

# Description of Selected Advanced Courses

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A complete list of my most advanced coursework in Economics, Mathematics, Statistics and Econometrics is presented. First, grades in the Queensland-Australian System of Education go from 0-7 where 4 is the minimum passing grade. In turn, Peruvian universities scale performance from 0-20 where 11 is the the minimum passing grade. In addition, I mention the equivalent alphabetic grade according to [Scholaro Inc.](#) Then, a detailed description of the most advanced courses is provided. This material is only complementary to the official transcripts. Lastly, it is important to contextualize that in Peruvian universities there are no perfect scores (20/20) and only in exceptional cases students obtain final scores superior to 15-16.00.

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# 1 Econometrics, Probability and Statistics

## 1.1 Social Interactions and Inequality, Grade: (A)

**Program:** Master of Arts in Public Policy studies with a Certificate in Research Methods - University of Chicago

**Level:** PhD

**Professor:** Steven Durlauf, PhD Economics, Yale

**Papers and Textbooks:**

- Topkis, D. 1998. Supermodularity and Complementarity. New York: Princeton University Press.
- Stein, D. and C. Newman. 2013. Spin Glasses and Complexity. Princeton: Princeton University Press.
- Bollabas, G. 2001. Random Graph Theory, second edition. New York: Cambridge University Press.
- Blume, L. W. Brock, S. Durlauf, and Y. Ioannides, (2011), "Identification of Social Interactions," in Handbook of Social Economics, J. Benhabib, A. Bisin, and M. Jackson, eds. Amsterdam: North Holland.

**Topics:**

- Games with complementarities: Cooper and John (1988), Milgrom and Roberts (1990), Complementarities in characteristics and assortative matching, Becker (1973). Lattice Theory, Tarski's fixed point theorem.
- Stochastic Processes and Random Fields: Kolmogorov Extension Theorem, Dobrushin Extension Theorem. Markov Random Field, Ising Model, Curie-Weiss model, Clique, Potential, Gibbs measure, mean field approximations, nonergodicity redux, Hammersley-Clifford theorem, Spin glasses and frustration.
- Graphs: Undirected (directed) graph, order, size, multigraph, subgraph, In(out)-degree, some Canonical graphs. Graph properties: Connectedness, Acyclicity, coonection between components and unconnected graphs, etc. Random graphs and Erdos-Renyi Theorem.

- Discrete choice models of social interactions, the Linear-in-means model and identification issues, Identification and General Linear Social Structures.

## 1.2 Applied Econometrics I, Grade: (A)

**Program:** Master of Arts in Public Policy studies with a Certificate in Research Methods - University of Chicago

**Level:** PhD

**Professor:** Steven Durlauf, PhD Economics, Yale

**Papers and Textbooks:**

- Ash, R. B., & Gardner, M. F. (1976). Topics in stochastic processes.
- Lecture Notes

**Topics:**

- Probability Theory: Stochastic Processes, ergodicity, measure preserving transformation, invariant set, ergodic theorems, exchangeability, DeFinetti's Theorem (justification for treating data as iid).
- Statistical Decision Theory: Provide links between econometric analysis and policy evaluation. Under uncertainty: Bayesian analogues, loss functions, posteriors and priors, Jeffrey's prior, principle of insufficient reason, Fisher's information matrix, etc. Decision theory without probabilities: minimax, minimax regret, independence of irrelevant alternatives property, Hurwicz criterion. Bayes versus frequentist estimation, fiducial inference.
- Identification: Koopmans (1953) and Marschak (1950) and a definition of identification in statistical models, Marschak's maxim. Partial Identification and Manski (1995). Applications: OLS and Treatment effects. Bayesian perspectives on identification and failure of identification.
- Linear System Theory: Completeness, Banach space, Inner product, Hilbert space, Decomposability of Hilbert space into orthogonal subspaces, Orthonormal bases for Hilbert space, Existence of an orthonormal basis, Existence of a countable orthonormal basis.
- Linear Statistical Models/Regression: Application of Hilbert Space machinery to OLS, Omitted variable bias and measurement error.
- Simultaneous Systems, Endogeneity, Instrumental Variables
- Time Series: Wold decomposition theorem, Equivalence between the Hilbert space of a purely indeterministic time series and its associated fundamental innovations, from moving average to autoregressive representations, optimal linear predictor, AR Wiener-Kolmogorov formula. Unit roots, Trend/Cycle decompositions, Cointegration, ARMA representation. Vector autoregressions: Granger causality, Sims causality, Causality and econometric exogeneity, Variance decompositions.
- Frequency domain: Fourier transforms, Spectral densities, Spectral representation theorem (Cramér's theorem). Filters: Construction of spectral representation from white noise spectral representation, differencing, averaging, band pass filter.
- Deep Roots and identification issues.
- Social Interactions, the Linear-in-means model and identification issues.

