# Advanced Econometrics (MPhil in Economics, Michaelmas Term)

Anders Bredahl Kock University of Oxford CREATES, Aarhus University 10 Manor Rd, Oxford OX1 3UQ anders.kock@economics.ox.ac.uk

September 26, 2022

### Course outline

- 1. Some basic results from measure theory. A more detailed coverage is given in the mathematics course in Trinity Term.
  - σ-algebras, measures, measurable functions, the Lebesgue integral, Dominated Convergence Theorem, Monotone Convergence Theorem, Substitution rule, Tonelli's and Fubini's Theorem, Radon-Nikodym, Regular Conditional Distributions.
- 2. Classic finite sample estimation theory.
  - Statistical experiments, loss functions, risk, unbiased estimators, Exponential families, sufficient statistics, factorization theorem, sufficiency in

exponential families, Rao-Blackwell theorem, Complete statistics, Completeness in exponential families, UMVU estimators and the Rao-Blackwell-Lehmann-Scheffé theorem, (Cramér-Rao lower bound).

- 3. Classic finite sample testing theory.
  - Definition of testing problem and tests, power functions, general nonexistence of "best" tests, size and level of a test, UMP tests, Likelihood ratios, likelihood ratio tests, Neyman-Pearson lemma, unbiasedness of tests, monotone likelihood ratios (MLR), MLR and the Karlin-Rubin theorem, MLR in exponential families.
- 4. Extremum estimators: Consistency and asymptotic normality.
  - Exact vs. asymptotic theory, the asymptotic framework and sequences of experiments, consistency, (asymptotic) extremum estimators, MLE and GMM as examples of extremum estimators, a general consistency theorem and its ingredients, how to verify the sufficient conditions for consistency, uniform convergence in probability and Glivenko-Cantelli classes of functions, bracketing entropty, consistency of MLE, pitfalls of MLE, consistency of GMM, consistency without compactness of the parameter space, convergence in distribution of sequences of estimators, basic idea of asymptotic normality under twice continuously differentiable objective functions, asymptotic normality of MLE and GMM.
- 5. If time permits (it very likely won't...): Local asymptotic normality (LAN), contiguity, Le Cam's lemmas, regular estimators, Hodges estimator, asymptotic optimality of MLE, Hájek-Inagaki convolution theorem, application of LAN to testing.

## **Advanced Econometrics**

### (MPhil in Economics, Hilary Term)

Martin Weidner Department of Economics University of Oxford

#### **Course Outline**

- 1. (Partial) identification and (non-parametric) estimation
  - Point identification and partial identification, e.g. definition of the identified set in structural models, observationally equivalent parameters, population distribution, analog estimation.
  - Incomplete models, e.g. the two-player entry game.
  - Nonparametric estimation, in particular, kernel density estimation and kernel regressions.
- 2. Causality and program evaluation
  - Causality and the potential outcome framework
  - Inference on treatment effects, e.g. propensity score weighting, matching, double robustness, instrumental variables, LATE.
  - Difference-in-differences, and treatment effect estimation in panel data
- 3. High-dimensional inference problems
  - High-dimensional nuisance parameters and Neyman orthogonality, e.g. double/debiased machine learning.
  - Fixed effects in panel data models: The incidental parameter problem and its possible solutions in the context of panel data and network models.
  - Dimensional reduction and sparsity, e.g. principal components and LASSO.