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Presentation of the Proceedings Book of the Project edited with Springer

Fulvia Pennoni

Department of Statistics and Quantitive Methods
University of Milano-Biccoca, Milan, Italy

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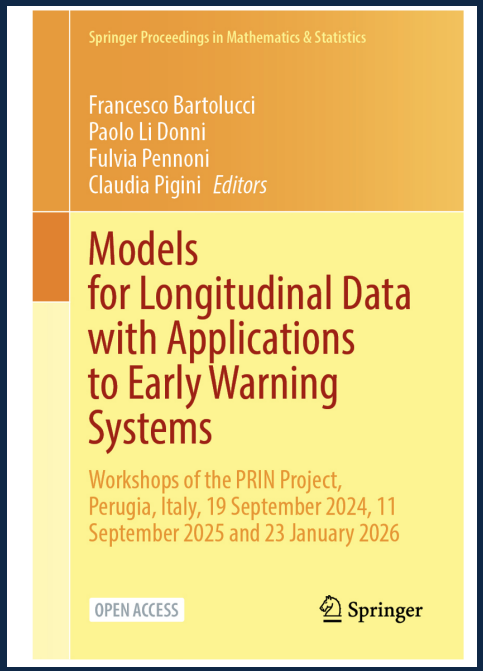
Outline

Proceedings of the PRIN Workshops – Springer
Content: Brief Summary of the Chapters



Models for Longitudinal Data with Applications to Early Warning Systems

- This book is the result of the joint work of the group of researchers of the *four local research units* of PRIN 2022 – Projects of Significant National Interest titled: *"Hidden Markov Models for Early Warning Systems"*

- The *Editors* are:
  - Francesco Bartolucci: University of *Perugia* – Leading unit
  - Claudia Pigini: Università Politecnica delle *Marche* (Ancona)
  - Fulvia Pennoni: University of *Milano-Bicocca*
  - Paolo Li Donni: University of *Palermo*

Content

- The book focuses on *forecasting events and rare events* relying on an important class of models for longitudinal data especially hidden Markov models
- Related models are also considered, together with *measures of predictive performance*, which are used to evaluate the proposed approaches
- Applications range from *economics* to *health*, as the proposed methods lie at the intersection of *econometrics* and *statistics* and have connections with *machine learning*
- The book has *eight* chapters, which are briefly summarized in the following

Chapter 1

Sampling-based and Cost-sensitive Classification in Early Warning Systems for Financial Crises

Authors: Mircoli A., Pigini C. and Potena D.

- Address rare events, *imbalance* and uncertainty
- Present the *k-means synthetic minority oversampling technique* approach aimed at balancing the training sample
- Explore the potential of *cost-sensitive classification* through the MetaCost algorithm to assign different costs to different misclassification errors
- Application through a systemic *banking crises* database

Chapter 2

Auto Machine Learning for Early Warning Crisis Detection

Authors: Cesarini M., Brusa L., Pennoni F. and Vittadini G.

- Present *auto machine learning (AML) techniques* based on supervised learning
- Involve to data preparation, handling of *imbalanced data*, and construction of optimal subsets of training data
- Application related to *forecasting financial crises* based on historical data
- Show the *competitive performance of AML* with reduced manual tuning

Chapter 3

Exploring Binary Regression and Hidden Markov Models for Early Warning Systems

Authors: Brusa L., Pennoni F., Peruilh Bagolini R., Bartolucci F.

- Propose *logit, probit, and hidden Markov (HM) models* as predictive and forecasting tools
- Application related to *longitudinal data* on banking crises with a set of macroeconomic and monetary covariates
- Compare the *predictive performance* using various metrics
- Provide a special focus on the *distinctive features* of HM models

Chapter 4

A Regularized EWS for Banking Crises: a Grouped Fixed Effects Approach

Authors: Pigini C. and Pionati A.

- Propose a *regularized grouped fixed-effects* estimator for financial crisis prediction
- Adopt a data-driven strategy using *k-means clustering* to generate low-dimensional group-specific fixed effects
- Show *effective detection* of first-ever crises and provide *a comparison* with a fixed-effects logit model
- Highlight that the proposed statistical model *enhances the interpretability of the results*

Chapter 5

*A Bayesian Student's t-hidden Markov Model Approach for Cryptocurrencies Time Series**

Authors: Peruilh Bagolini R., Tancini D. and Pandolfi S.

- Propose a multivariate Student's t hidden Markov model for *heavy-tailed time series*
- Develop a *Bayesian formulation* based on a Metropolis-within-Gibbs algorithm to exploit the full predictive distribution
- Provide an application to *three major cryptocurrencies by market capitalization*
- Identify *distinct latent regimes* corresponding to varying levels of financial risk

Chapter 6

*Link Prediction in Temporal Networks: A Dynamic Stochastic Block Model Approach**

Authors: Pandolfi S., Brusa L., Pennoni F. and Bartolucci F.

- Present *undirected binary graphs* based on dynamic stochastic block models
- Propose a new approach for *link prediction in longitudinal networks* based on discrete latent variables
- Implement a *simulation study* to evaluate the proposed method to predict connection probabilities
- Provide an application to dynamic networks generated by *patterns of individual encounters* and interactions in *an ant colony*

Chapter 7

*The Substitution Between Primary And Emergency Care In Individuals With Chronic Conditions: Evidence From A Structural Model**

Authors: Laudicella M. and Li Donni P.

- Propose a *hidden Markov bivariate Poisson model*
- Application related to the *Danish National Patient Register*, including primary care and emergency secondary care visits
- Account for *three sources of association*: within and between outcomes, unobserved heterogeneity in patient health and utilization preferences, and time-specific demand shocks
- Provide important *policy implications*

Chapter 8

*The Demand of Primary and Secondary Care: A Bayesian Hierarchical Approach**

Authors: Li Donni P. and Nicodemo C.

- Present a *Bayesian hierarchical bivariate Poisson model*
- Use data from the Aurum Clinical Practice Research Datalink, one of the *largest databases of anonymized primary care electronic health* records in the United Kingdom
- Consider a Hamiltonian *Monte Carlo* approach for estimation
- Highlight the *key drivers* of healthcare utilization across care settings

Key Contributions

- *Advanced modeling* of rare events with both maximum likelihood inference and *Bayesian* methods
- Integration with *machine learning* methods
- *Innovative* early warning system methodologies
- *Applications* in finance, network science, and health
- *Policy relevance* and evidence-based insights
- *Open and reproducible research* with supplementary Python, **R**, and STATA code

Acknowledgments

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