### 1.3 Advanced Econometric Theory, Grade: 7/7 (A+)

**Program:** Bachelor of Economics (Honours) - The University of Queensland

**Level:** PhD or Advanced Master course

**Professor:** Mohamad Khaled, PhD Economics, La Sorbonne

**Papers and Textbooks:**

- Bierens, H. J. (2004). Introduction to the mathematical and statistical foundations of econometrics. Cambridge University Press.
- DasGupta, A. (2008). Asymptotic theory of statistics and probability. Springer.
- Gut, A. (2013, second edition) Probability: A Graduate Course. Springer.
- Tsybakov, A. B. (2009) Introduction to Nonparametric Estimation. Springer.
- van der Vaart, A.W. (1998). Asymptotic statistics. Cambridge University Press.

**Topics:**

- Review of Real Analysis:  $\liminf$ ,  $\limsup$ , metric spaces, convergence of functions, Lebesgue integration
- Introduction to Probabilistic Measure Theory: sigma-algebras, continuity of measure thm., convergence concepts and the corresponding hierarchical implications, the two Borel Cantelli lemmas, Central limit Thm., characteristic function, Berry-Esseen thm., Kolmogorov-Arnold representation thm., bounded convergence thm., portmanteau thm. , etc.
- Concentration inequalities: Dvoretzky – Kiefer – Wolfowitz inequality, Hoeffding's inequality, Glivenko- Cantelli thm., function spaces (Hölder space).
- Combinatorics: e-covers, e-packings, e-brackets, entropy numbers, proofs of different uniform laws of large numbers, application to Kernel density estimation
- Complexity: Shatter coefficient, Vapnik- Chervonenkis dimension, etc.
- M-estimation theory

### 1.4 Advanced Microeconometrics, Grade: 7/7 (A+)

**Program:** Bachelor of Economics (Honours) - The University of Queensland

**Level:** PhD or Advanced Master course

**Professor:** Christiern Rose, PhD Economics, University of Bristol

**Papers and Textbooks:**

- Cameron, A.C. and P.K. Trivedi (2009) Microeconometrics Using Stata Revised Edition, Stata Press
- Cameron, A.C., and P.K. Trivedi (2005) Microeconometrics: Methods and Applications. Cambridge University Press
- I. Ahamada and E. Flachaire, Non-Parametric Econometrics, Oxford University Press, 2010
- Koenker, R. (2005) Quantile Regression. Cambridge University Press

- Koop, G., Poirier, D.J., and J. Tobias, Bayesian Econometric Methods, Cambridge 2007

### Topics:

- Review of Multiple Regression and M-estimation : Review matrix treatment of multiple regression; Gauss-Markov Theorem and assumptions; conditional prediction; loss function; M-estimation; causal vs. non causal relations. Maximum Likelihood : Basic likelihood concepts; score functions; computation of MLE; large sample properties; The trio: Wald, score, and likelihood ratio tests.
- GMM Basics and Extensions : Simultaneous equations framework. Essential GMM Motivation; the Analogy Principle; causal parameters; simultaneous equations; IV estimation; GMM extensions; large sample properties
- Linear Panel Models: Advantages of panel data; basics of linear panel models; pooled, random effects and fixed effect models; target parameters and estimation by GLS. Extensions of basic models; types of exogeneity; endogenous regressors; dynamic models; GMM methods.
- Simulation-based estimation and inference : Computer-intensive methods for estimation and inference; simulation-based MLE and GMM; bootstrap standard errors; applications to panel models.
- Quantile Regression: Conditional quantiles (CQ); semiparametric models; marginal quantiles; MAD and CQ estimation; advantages of non separable heterogeneous responses; treatment effects.
- Bayesian Regression : Bayesian approach; role of priors; Bayesian inference; quantities and distributions of interest; Gibbs sampler.
- Non-parametric and Flexible Parametric models: Kernel density and kernel regression; mixture of normals; inference on mixture models; relationship to semiparametric models; random effects and mixed models.

## 1.5 Econometric Analysis, Grade: 7/7 (A+)

**Program:** Bachelor of Economics - The University of Queensland

**Level:** Master or Advanced undergraduate

**Professor:** Antonio Peyrache, PhD Economics, University of Rome 'La Sapienza'

### Papers and Textbooks:

- Abadir, K. M., & Magnus, J. R. (2005). Matrix algebra (Vol. 1). Cambridge University Press.
- Davidson, R., & MacKinnon, J. G. (2004). Econometric theory and methods. Oxford University Press.

