

Course Syllabus 2nd Part: Econometrics

General Information:

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Office Hours: Wednesdays, 13:30-15:30

e-Class: <https://eclass.aueb.gr/courses/OIK438/>¹

Microsoft Teams Code: nf93r02 ²

Tutorial Information: tba

2nd Part Course Description

The 2nd part of the course intends to the introduction of a large class of estimators and statistical tests emerging from the optimization of criteria that (partially) reflect the structure of the statistical/econometric model at hand. The respective criteria usually admit the form of distances or divergences between-relevant to the models at hand-probability distributions, or some of their representations.

The resulting-so-called-M-estimators (and the subsequent tests based on suchlike criteria) are suitable for parametric and semi-parametric inference, and among others encompass as special cases the LS estimators (and their variants) in the linear models, the ML estimators in general parametric models, the GMM estimators or the EL estimators, in semi-parametric models, etc.

The resulting theory is then specialized to the study of a. elements of parametric inference via the theory of the likelihood function, and b. elements of semi-parametric inference via the theories of b.1. the Generalized Method of Moments and b.2. of the Empirical Likelihood function (if time permits). Both latter cases are introduced in models structured by systems of moment (in-)equalities.

Issues of definition, existence, and numerical derivation are examined with a special view towards the establishment of the limit theories of the procedures

¹ The course's e-class will be containing the course's blog, notes, exercises, further readings and information concerning the lectures, corrections, announcements, etc. The relevant material could be updated during the course. The students must consult the e-class systematically and are strongly encouraged to upload questions, answers, comments, etc.

²The MS Teams group can be also useful since it may contain videos of elaborations of notions examined in the lectures, corrections of errors, etc.

mentioned above. Examples are introduced in several (potentially non-linear) econometric models or re-interpreted in the context of the work done in the first part of the course.

Material we intend to cover (yet most probably will not have time to!)

The following consists of a brief and incomplete synopsis of the course material. It is understood that any partial modification, rearrangement, etc., is in the instructors' facility.

I. Introduction to the theory of M-Estimators and inference. Statistical models with structure representable by optimality characterizations and identification. The empirical analogue of the optimization problem. Definition and derivation of the estimators and the subsequent tests. Asymptotic properties of estimators or tests: consistencies, rates of convergence and asymptotic distributions derivable by convergence of stochastic processes. Examples.

II. a. Parametric Models: The Kullback-Leibler (KL) divergence and the theory of the likelihood function. Definition, properties, asymptotic behavior. The MLE (maximum likelihood estimator): consistency, rates of convergence, asymptotic distribution. The limiting Fisher Information Matrix and asymptotic efficiency. The likelihood ratio test (LR), and asymptotic properties. A glimpse on the issue of misspecification of the likelihood function. Numerical issues and examples.

II.b.1. Semi-Parametric Models: moment equalities-inequalities and set identification. Generalized Method of Moments criteria, weighting matrix, GMM Estimator (the two step and the adaptive versions), consistency, rates and asymptotic distribution, (Gauss-Markov) optimal choice of the weighting matrix, hypothesis testing, J-test. Special cases: Score estimator in parametric models, Instrumental Variables Estimator-Endogeneity in the Linear Model, Full Information Instrumental Variables Efficient Estimator, etc. Numerical issues and further examples. (If time permits: a glimpse in partial identification).

II.b.2. (If time permits) Semi-Parametric Models: moment equalities-inequalities and set identification. The KL divergence w.r.t. the empirical distribution and the Empirical Likelihood function. Saddle point optimization, the EL estimator, and asymptotic properties. A glimpse in higher order asymptotics. ELR test and asymptotic optimality. A glimpse in partial identification and asymptotic optimality.

Indicative Readings

The following references are merely indicative. During the lectures this catalogue can be enriched with further readings. In any case the students are *strongly advised to study from more available sources and try to solve plethora of exercises.*

1. Davidson J., *Econometric Theory*, Blackwell, 2000.
2. Judge, George G., and Ron C. Mittelhammer, *An information theoretic approach to econometrics*, Cambridge University Press, 2011.
3. Hayashi F., *Econometrics*, McGraw-Hill, 2000.
4. Gourieroux C., Monfort A., *Statistics and Econometric Models*, CUP, 1995.
5. Owen, Art B., *Empirical likelihood*, Chapman and Hall/CRC, 2001.
6. van der Vaart A., *Asymptotic Statistics*, CUP, 2000.