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Sylvia Frühwirth-Schnatter

Finite Mixture and Markov Switching Models

Springer

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To my husband

Rudi Frühwirth,

to our sons

Felix, Matthias, and Stephan,

and to my parents

Elfriede and Karl Schnatter

Preface

Modelling based on finite mixture distributions is a rapidly developing area with the range of applications exploding. Finite mixture models are nowadays applied in such diverse areas as biometrics, genetics, medicine, and marketing whereas Markov switching models are applied especially in economics and finance. There exist various features of finite mixture distributions that render them useful in statistical modelling. First, finite mixture distributions arise in a natural way as marginal distribution for statistical models involving discrete latent variables such as clustering or latent class models. On the other hand, we find that statistical models which are based on finite mixture distributions capture many specific properties of real data such as multimodality, skewness, kurtosis, and unobserved heterogeneity. Their extension to Markov mixture models is able to deal with many features of practical time series, for example, spurious long-range dependence and conditional heteroscedasticity.

Finite mixture models provide a straightforward, but very flexible extension of classical statistical models. The price paid for this flexibility is that inference for these models is somewhat of a challenge. Although the specific models discussed in this book are very different, they share common features as far as inference is concerned, namely a discrete latent structure that causes certain fundamental difficulties in estimation, the need to decide on the unknown number of groups, states, and clusters, and great similarities in the algorithms used for practical estimation.

In the beginning, my intention was to write the book entirely from a Bayesian viewpoint, which has been the only way of statistical thinking that was to able to satisfy my own intellectual needs. I was introduced into the Bayesian approach as a student during a course on reliability theory read by Reinhold Viertl in the winter term 1981/82 at the University of Technology. I became a practical Bayesian a few months later when I had the incredible luck to start my scientific career on a project using Bayesian methods for flood design in hydrology (Kirnbauer et al., 1987).

However, the more this book project progressed, the clearer it became that a lot would be said about finite mixture and Markov switching models, about their mathematical formulation, their properties, and their applications, that would have been said with the very same words by any non-Bayesian. Therefore I decided to put the whole project on a broader basis as far as statistical inference is concerned.

I hope that by reading this book many frequent users of statistical models will become familiar with the finite mixture and Markov switching modelling approach, and by using the software developed especially for this book may succeed in pursuing this approach also in practice.

I am grateful to several researchers who raised my interest in the models and methods discussed in the book. Dieter Gutknecht introduced me to Kalman filtering and the application of (switching) state space models in hydrology in 1984 and the wonderful hours we spent discussing our ideas encouraged me to follow a scientific career. Sylvia Kaufmann drew my attention to Markov switching models and their usefulness in empirical economics and finance in 1994, which was the starting point for a rewarding friendship and cooperation. In 1995 Thomas Otter introduced me to the world of Bayesian methods in marketing research and I owe him and my former PhD student Regina Tüchler wonderful and exciting experiences with using finite mixture models for this line of research.

This book project was started when I was a member of the Statistics Department of the Vienna University of Economics and Business Administration and I would like to thank Helmut Strasser for his continuous support and encouragement. I am indebted to colleagues at the Department of Applied Statistics of the Johannes Kepler University in Linz for their enduring patience with my difficulty reconciling my duties as department head and bringing this project to an end. I am particularly grateful to Helga Wagner, who provided useful comments and help with proofreading the book. I am grateful to several anonymous publisher's referees for many helpful suggestions for improving the presentation of the material and to John Kimmel of Springer for his support.

Finally, I am greatly indebted to my husband Rudi Frühwirth for his love and his continuous understanding and support for my research activities throughout the years.

Linz and Vienna, Austria — *Sylvia Frühwirth-Schnatter*

February 2005

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