### Topics:

- Review of statistical concepts and matrix algebra.
- Geometry of vector spaces; geometry of OLS
- Statistical Properties of OLS

- Hypothesis Testing and Confidence Intervals
- GLS estimator; FGLS; Panel Data, IV Estimation
- ML Estimation, Logit and Probit, GMM, Seemingly Unrelated Regression Model (SUR)

## 1.6 Statistical Theory for Economists, Grade: 6/7 (A)

**Program:** Bachelor of Economics - The University of Queensland

**Level:** Master or Advanced undergraduate

**Professor:** Christiern Rose, PhD Economics, University of Bristol

**Papers and Textbooks:**

- Amemiya, Takeshi "Introduction to Statistics and Econometrics" Harvard University Press, Cambridge, 1994
- Moss, C. B. (2014). Mathematical statistics for applied econometrics
- William H. Greene, Econometric Analysis, Sixth Edition, 2008, Prentice Hall. Appendix B, C, D.

**Topics:**

- Probability and its axioms, random variables, cumulative distribution functions and density functions (marginal, joint, conditional), transformations, etc.
- Expected value and variance of discrete and continuous random variables; proofs of Chebyshev's and Markov's inequalities, Moment Generating Functions (MGF) and its properties
- Probability distributions and derivation of properties: Binomial, Normal, Student, Gamma, F, Poisson, etc.
- Small sample properties of an estimator, estimators based on Least Squares principle; estimators based on Method of Moments, Asymptotic unbiasedness, convergence in probability (consistency) and convergence in mean squared error; Law of Large Numbers; Slutsky's theorem; Convergence in distribution and the notion of asymptotic distribution; Asymptotic Equivalence theorems.
- Maximum Likelihood (ML) principle; Cramér-Rao theorem and notion of asymptotic efficiency; properties of ML estimator, Proof of Lindeberg-Lévy Central Limit Theorem (CLT); Lindberg-Feller CLT, Lyapunov CLT, etc.; Edgeworth expansion; applications of CLT; Delta Method; notion of speed of convergence.
- Interval estimators and construction of confidence intervals; hypothesis testing, type I and II errors, critical value, size and power(function); Likelihood ratio test; Wald test; Lagrange multiplier test.

## 2 Mathematics

### 2.1 Real Analysis in $R^n$ I, Grade: (A-)

**Program:** Master of Arts in Public Policy studies with a Certificate in Research Methods - University of Chicago

**Level:** Bachelor

**Professor:** Robert Fefferman, PhD in Mathematics, Princeton

**Papers and Textbooks:**

- Rudin, W. (1976). Principles of mathematical analysis

**Topics:**

- Characterizing the real numbers
- Point-set topology
- Multidimensional Euclidean spaces
- Completeness and Compactness in Euclidean spaces
- The Bolzano Weierstrass Theorem
- General Metric Spaces: Examples
- Completeness and Compactness in metric spaces
- The Contraction Mapping Theorem
- Solution of ODEs
- The Stone Weierstrass Theorem
- Introduction to Fourier Series
- The Baire Category Theorem and its applications

### 2.2 Quantitative Skills for Economists ~ PhD Mathcamp

**Program:** Bachelor of Economics (Honours) - The University of Queensland

**Level:** Participation is required to pursue PhD level courses

**Professor:** Kieran Gibson, Doctoral Candidate in Economics, The University of Queensland

**Papers and Textbooks:**

- Greene, W. H. (2012). Econometric Analysis 7th Edition
- Simon, C. P., & Blume, L. (1994). Mathematics for economists.
- Stokey, N. L. (1989). Recursive methods in economic dynamics. Harvard University Press.
- Sundaram, R. K. (1996). A First course in Optimization Theory. Cambridge University Press.

