Inference in Hidden Markov Models (Springer Series in Statistics)

By Olivier Cappé, Eric Moulines, Tobias Ryden

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This book is a comprehensive treatment of inference for hidden Markov models, including both algorithms and statistical theory. Topics range from filtering and smoothing of the hidden Markov chain to parameter estimation, Bayesian methods and estimation of the number of states. In a unified way the book covers both models with finite state spaces and models with continuous state spaces (also called state-space models) requiring approximate simulation-based algorithms that are also described in detail. Many examples illustrate the algorithms and theory. This book builds on recent developments to present a self-contained view.

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Editorial Review

Review

From the reviews:

"By providing an overall survey of results obtained so far in a very readable manner, and also presenting some new ideas, this well-written book will appeal to academic researchers in the field of HMMs, with PhD students working on related topics included. It will also appeal to practitioners and researchers from other fields by guiding them through the computational steps needed for making inference HMMs and/or by providing them with the relevant underlying statistical theory. In the reviewer's opinion this book will shortly become a reference work in its field." *MathSciNet*

"This monograph is a valuable resource. It provides a good literature review, an excellent account of the state of the art research on the necessary theory and algorithms, and ample illustrations of numerous applications of HMM. It goes much beyond the earlier resources on HMM...I anticipate this work to serve well many *Technometrics* readers in the coming years." *Haikady N. Nagaraja for Technometrics, November 2006*

"This monograph is an attempt to present a reasonably complete up-to-date picture of the field of Hidden Markov Models (HMM) that is self-contained from a theoretical point of view and self sufficient from a methodological point of view. … The book is written for academic researchers in the field of HMMs, and also for practitioners and researchers from other fields. … all the theory is illustrated with relevant running examples. This voluminous book has indeed the potential to become a standard text on HMM." (R. Schlittgen, Zentralblatt MATH, Vol. 1080, 2006)

"Providing an overall survey of results obtained so far in a very readable manner … this well-written book will appeal to academic researchers in the field of HMMs, with PhD students working on related topics included. It will also appeal to practitioners and researchers from other fields by guiding them through the computational steps needed for making interference on HMMs and/or by providing them with the relevant underlying statistical theory. In the reviewer's opinion this book will shortly become a reference work in its field." (M. Iosifescu, Mathematical Reviews, Issue 2006 e)

"The authors describe Hidden Markov Models (HMMs) as 'one of the most successful statistical modelling ideas … in the last forty years.' The book considers both finite and infinite sample spaces. … Illustrative examples … recur throughout the book. … This fascinating book offers new insights into the theory and application of HMMs, and in addition it is a useful source of reference for the wide range of topics considered." (B. J. T. Morgan, Short Book Reviews, Vol. 26 (2), 2006)

"In Inference in Hidden Markov Models, Cappé et al. present the current state of the art in HMMs in an emminently readable, thorough, and useful way. This is a very well-written book … . The writing is clear and concise. … the book will appeal to academic researchers in the field of HMMs, in particular PhD students working on related topics, by summing up the results obtained so far and presenting some new ideas … ." (Robert Shearer, Interfaces, Vol. 37 (2), 2007)

From the Back Cover

Hidden Markov models have become a widely used class of statistical models with applications in diverse areas such as communications engineering, bioinformatics, finance and many more. This book is a comprehensive treatment of inference for hidden Markov models, including both algorithms and statistical theory. Topics range from filtering and smoothing of the hidden Markov chain to parameter estimation, Bayesian methods and estimation of the number of states.

In a unified way the book covers both models with finite state spaces, which allow for exact algorithms for filtering, estimation etc. and models with continuous state spaces (also called state-space models) requiring approximate simulation-based algorithms that are also described in detail. Simulation in hidden Markov models is addressed in five different chapters that cover both Markov chain Monte Carlo and sequential Monte Carlo approaches. Many examples illustrate the algorithms and theory. The book also carefully treats Gaussian linear state-space models and their extensions and it contains a chapter on general Markov chain theory and probabilistic aspects of hidden Markov models.

This volume will suit anybody with an interest in inference for stochastic processes, and it will be useful for researchers and practitioners in areas such as statistics, signal processing, communications engineering, control theory, econometrics, finance and more. The algorithmic parts of the book do not require an advanced mathematical background, while the more theoretical parts require knowledge of probability theory at the measure-theoretical level.

Olivier Cappé is Researcher for the French National Center for Scientific Research (CNRS). He received the Ph.D. degree in 1993 from Ecole Nationale Supérieure des Télécommunications, Paris, France, where he is currently a Research Associate. Most of his current research concerns computational statistics and statistical learning.

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Tobias Rydén is Professor of Mathematical Statistics at Lund University, Sweden, where he also received his Ph.D. in 1993. His publications include papers ranging from statistical theory to algorithmic developments for hidden Markov models.

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