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Data Science, Learning by Latent Structures, and Knowledge Discovery

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Foreword

Dear Scholars,

It is both my privilege and my pleasure to invite you to this volume and to get inspired for further research in the fields of Data Analysis, Learning by Latent Structures, and Knowledge Discovery. After having held the first European Conference on Data Analysis (ECDA) in Luxembourg in the year 2013, this book is the outcome of intensive work of excellent researchers from different disciplines united under the roof of data analysis. When the Gesellschaft für Klassifikation (GfKI) accepted Luxembourg's offer to host the European Conference on Data Analysis, the GfKI was aware to come to the "very data heart of Europe," quoted from the former Prime Minister of the Grand Duchy of Luxembourg, Jean Claude Juncker. With STATEC, the government statistics service, Luxembourg provides an institute serving citizens, companies, and political decision-makers that is one of the country's largest producers and disseminator of information. With EUROSTAT, Luxembourg is hosting the key to European statistics, and with LIS, formerly known as The Luxembourg Income Study, Luxembourg gives home to two databases, the Luxembourg Income Study Database and the Luxembourg Wealth Study Database.

In business "analytics will define the difference between the losers and winners going forward," says Tim McGuire, director at the global management consulting firm McKinsey & Company. Even if this book is dedicated to science and not to business, let's be winners! Thus, I hold high expectations for this volume, and I invite you to read this book with gusto. This book is a work that covers the key challenges of data analysis, so, enjoy the read and get inspired.

Sincerely yours,
Marc Hansen
Secretary of State for Higher Education and Research

Preface

This volume contains the revised versions of selected papers presented during the European Conference on Data Analysis (ECDA 2013), which was jointly held by the German Classification Society (GfKI) and the French speaking Classification Society (SFC). The conference took place in July 2013 at the CCRN Neumünster Abbey, Luxembourg, under the patronage of the Prime Minister of the Grand Duchy of Luxembourg, and it was hosted by the University of Luxembourg. About 300 participants from 44 countries joined ECDA 2013. At the conference venue, 196 presentations including 11 keynote speeches, 3 invited symposia, and 3 invited talks were given. Thus, the conference provided an international forum for discussions and mutual exchange of knowledge. This international scope was also reflected by the keynote speakers from five European countries and the USA.

The scientific program included sessions from a broad range of topics. Special emphasis was laid on interdisciplinary research and the interaction between theory and practice. The program of ECDA 2013 covered theory, methods, and applications of data analysis from the following seven thematic areas, which were organized by the members of the scientific program committee:

1. Statistics and Data Analysis, organized by Claus Weihs, Eva Ceulemans, Christian Hennig, and Patrice Bertrand;
2. Machine Learning and Knowledge Discovery, organized by Myra Spiliopoulou, Mohamed Nadif, and Eyke Hüllermeier;
3. Data Analysis in Marketing, organized by Daniel Baier, Reinhold Decker, and Vincenzo Esposito Vinzi;
4. Data Analysis in Finance, organized by Krzysztof Jajuga and Michael Hanke;
5. Data Analysis in Biostatistics and Bioinformatics, organized by Hans Kestler, Rudi Balling, Rainer Spang, Matthias Schmid, and Amedeo Napoli;
6. Data Analysis in Interdisciplinary Domains, organized by Sabine Krolak-Schwerdt, Claus Weihs, Alexandra Schwarz, Hans-Joachim Mucha, and Pascale Kuntz-Cosperec;
7. The Workshop Library and Information Science (LIS' 2013), organized by Frank Scholze.

This volume with 48 contributions is the result of a post conference paper submission and reviewing process. It comprises papers dedicated to the extraction of knowledge from many types of data such as structural, quantitative, or statistical approaches for the analysis of data; advances in classification, clustering, and pattern recognition methods; strategies for modeling complex data and mining large data sets as well as applications of advanced methods in specific domains of practice. Among the disciplines represented in the contributions are Statistics, Psychology, Biology, Information Retrieval and Library Science, Archeology, Banking and Finance, Computer Science, Economics, Engineering, Geography, Geology, Linguistics and Musicology, Marketing, Mathematics, Medical and Health Sciences, Sociology and Educational Sciences.

Empirical research in these disciplines requires the analysis of multiple data types. Even though underlying research questions and corresponding data emerge from most various areas, they often require similar statistical, structural, or quantitative approaches for the analysis of data. The specific scientific impact of the post conference volume concerns the presentation of methods, which may commonly be used for the analysis of data stemming from different domains and domain-specific research questions with the aim of solving the numerous domain-specific problems of data analysis on a theoretical as well as on a practical level, fostering their effective use for answering specific questions in various areas of application as well as evaluating alternative methods in the framework of applications. Accordingly, the volume is organized into the following sections:

Part I: Invited Papers

Part II: Data Science and Clustering

Part III: Machine Learning and Knowledge Discovery

Part IV: Data Analysis in Marketing

Part V: Data Analysis in Biostatistics and Bioinformatics

Part VI: Data Analysis in Education and Psychology

Part VII: Data Analysis in Musicology

Part VIII: Data Analysis in Communication and Technology

Part IX: Data Analysis in Administration and Spatial Planning

Part X: Data Analysis in Library Science

Organizing the ECDA 2013 conference required the coordination of myriad people and topics; it lived from the effort of dedicated colleagues and the great team of the Faculty of Language and Literature, Humanities, Arts and Education of the University of Luxembourg. We would like to thank the Area Chairs and the LIS Workshop Chair for the organization of the areas during the conference, author recruitment, and the evaluation of submissions.

We are grateful and thank all reviewers:

Daniel Baier, Rudi Balling, Martin Behnisch, Ghazi Bel Mufti, Patrice Bertrand, Matthias Böhmer, Adrian Bruhin, Michael Bruschi, Andrea Cerioli, Eva Ceulemans, Miguel Couceiro, Ines Daniel, Reinhold Decker, Christian Dittmar, Florent Doménach, Jozef Dziechciarz, Patrizia Falzetti, Andreas Geyer-Schulz, Giuseppe Giordano, Cynthia-Vera Glodeanu, Erhard Godehardt, Tomasz Górecki, Bettina Gruen,

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We would also like to express our thanks to the Fonds National de la Recherche of Luxembourg (FNR). Furthermore, we would like to thank Martina Bihn, Springer-Verlag, Heidelberg, for her support and dedication to the production of this volume. Last but not least, we would like to thank all participants of the ECDA 2013 conference for their interest and activities, which made the conference and this volume an interdisciplinary possibility for scientific discussion.

Colchester, UK
Luxembourg, Luxembourg
Luxembourg, Luxembourg

Berthold Lausen
Sabine Krolak-Schwerdt
Matthias Böhmer

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