**Topics:**

- Review: Methods of Proofs, Set Theory, Cardinality, Metric Spaces.
- Real analysis: Convergence of sequences, cauchy sequences, point-set topology, completeness, compactness, open covers, Heine-borel, continuity, Weirstrass extreme value theorem, Intermediate value theorem, Contraction mappings, Banach fixed-point theorem, etc.
- Linear algebra: Systems of Linear Equations, rank, vector spaces, subspaces, column space, null space, affine subspaces, fundamental theorem of linear algebra, determinant, invertibility, normed vector spaces, inner product spaces, projections, eigenvalues and eigenvectors, diagonalization, applications to system of difference equations.
- Probability: Axioms, Bayes theorem, Law of total probability, random variables, expectation, moment generating functions, multivariate normal, distribution of quadratic forms, Markov's inequality, Chebyshev's inequality, Jensen's Inequality.
- Probability and Statistics: Convergence in probability, almost surely, in distribution, Continuous mapping theorem, Slutsky's Theorem, Khinchin's weak law of large numbers, Kolmogorov's strong law of large numbers, Central limit theorems such as Lindeberg-Levy CLT and Multivariate CLT. Hypothesis tests, Gauss-Markov Theorem.
- Optimization: Analytic functions, Taylor series in  $\mathbb{R}^n$ , first and second order conditions, global extrema, total differential, chain rules, gradient, directional derivative, the Hessian. Constrained optimization, Theorem of Lagrange, Envelope Theorems, Kuhn-Tucker Theorem.
- Dynamic Programming: value functions, policy function, Principle of Optimality, Bellman Equation and functional equation problems, Bellman Operator, Norms, Contraction mappings and Blackwell's sufficient conditions, Value Function Iteration, adding randomness. Programming deterministic and Stochastic VFI in Python.

## 2.3 Mathematical Analysis, Grade: 4/7 (C)

**Program:** Bachelor of Economics - The University of Queensland

**Level:** Math course elective

**Professor:** Travis Scrimshaw, PhD in Mathematics, UC Davis

**Papers and Textbooks:**

- Lebl, J. (2020). Basic Analysis I: Introduction to Real Analysis I
- Lebl, J. (2020). Basic Analysis II: Introduction to Real Analysis II
- Rudin, W. (1976). Principles of mathematical analysis

**Topics:**

- Construction of the real numbers, equivalence relations, LUB, Archimedean property.
- Sequences, series, power series, continuity, derivative, Inverse Function Theorem, Rolle's and Mean Value theorems, Bolzano-Weierstrass theorem, Zeta function, rearrangements, Intermediate value theorem, etc.
- Riemann integrals, Fundamental theorem of calculus, pointwise and uniform convergence, uniformly Cauchy.



- Vector spaces, linear mappings and convexity, analysis on vector spaces, operator norm, continuity of linear operators and the inverse map,
- Continuity of entries of a matrix, derivatives in  $\mathbb{R}^n$ , continuity of the derivative, inverse and implicit function theorems.
- Introduction to general topology: topology, continuous functions, metric topology.

## 2.4 Calculus and Linear Algebra 2, Grade: 6/7 (A)

**Program:** Bachelor of Economics - The University of Queensland

**Level:** Math course elective

**Professor:** Mark Gould, PhD in Mathematics, The University of Adelaide

**Papers and Textbooks:**

- Anton, H., & Rorres, C. (2013). Elementary linear algebra: applications version. John Wiley & Sons.
- Kreyszig, E. (2007). Advanced Engineering Mathematics 9th Edition. John Wiley & Sons.

**Topics:**

- Calculus: exact first order and non-homogeneous linear second order differential equations; undetermined coefficients, variation of parameters. Multi-dimensional calculus; surface & volume integrals, cylindrical, spherical and general coordinate transformations. Stoke's & Green's theorems, applications (flux, heat equations).
- Linear Algebra (proof based): eigenvalues, eigenvectors, diagonalization, quadratic forms, complex matrices. Elementary numerical linear algebra. Taylor series, maxima, minima and saddle points in N-dimensions. Vector spaces, norms and inner products (for square-integrable functions). Gram-Schmidt orthogonalisation and orthogonal matrices.

## 2.5 Mathematical Economics, Grade: 5/7 (B)

**Program:** Bachelor of Economics - The University of Queensland

**Level:** Math course elective

**Professor:** Christoph Mueller, PhD in Economics, University of Minnesota

**Papers and Textbooks:**

- Simon, C. P., & Blume, L. (1994). Mathematics for economists.
- Sydsæter, K., Hammond, P., Seierstad, A., & Strom, A. (2008). Further mathematics for economic analysis. Pearson education.

**Topics:**

- Logic and proof methods
- Extends elementary calculus concepts to the analysis of functions of several variables.
- Convex multivariate optimization.
- Constrained optimization (Kuhn-Tucker conditions).
- Essential elements of dynamic optimization in discrete time.

