Topics in Applied Economics III:
Advanced Techniques in Applied Economics

2022-2023 Academic Year
Master of Research in Economics, Finance and Management

1. Description of the subject

- Advanced Techniques in Applied Economics
- Total credits: 3 ECTS

Code: 32088
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 R. Selected aspects of the theory will be presented to improve the overall statistical maturity of the students.

Teaching methodology

Each of the main concepts presented in the lecture will be illustrated with an applied problem. Worked-out examples in R will be provided.

Contents

The course is divided into five parts that roughly correspond to the five weeks of the course's duration.

1. Basic concepts:
   main concepts: graphs, random graphs, conditional independence
2. LASSO estimation:
   main concepts: sparse estimation, high-dimensional estimation
3. Contemporaneous Networks:
   main concepts: Gaussian graphical models, partial correlation networks
4. Filtering on networks:
   main concepts: trendfiltering on graphs, breakpoint detection
5. Uncertainty quantification:
   main concepts: LASSO prediction intervals, conformal inference

Assessment and Grading System

The final grade is based on the project submitted at the end of the course.

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