors, hypothesis testing, confidence intervals with multiple linear regression
- ▶ Testing joint hypotheses
- ▶  $F$ -statistics
- ▶ Overall regression  $F$ -statistic
- ▶ Homoskedasticity-only  $F$ -statistic
- ▶ Testing single restrictions involving multiple coefficients
- ▶ Confidence sets for multiple coefficients
- ▶ Model specification, omitted variable bias, coefficients of interest, control variables
- ▶ Conditional mean independence
- ▶ Choosing coefficients of interest and control variables
- ▶ Applications: policy, testing theory, exploration

# Lecture Note 8: Nonlinear Regression

- ▶ Economics of immigration motivating example
- ▶ Modeling nonlinear regression functions
- ▶ Quadratic regression
- ▶ General framework for estimating and testing nonlinear regression models
- ▶ Standard errors for estimated nonlinear effects
- ▶ Polynomial regression functions
- ▶ Logarithmic regression functions: log-linear, linear-log, log-log models
- ▶ Interactions between independent variables: binary-binary, continuous-binary, continuous-continuous models
- ▶ Polynomial or logarithmic models with interactions

# Lecture Note 9: Assessing Studies Based on Multiple Regression

- ▶ Internal and external validity
- ▶ Threats to external validity
  - ▶ Populations
  - ▶ Settings
- ▶ Threats to interval validity
  - ▶ Omitted variable bias
  - ▶ Model misspecification
  - ▶ Measurement error
  - ▶ Missing data and sample selection
  - ▶ Simultaneous causality
  - ▶ Sources of inconsistency with standard errors
- ▶ Forecasting with regression models

# Applications

- ▶ Individual-level microdata
  - ▶ Immigration and earnings
  - ▶ Congress members voting on women's issues
  - ▶ Gender wage gap
  - ▶ Height and earnings
  - ▶ Smoking and infant birth weight
- ▶ Group-level microdata
  - ▶ Pokies supply across Australian Local Government Areas
  - ▶ Class size and test scores in high school classes
  - ▶ Company profits with retail and wholesale petrol prices in Australian cities
  - ▶ Crime and police supply in UK counties
- ▶ Country-level macrodata
  - ▶ Democracy and economic development
  - ▶ International trade and economic growth
  - ▶ GDP, growth, unemployment, exchange rate time series

# What can I do better with ECOM20001?

- ▶ Are there things working well to promote learning in other classes that could apply to ECOM20001?
- ▶ With virtual learning what has worked? What has not worked? What could be done better?
- ▶ What have you seen from other subjects that I could apply to ECOM20001 teaching?
- ▶ I will be collating this feedback and sending it to other faculty in the FBE to ensure we all do the best we can in a virtual teaching environment at least for Semester 2

# Gender Bias in Teaching Evaluations

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## Gender biases in student evaluations of teaching<sup>☆</sup>



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### ABSTRACT

This article uses data from a French university to analyze gender biases in student evaluations of teaching (SETs). The results of fixed effects and generalized ordered logit regression analyses show that male students express a bias in favor of male professors. Also, the different teaching dimensions that students value in male and female professors tend to match gender stereotypes. Men are perceived by both male and female students as being more knowledgeable and having stronger class leadership skills (which are stereotypically associated with males), despite the fact that students appear to learn as much from women as from men.

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# Final Exam

- ▶ 3-hour final with 30-minute reading period
  - ▶ Open book and to be done online via the LMS
- ▶ Five multi-part questions (e.g., 1 a., 1 b., 1 c.,...,2 a., 2 b., 2 c.,... and so on), all parts of all questions to be attempted
  1. Multiple choice
  2. Short answer questions, derivations and calculations
    - ▶ answer to each part of the question should be half a page or so
  3. Interpreting graphs, regression results, R output, pseudo R-code
  4. Interpreting graphs, regression results, R output, pseudo R-code
  5. Interpreting graphs, regression results, R output, pseudo R-code
- ▶ Formula sheet provided



# Final Exam Preparation

- ▶ Practice final exam and previous final exams, with solutions
  - ▶ practice final exam with solutions, including the formula sheet that will be provided on the final exam
  - ▶ 2018-2019 ECOM20001 final exams for semester 1 and 2
- ▶ Review lecture notes, assignments, quizzes as well

# Final Exam Preparation

- ▶ Other sources of help and preparation
  - ▶ Pitstop tutorials
  - ▶ Review assignment and tutorial questions
  - ▶ Practice explaining subject material to classmates
  - ▶ Write your own summaries of the material covered
  - ▶ Identify weak points in understanding and work hard at them
- ▶ Announcements page on the LMS lists the times and locations for multiple pitstop tutorials

## Next subjects - 30000-Level

- ▶ I want to flush out **fundamentals** in econometric methodology and expertise in R and/or be eligible for honours
  - ▶ [ECOM30002: Econometrics 2](#) (S1, S2)
- ▶ I like **micro**economics and individual-level data on individuals (e.g. immigration and earnings, congress members voting, website search data, retirement decisions, gender, health, environmental, development)
  - ▶ [ECOM30003: Applied Microeconometric Modelling](#) (S2)
- ▶ I like **macro**economics and market-level or country-level data on GDP, unemployment, interest rates, stock prices
  - ▶ [ECOM30004: Time Series Analysis and Forecasting](#) (S2)
- ▶ ECOM20001 satisfies the prerequisite for these subjects

## Next subjects - 30000-Level

- ▶ I like the idea of using experiments in the lab and the field to understanding economic decision-making
  - ▶ ECON30019: Behavioural Economics (S2)
  - ▶ ECON30022: Experimental Economics (S2)
  - ▶ These subjects involve elements of both microeconomics and econometrics
- ▶ ECON20002 satisfies the prerequisite for these subjects