## 2.6 Mathematical Methods III, Grade: 17/20 (A)

**Program:** Bachelor of Economics - Universidad de Lima

**Level:** Undergraduate

**Professor:** Aldo Ramirez, PhD in Economics, Indiana University

**Papers and Textbooks:**

- Chiang, A. (1999) Elements of Dynamic Optimization.
- Bergin (1998). Notes on Dynamic Programming, UC Davis.
- Sims, C. A. (2002). Solving linear rational expectations models. Computational economics.
- Stokey, N. L. (1989). Recursive methods in economic dynamics. Harvard University Press.

**Topics:**

- First Order Linear Differential Equations. Exact Differential Equations. Non-linear Differential Equations of First Degree and First Order. Second Order Linear Differential Equations, Higher Order Differential Equations.
- First Order Difference Equations, Non-linear Difference Equations, Second Order Difference Equations.
- Simultaneous Differential Equations and Difference Equations: Origin and solution of dynamic systems, Bivariate Phase Diagram, Non-linear System Linearization using MATLAB.
- Optimal Control: Hamiltonian; Maximum Principle.; Transversality Conditions., Sufficient Conditions. Problems of Optimal Control with infinite temporary horizon. Hamiltonian in present value.
- Delay Operators, stochastic difference equations. Some stochastic processes: martingale, white noise.
- Dynamic Programming: recursive solution, Envelope Theorem, Bellman Equation. Benveniste Scheinkman Equation. Analytical solution in a discrete time: Lagrange Method, solution by guessing, solution by iteration. Stochastic Dynamic Programming: Uncertainty. Linearization, solution and calibration of the Brock-Mirman Growth Model with MATLAB.

## 3 Microeconomics

### 3.1 Game Theory, Grade: (A)

**Program:** Master of Arts in Public Policy studies with a Certificate in Research Methods - University of Chicago

**Level:** PhD

**Professor:** Konstantin Sonin, PhD Mathematics, Moscow State University

**Papers and Textbooks:**

- Myerson, Roger B. (1991) Game Theory: Analysis of Conflict, Harvard University Press.

**Topics:**

- Strategic-Form Games, Games in Extensive Form, Existence of Nash Equilibrium, Models of Political Competition, Committee Decision-Making.
- Games of Imperfect Information, Signaling Games, Bayesian Persuasion.
- Repeated Games, The Folk Theorem, Markov Games and Markov Perfect Equilibrium, Bargaining and Coalition Formation, Cooperative Games.
- Matching, Auctions, Social Choice and Mechanism Design.

### 3.2 Microeconomics B, Grade: 6/7 (A)

**Program:** Bachelor of Economics (Honours) - The University of Queensland

**Level:** PhD or Advanced Master course

**Professor:** Antonio Rosato, PhD Economics, UC Berkeley

**Papers and Textbooks:**

- Jehle, Geoffrey A. and Philip J. Reny (2011) Advanced Microeconomic Theory, 3rd Edition, Prentice Hall.
- Mas-Colell, Andreu; Michael D. Whinston; and Jerry R. Green (1995) Microeconomic Theory, Oxford University Press
- Myerson, Roger B. (1991) Game Theory: Analysis of Conflict, Harvard University Press.

**Topics:**

- Decision under uncertainty: Mixture Space Theorem, Expected utility thm., Anscombe & Aumann Acts, State-Dependent Expected Utility, Subjective Expected Utility.
- Review theory of correspondences and metric spaces. Normal form games, Supporting Hyperplane Thm., Kakutani fixed point thm., formal proof of existence of Nash equilibrium (1950), etc.
- Bayesian games: hierarchies of beliefs, rationalizability, type spaces, applications to auctions.
- Extensive form games: mixed and behavior strategies, Kuhn's theorem, Subgame-perfect eq., One-shot deviation property, WPBE, sequential eq., backward induction.
- Information economics: Screening(subgame and subgame perfection, belief consistency, sequential equilibrium), signaling (Signalling model, single-crossing property, separating and pooling equilibria, Cho Kreps Intuitive criterion), adverse selection games (Screening model, separating equilibrium, non existence of equilibrium) and principal agent models( first best and second best contracts).
- Mechanism design: Mechanisms and Implementation, Revelation principle, Gibbard-Satterthwaite Theorem, Vickrey-Clark-Groves Mechanisms, Bayesian Implementation, Bayesian Incentive Compatible Social Choice Functions, Revenue Equivalence, Optimal auction

### 3.3 Microeconomics A, Grade: 6/7 (A)

**Program:** Bachelor of Economics (Honours) - The University of Queensland

**Level:** PhD or Advanced Master course

**Professor:** Jeffrey Kline, PhD Economics, Virginia Tech

**Papers and Textbooks:**

- Jehle, Geoffrey A. and Philip J. Reny (2011) Advanced Microeconomic Theory, 3rd Edition, Prentice Hall.
- Mas-Colell, Andreu; Michael D. Whinston; and Jerry R. Green (1995) Microeconomic Theory, Oxford University Press
- De La Fuente, A., (2000), Mathematical Methods and Models for Economists, Cambridge University Press.
- Sundaram, R. K. (1996). A First course in Optimization Theory. Cambridge University Press.

