Universitat Pompeu Fabra Barcelona

Topics in Applied Economics III: Advanced Techniques in Applied Economics

2023-2024 Academic Year
Master of Research in Economics, Finance and Management

1. Description of the subject

- Advanced Techniques in Applied Economics — Code: 32088
- Total credits: 3 ECTS — Workload: 75 hours — Term: 3rd
- Type of subject: Elective
- Department of Economics and Business
- Teaching team: Lorenzo Cappello

2. Teaching guide

Introduction

Modeling increasingly complex datasets in applied economics requires a broad range of tools from statistics and machine learning that go beyond regression analysis. This course focuses on network models, one of the most prominent classes of models used to describe complex dependencies exhibited in today's data sets.

The aim of this course is to give a concise introduction to network models, with a specific focus on covariance estimation, which has applications, among other things, when dealing with large panels of times series. The methodologies introduced will involve a progressive degree of sophistication. We will deal with some issues that arise with their deployment, such as how to quantify uncertainty. The course will be kept relatively high-level and will be based on workout examples in Python (most of the analysis can be easily replicated in R). Selected aspects of the theory will be presented to improve the overall statistical maturity of the students.

Note that, despite the applications involving data sets in Economics and Finance, the class is mostly methodological, with an emphasis on the Statistics side of the story.

Teaching methodology

The approach will be quite hands on. Each of the main concepts presented in the lecture will be illustrated with an applied problem. Some class will be based on Python notebook, others on lecture slides

Contents

The course is divided into five parts (part 3 will roughly cover 2 weeks)

1. Basic concepts:
   main concepts: graphs terminology, random graphs
2. LASSO estimation:
   main concepts: sparse estimation, high-dimensional estimation
3. Contemporaneous Networks:
   main concepts: Gaussian graphical models, partial correlation networks
4. Dynamic Networks:
   main concepts: Granger Network
5. Filtering on networks:
   main concepts: trend filtering on graphs, breakpoint detection

Some students may be exposed to some of the notions in Section 2 in the earlier Econometrics modules.

Assessment and Grading System

The final grade is based on a group project submitted at the end of the course. The project will be presented half way through the class

Literature

Billio, M., Getmansky, M., Lo, A., & Pellizzon, L. (2012). Econometric measures of connectedness and systemic risk in the finance and insurance sectors. Journal of Financial Economics, 104, 535–559.

Dahlhaus, R. (2000). Graphical interaction models for multivariate time series. Metrika, 51, 157–172.

Davis, R. A., Zang, P., Zheng, T. (2016). Sparse vector autoregressive modeling. Journal of Computational and Graphical Statistics, 25, 1077–1096.

Dempster, A. P. (1972). Covariance selection. Biometrics, 28, 157–175.

Friedman, J., Hastie, T., & Tibshirani, R. (2008). Sparse inverse covariance estimation with the graphical lasso. Biostatistics, 9, 432–441.

Fu, W. J. (1998). Penalized regression: The bridge versus the lasso. Journal of Computational and Graphical Statistics, 7, 397–416.

Kock, A. B. (2016). Consistent and conservative model selection with the adaptive lasso in stationary and nonstationary autoregressions. Econometric Theory, 32, 243–259.

Meinshausen, N., Bühlmann, P. (2006). High dimensional graphs and variable selection with the lasso. Annals of Statistics, 34, 1436–1462.

Lauritzen, S. L. (1996). Graphical models. Oxford, UK: Clarendon Press.

Lei, J., G'Sell, M., Rinaldo, A., Wasserman, L. (2018) Distribution-free predictive inference for regression. Journal of the American Statistical Association. 112,1094-1111

Wang, Yx, Sharpnack, J., Smola, A.J., Tibshirani, R. (2016) Trend filtering on graphs. Journal of Machine Learning Research. 17, 1-41