## Next subjects - 40000-Level

- ▶ 40000-level econometrics subjects
  - ▶ ECOM40006: Econometrics 3
  - ▶ ECOM40001: Microeconometrics
  - ▶ ECOM40003: Macroeconometrics
  - ▶ ECOM40004: Financial Econometrics
  - ▶ ECON40008: Labour Economics
  - ▶ ECON40011: Public Economics
  - ▶ ECON40012: Development Economics
  - ▶ ECOM40017: Econometrics of Markets and Competition
- ▶ Consider doing a **B.Com Honours Economics** degree if you are interested in pursuing these more advanced subjects in econometric theory and applied microeconometrics and macroeconometrics
  - ▶ <https://handbook.unimelb.edu.au/courses/bh-com>
  - ▶ You need ECON30010 (micro), ECON30009 (macro), ECOM30002 (metrics), to be eligible for honours

## Next subjects - 90000-Level

- ▶ 90000-level econometrics subjects
  - ▶ ECOM90002: Econometrics 4
  - ▶ ECOM90005: Advanced Econometric Techniques 1
  - ▶ ECOM90007: Macroeconometrics
  - ▶ ECOM90008: Microeconometrics
  - ▶ ECOM90009: Quantitative Methods for Business
  - ▶ ECOM90010: Bayesian Econometrics
  - ▶ ECOM90011: Financial Econometrics
  - ▶ ECOM90012: Modelling the Australian Macroeconomy
  - ▶ ECOM90013: Advanced Econometric Techniques 2
  - ▶ ECOM90020: Computational Economics and Business
  - ▶ ECOM90023: Treatment Effects and Program Evaluation
- ▶ Consider doing a **M.Com in Applied Econometrics** if you interested in pursuing these various advanced subjects in econometric theory and applied microeconometrics and macroeconometrics
  - ▶ <http://study.mbs.unimelb.edu.au/study/degrees/master-of-applied-econometrics/overview>

# Careers in Economics and Econometrics

- ▶ A lot of students ask: what types of industries hire people with econometrics and R training?
- ▶ There are economists and data analysts in virtually all areas of government and industry
  - ▶ **Government:** State and Commonwealth treasuries, environmental/health/infrastructure/energy departments, Productivity Commission, Australian Consumer and Competition Commission . . .
  - ▶ **Consultancies:** Frontier Economics, Houston-Kemp NERA Economics, Alpha-Beta, Charles River and Associates, RBB Economics, Deloitte Access, EY, KPMG, PWC . . .
  - ▶ **Industry:** Coles, Woolworths, BP, Caltex, Telstra, Optus, Vodafone, Cricket Australia, AFL, Qantas, Virgin, ANZ, CBA, NAB, Westpac, Energy Australia, Origin, AGL, Simply Energy, Ppwershop, Red Energy, AusNet, United Energy, Jemena, CitiPower and Powercor, South East Water, Melbourne Water, Yarra Valley Water, Facebook, Amazon, eBay, Uber . . .

# Careers in Economics and Econometrics

- ▶ Many students have also asked how can they land a job in data analysis and econometrics
  - ▶ While I am not a career counsellor, I can make two observations
1. There are at least 3 important things you are in direct control of that can help you on the job market
    - ▶ working hard, getting good grades
    - ▶ continually searching and applying for jobs either online or through FBE-supported job placement
    - ▶ complementing grades with extracurriculars



# Careers in Economics and Econometrics

2. Being open-minded about the types of data-related jobs you initially pursue is important for starting your journey toward building the career that you want
  - ▶ could be hardcore number crunching and data analysis
  - ▶ also could be “light touch” empirical analysis
  - ▶ even could be jobs that help develop infrastructure for collecting and storing data
  - ▶ or you could be supporting the more experienced econometricians at first by doing what seems to not be “econometrics/economics work” including formatting excel files and powerpoint slides all the time
  - ▶ do not expect to find your dream job right away; you are extremely lucky if you do
- ▶ Many of my past students have switched jobs within 2-5 years of their first job

# Careers in Economics and Econometrics

- ▶ Key take-aways with your first job(s)
  - ▶ learn about what you are interested in
  - ▶ learn how to work in a professional environment
  - ▶ keep building your resume, LinkedIn profile, and professional network as you learn about what interests you, and as you work toward establishing a career in that area
- ▶ Keep an open mind. Work hard at things you are in control of. Make your own luck. Don't get too high with success and too low with failure as the job market is a marathon, not a sprint.

<http://fbe.unimelb.edu.au/students/bcom/enrich/workplace-opportunities/internships>

# Careers in Economics and Econometrics

- ▶ My story: I initially pursued economics and econometrics subjects so that I could earn a B.Com degree and become eligible to be a golf professional in Canada
  - ▶ I had 0 interest in any of this until I started taking subjects in second year and got an itch for data
  - ▶ worked hard, got good grades as an undergraduate
  - ▶ applied for research assistantships with faculty as an undergrad
  - ▶ went to graduate school, kept wanting to learn more economics and econometrics (my wife hated it, got a real job)
  - ▶ I learned over a 5-year PhD that liked teaching and doing research, would enjoy the academic career
  - ▶ applied to 150 jobs, had 130 rejections and 20 interviews, 6 campus visits, 5 job offers, moved to Melbourne in 2010

# Careers in Economics and Econometrics

- ▶ In sum, when I was in your shoes I . . .
  - ▶ had a very loose idea of what I wanted to do
  - ▶ tried to keep my options open by working hard, getting the best grades i could
  - ▶ learned about what options I liked along the way
  - ▶ when I found things I liked, worked at them and pursued them as aggressively as I could
- ▶ There was definitely no “grand plan” in landing a job I love to do, just a lot of hard work and constantly asking myself what do I like/dislike

Thank you and good luck!