**Topics:**

- Consumer Theory, Preferences and Utility
- Quasi-concavity and utility max, Demand and Consumer Welfare
- Uncertainty
- Producer Theory, Competitive Firms, Perfect Competition
- Monopoly and Oligopoly
- General Equilibrium Theory and Welfare

### 3.4 Advanced Microeconomics, Grade: 7/7 (A+)

**Program:** Bachelor of Economics - The University of Queensland

**Level:** Master course or Advanced undergraduate

**Professor:** Metin Uyanik, PhD Economics, John Hopkins

**Papers and Textbooks:**

- A. Rubinstein: Lecture Notes in Microeconomic Theory: The Economic Agent.
- Jehle, Geoffrey A. and Philip J. Reny (2011) Advanced Microeconomic Theory, 3rd Edition, Prentice Hall.
- S. Tadelis: Game Theory: An Introduction, Princeton University Press 2013.

**Topics:**

- Introductions to proofs, logic and set theory.
- Preferences, Utility Theory, Utility maximization, Consumer Theory, Dual Consumer and producer.
- General Equilibrium theory.
- Expected Utility and Risk aversion
- Mathematical introduction to game theory

## 4 Macroeconomics

### 4.1 Macroeconomics A, Grade: 7/7 (A+)

**Program:** Bachelor of Economics (Honours) - The University of Queensland

**Level:** PhD or Advanced Master course

**Professor:** Begoña Dominguez, PhD Economics, Universitat de Barcelona

**Papers and Textbooks:**

- Acemoglu, Daron (2009), Introduction to Modern Economic Growth, Princeton University Press.
- Chiang, Alpha C. (1992), Elements of Dynamic Optimization, McGraw-Hill.
- Stokey, N. L. (1989). Recursive methods in economic dynamics. Harvard University Press.
- Ljungqvist, Lars, and Thomas Sargent (2012), Recursive Macroeconomic Theory, 3rd Ed., MIT Press, Cambridge.

**Topics:**

- Theoretical foundation for macroeconomic analysis: dynamic general equilibrium theory and its application to economic growth and fluctuations.
- Overlapping generations and representative agent frameworks, with both exogenous and endogenous technological change.
- Applications to the open economy, assets and bubbles, unemployment, money and inflation.
- Advanced mathematical techniques required to understand the material where introduced (Dynamic programming, Bellman Equation, Calculus of Variations, Pontryagin's Maximum Principle, etc.).

### 4.2 Advanced Macroeconomics, Grade: 7/7 (A+)

**Program:** Bachelor of Economics - The University of Queensland

**Level:** Master course or Advanced undergraduate

**Professor:** Andres Bellofatto, PhD Economics, Carnegie Mellon University

**Papers and Textbooks:**

- Romer (2011). Advanced macroeconomics, 4th edition, McGraw Hill.
- Blanchard and Fischer (1989). Lectures on Macroeconomics, The MIT Press.
- McCandless and Wallace (1992). Introduction to Dynamic Macroeconomic Theory: An Overlapping Generations Approach

**Topics:**

- Baseline OLG Model, applications to Growth
- Introduction to short-run macroeconomics; New-Keynesian model.
- Monetary policy trade-offs. The Zero Lower Bound, interaction between monetary and fiscal policy, unconventional monetary policy.

## 5 Applied Econometrics

### 5.1 A Course In Experimental Economics, Grade: (A)

**Program:** Master of Arts in Public Policy studies with a Certificate in Research Methods - University of Chicago

**Level:** PhD

**Professor:** John List, PhD Economics, University of Wyoming

**Papers and Textbooks:**

- Lecture Notes

**Topics:**

- Internal Validity: Identification in Economic Experiments, Statistical Conclusion Validity: Estimation in Economic Experiments
- Optimal Experimental Design, Randomization Techniques, Heterogeneity and Causal Moderation, Mediation: Exploring Relevant Mechanisms, Experiments with Longitudinal Elements, Within-Subject Design
- SUTVA: Interference and Hidden Treatments, Observability: Non-Random Attrition, Complete Compliance: One-Sided and Two-Sided Violations
- Building Confidence in Experimental Results, Generalizability and Scaling
- Pre-Treatment Administrative Responsibilities, Incentives in Experiments

