Applied Multivariate Techniques

Monica Chiogna, Pier Francesco Perri
PhD School, XXIV cicle

Course Description

This course provides a quick overview of multivariate techniques. Topics include: dimension reduction, classification, clustering. The course will also try to touch some modern data analysis techniques, through the development of small projects.

Objectives

The objectives of this course are:

- to learn some of the traditional as well as the more recent tools for analysing multidimensional data;
- to learn some of the statistical inference tools for model selection and inference;
- to get hands-on experience in using some of these techniques, through the development of a small project.

Schedule

20	May	15.00-17.00	Introduction, course organization, etc.
23	June	15.00-17.00	Basic techniques (Chiogna)
24	June	11.00-13.00	Basic techniques (Chiogna)
25	June	11.00-13.00	Project proposals(Chiogna)
3	July	24.00	Final report(Chiogna)
8	July	9.00-11.00	*Sampling theory (Perri)*
8	July	15.00-17.00	Poster presentation and discussion(Chiogna)
9	July	9.00-11.00	*Sampling theory (Perri)*
9	July	15.00-17.00	Poster presentation and discussion(Chiogna)

Recommended texts

- Mardia, K.V., Kent, J.T., and Bibby, J.M. (1979). *Multivariate Analysis*, Academic Press.
- Hastie, T., Tibshirani, R., and Friedman, J. (2001). *The Elements of Statistical Learning: Data Mining, Inference, and Prediction*, Springer.

Final Exam

July, 20 h.15.00

Generalized Linear Mixed Models

Nicola Torelli, Matilde Trevisani, Ruggero Bellio
PhD School, XXIV cicle

Course Description

This course provides an introduction to Generalized Linear Models (GLM) and its extension to mixed-effects (hierarchical) models. Relevant theoretical results will be reviewed and practical issues arising in modeling complex data (i.e., correlated or clustered data) will be considered.

Objectives

The objectives of this course are:

- To learn (or review) basic theoretical results about inference for generalized linear and mixed-effects models.
- To understand how to build, fit and interpret GLMMs
- To fit hierarchical models to some real datasets by using R and Bugs.

Schedule

15	June	10.00-13.00	Introduction to the course: basic ideas (Torelli)
16	June	10.00-13.00	Generalized linear models: structure and inference (Torelli)
17	June	10.00-13.00	Binary, multinomial and count data: some important applications of GLMs (Torelli)
18	June	11.00-13.00	Overdispersion in GLMs (Torelli)
19	June	10.00-13.00	Introduction to hierarchical models and to GLMMs (Torelli)
6	July	10.00-12.00	Likelihood inference in GLMM (Bellio)
		15.00-17.00	Practical session with R (Bellio)
7	July	10.00-12.00	Bayesian Hierarchical Models(Trevisani)
		15.00-17.00	Practical session with R-Bugs (Trevisani)

Recommended texts

- Bryk A.S., Raudenbush S.W. (2002), *Hierarchical linear Models*, Sage.
- Gelman, A. & Hill J. (2007), *Data Analysis Using Regression and Multilevel/Hierarchical Models*, Cambridge University Press, NY.
- Fahrmeir L., Tutz, G. (2001) *Multivariate Statistical Modelling Based on Generalized Linear Models*, Springer, New York. Chapter 6.
- McCulloch, C.E., Searle, S.R. (2001) *Generalized, Linear and Mixed Models*, J. Wiley, New York.
- Snijders T, Bosker, J, (1999) *Multilevel Analysis*, Sage.

Final Exam

July, 21 h.15.00

Time Series Analysis

Luisa Bisaglia, Tommaso Proietti
PhD School, XXIV cycle

Course Description

This course attempts to give an introductory account of time series models and their application to modelling and prediction of data collected sequentially in time. The aim is to provide specific techniques for handling data and at the same time to provide some understanding of the theoretical basis for the techniques. Topics covered will include univariate non linear models (such as switching regime models) and state space models.

Objectives

The objectives of this course are:

- to introduce the students to the main developments in time series analysis;
- to learn theoretical, applied and computational methods for time series analysis and forecasting;
- to gain experience in model building;
- to learn state-space models and Kalman filter.

Schedule

8	September	11.00-13.00	Introduction to linear and nonlinear time series models. (Bisaglia)
9	September	11.00-13.00	Regime swiching time series models. (Bisaglia)
10	September	11.00-13.00	Non linear time series models in finance. (Bisaglia)
14	September	11.00-13.00	Introduction.The state space representation and its role in macroeconometrics. Review of optimal and linear prediction theory. (Proietti)
14	September	15.00-17.00	Unobserved components models for economic time series. Models for the trend component. Cyclical components. Seasonality and Calendar components. Outliers and structural breaks.(Proietti)
15	September	11.00-13.00	Business cycle analysis.(Proietti)
15	September	15.00-17.00	State space models and their statistical treatment.
16	September	11.00-13.00	Kalman filter. Maximum likelihood estimation. Smoothing filters. Forecasting. Diagnostics.(Proietti)
16	September	15.00-17.00	Applications to business cycle analysis.(Proietti)
17	September	12.00-13.00	seminar of Prof. Koopman
18	September	12.00-13.00	seminar of Prof. Koopman

Recommended texts

- Fan J., Yao Q. (2003), Nonlinear time series, Springer-Verlag, New York.
- Tsay R.S., (2005) Analysis of Financial Time Series, Wiley-Interscience.
- Durbin, J., and Koopman, S.J. (2001), Time Series Analysis by State Space Methods, Oxford University Press, Oxford, UK.
- Harvey A.C., (1993), Time Series Models, 2nd Edition, Harvester Wheatsheaf, Chapters 4 and 5.
- Harvey, A.C. (1989), Forecasting, Structural Time Series and the Kalman Filter, Cambridge University Press, Cambridge, UK. Chapters 2 and 3.
- Proietti, T. (2002), Forecasting with Structural Time Series Models, in Clements, M.P. and D. F. Hendry (eds.), A Companion to Economic Forecasting, Blackwell Publishers, Oxford.

Final Exam

To be defined

Nonparametric smoothing techniques

Carlo Gaetan
PhD School, XXIV cicle

Course Description

This course presents to the students an overview of recent nonparametric techniques in statistical analysis. The discussed techniques form the basis of modern nonparametric or so-called smoothing procedures.

Objectives

The idea of this course is to get the students acquainted with the fundamentals, basic properties and use of the most important recent nonparametric techniques. One of these techniques will be explored in more detail. A second aim is to get students acquainted to research questions in this domain.

Schedule

28	September	9.00-11.00	Introduction of various smoothers
5	October	9.00-11.00	Local Regression
19	October	9.00-11.00	Splines
26	October	9.00-11.00	Resampling methods: Bias, Variance, and their trade-off
2	November	9.00-11.00	Wavelets
4	November	9.00-11.00	Density estimation

Recommended text

- Wasserman L. (2007) All of Nonparametric Statistics, Springer

Final Exam:

To be defined