### 5.2 Applied Econometrics III, Grade: (A-)

**Program:** Master of Arts in Public Policy studies with a Certificate in Research Methods - University of Chicago

**Level:** PhD

**Professor:** Koichiro Ito, PhD Agricultural and Resource Economics, University of California, Berkeley

**Papers and Textbooks:**

- Lecture Notes

**Topics:**

- Randomized Control Trials, Regression Discontinuity Design, Matching Estimators
- Synthetic Control Methods, Nonparametric Permutation tests, Randomization Inference
- Clustered Standard Errors, Bootstrap and Monte Carlo Simulations
- Maximum Likelihood Estimation and Discrete Choice Models, Generalized Method of Moments, Numerical Optimization
- Discrete Choice Models with Aggregated Data (BLP), Random-Coefficient Logit
- Marginal Treatment Effects, Roy's Selection Model

### 5.3 Applied Econometrics II, Grade: (A)

**Program:** Master of Arts in Public Policy studies with a Certificate in Research Methods - University of Chicago

**Level:** PhD

**Professor:** Ingvil Gaarder, PhD Economics, European University Institute

**Papers and Textbooks:**

- Lecture Notes

**Topics:**

- Large-sample inference
- Asymptotic properties of least squares estimators and large sample tests
- Generalized Least Squares
- Models for Panel Data, DiD
- Instrumental Variables, LATE Theorem
- Binary response models

### 5.4 Applied Econometrics to Macroeconomics and Finance, Grade: 7/7 (A+)

**Program:** Bachelor of Economics - The University of Queensland

**Level:** Master course or Advanced undergradate

**Professor:** Eric Eisenstat, PhD Economics, UC Irvine

**Papers and Textbooks:**

- Hamilton, J. D. (2020). Time series analysis. Princeton university press.
- Enders, Walter, Applied Econometric Time Series, 4th Edition, 2015. Wiley
- Tsay, Ruey S., Analysis of financial time series. Hoboken, NJ : Wiley, 2010.

**Topics:**

- ARMA(p,q). Single Equation Models of Multiple Time Series - Autoregressive, Distributed Lag Models and Error Correction Models
- Estimation and testing with unit roots and deterministic trends. Equilibrium relations modeled as cointegrating relations. Common stochastic trends. OLS regression with co-integrated variables. Testing for cointegration. Cointegration space and identification.
- ARCH, GARCH and Realized volatility. Tests for 'ARCH-type' errors and model identification. EGARCH; TGARCH; Leverage Effect; Realized Volatility; Stochastic Volatility.
- Vector Autoregressive Models/SVARs: Identification; Estimation; VMA Representation; Impulse Response Functions and Variance Decompositions; Granger Non- Causality. Cointegration - The multiple equation case. The VAR and Cointegration; the VECM; Estimation and Inference

## 5.5 Productivity and Efficiency Analysis, Grade: 6/7 (A)

**Program:** Bachelor of Economics - The University of Queensland

**Level:** Master course or Advanced undergraduate

**Professor:** Christopher O'Donnell, PhD Economics, The University of Sydney

**Papers and Textbooks:**

- O'Donnell, C.J. (2018) Productivity and Efficiency Analysis: An Economic Approach to Measuring and Explaining Managerial Performance. Springer Nature, Singapore.

**Topics:**

- Production Technologies: output and input sets; production possibilities sets; distance, revenue, cost and profit functions; other sets and functions.
- Measures of Productivity Change: output quantity indices; input quantity indices; productivity indices; other indices.
- Managerial Behavior: output maximization; input minimization; revenue maximization; cost minimization; profit maximization; productivity maximization; other types of behavior.
- Measures of Efficiency: output-, input-, revenue-, cost-, profit- and productivity-oriented measures; other measures.
- Piecewise Frontier Analysis: basic models; models with stronger assumptions, models with weaker assumptions, inference; productivity analysis.
- Deterministic Frontier Analysis: basic models; growth accounting estimation; least squares estimation, maximum likelihood estimation; productivity analysis; other models and extensions.
- Stochastic Frontier Analysis: basic models; least squares estimation; maximum likelihood estimation, productivity analysis; other models and extensions.

## 5.6 Causal Inference for Microeconometrics, Grade: 6/7 (A)

**Program:** Bachelor of Economics - The University of Queensland

**Level:** Master course or Advanced undergraduate

**Professor:** Fu Ouyang, PhD Economics, Duke University

**Papers and Textbooks:**

- Angrist, Joshua and Jörn-Steffen Pischke. 2009. Mostly Harmless Econometrics. Princeton: Princeton University Press.
- Cameron, Colin and Pravin Trivedi. 2009. Microeconometrics Using Stata. College Station, TX: Stata Press.
- Wooldridge, Jeffrey M. (2010) Econometric Analysis of Cross Section and Panel Data, MIT Press.

**Topics:**



- Review: Linear regression. Randomized controlled trials, IV; 2SLS; Testing for Endogeneity and Overidentifying restriction; Weak IV, Bias in OLS, Identification; Simultaneous Equations.
- Panel Data; 3SLS, pooled OLS; Random effects; FGLS; Fixed effects; Relationship between random effects and fixed effects; Hausman specification test; differences-in-differences(-in-differences method); Fixed effects vs lagged dependent models
- Regression discontinuity (RD) Design; Sharp RD; Fuzzy RD.
- Implementing matching estimator; Selection on observables; Propensity Score Matching.
- Quantile Estimation; Inference ; Quantile Regression for Panel Data.
- Limited dependent variable models; Maximum Likelihood Estimation; Probit and Logit Models.

## 6 Audits & Summer School courses

### 6.1 Advanced Numerical Methods in Macroeconomics

**Program:** CEMFI Summer School

**Level:** PhD

**Professor:** Jesús Fernández-Villaverde (University of Pennsylvania) and Galo Nuño (Banco de España)

**Topics:**

- Dynamic programming in continuous time: finite difference method. Application to sovereign default models.
- Deep learning, reinforcement learning and its application so solving high dimensional dynamic programming problems.
- Heterogeneous-agent models in continuous time.
- Application of machine learning to solve models with aggregate shocks.
- Application to macro finance

### 6.2 Machine Learning for Economics

**Program:** Lima Summer School in Economics

**Level:** Advanced Master course

**Professor:** Vadim Marmer (UBC)

**Topics:**

- Proof based course: Recap and limitations of traditional methods, data snooping, IV regression with many IVs.
- Selecting regressors using the Bayesian Information Criterion (BIC), asymptotic properties of the BIC and AIC., computational issues.

- Ridge and Least Absolute Shrinkage and Selection Operator (Lasso): Ridge Regression, Lasso criterion function, Convex minimization and subgradients, Analytical solution to the Lasso problem: a special case, Lasso: the general case, Weighted and adaptive Lasso (oracle properties), Sparse high dimensional models.
- Post and double Lasso: Post-Lasso, bias of a naive post-Lasso estimator, Double Lasso, partialling out approach.
- Lasso and instrumental variables estimation: Many potential IVs and few controls, Few IVs and many controls, Many IVs and many controls, IV estimation and second-stage controls.

### 6.3 Differences in Differences: foundations and new methodology

**Program:** Lima Summer School in Economics

**Level:** Master course

**Professor:** Sebastian Tello Trillo

**Topics:**

- Overview of Causal Inference & Overview of DD
- Parallel Trends, Formalizing Assumptions and Intro to DD with Regression
- Assessing PT (visually) & Event Study
- Extending DD, Time variant DD. Issues with Time variant DD, Bacon-Decomposition.
- Assumptions on Time-variant, Introduction to new methodology. Stacked DD. Sant'anna and Callaway, Continuous DD. Fisher Randomization Tests (FRTs). Assumptions on continuous DD, additional robustness considerations. Relaxing SUTVA, spill over effects.

### 6.4 Computational Methods in Economics

**Program:** The University of Queensland

**Level:** Audit PhD or Advanced Master course

**Professor:** Satoshi Tanaka

**Papers and Textbooks:**

- Stachurski, J. (2009). Economic Dynamics Theory and Computation, MIT Press.
- Judd, K.L. (1998). Numerical Methods in Economics, MIT press.
- H. B. Hildebrand (1987): Introduction to Numerical Analysis, 2nd ed., Dover Publications
- Stokey, N. and R. Lucas (1989). Recursive Methods in Economics Dynamics, Harvard University Press.

**Topics:**

- Basics of numerical methods and Python programming. Nonlinear Equations, Optimization, Computing fixed points.
- Function Approximation, Local approximation methods, Global approximation methods, Multidimensional methods.

- Numerical Integration and Differentiation, Monte Carlo and Quasi-Monte Carlo Methods.
- Methods for Functional Equations, Finite-Difference Methods, Projection Methods, Applications.
- Numerical Dynamic Programming, Perfect Foresight Models, Rational Expectations Models
- Heterogeneous Agent New Keynesian (HANK) models