An Introduction to Markov Modelling for Economic Evaluation

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Summary

Markov models are often employed to represent stochastic processes, that is, random processes that evolve over time. In a healthcare context, Markov models are particularly suited to modelling chronic disease. In this article, we describe the use of Markov models for economic evaluation of healthcare interventions. The intuitive way in which Markov models can handle both costs and outcomes make them a powerful tool for economic evaluation modelling. The time component of Markov models can offer advantages of standard decision tree models, particularly with respect to discounting. This paper gives a comprehensive description of Markov modelling for economic evaluation, including a discussion of the assumptions on which the type of model is based, most notably the memory-less quality of Markov models often termed the 'Markovian assumption'. A hypothetical example of a drug intervention to slow the progression of a chronic disease is employed to demonstrate the modelling technique and the possible methods of analysing Markov models are explored. Analysts should be aware of the limitations of Markov models, particularly the Markovian assumption, although the adept modeller will often find ways around this problem.

The use of decision-analytical modelling to estimate the cost effectiveness of healthcare interventions is becoming widespread.[1,2] Models have a range of uses including the synthesis of data from various sources and extrapolation from primary data sources. Hence, a sound knowledge of modelling can be an important and powerful tool for economic evaluation.

A particular type of model that is now used frequently in economic evaluation is the Markov model. Markov models have a long history of use in health service decision-making, including clinical and epidemiological applications.[3,4] Health economists are also beginning to use Markov models widely in economic-evaluation studies.[5-8] The fundamental difference between economic and other applications of Markov modelling in medical decision-making is that economists are interested in both the resource and health outcome consequences of healthcare interventions. The way in which Markov models simply and intuitively handle both costs and outcomes simultaneously is one of their strengths.

The aim of this article is to provide an introduction to the use of Markov models for performing economic evaluation. An excellent and comprehensive introduction to Markov modelling has been provided by Sonnenberg and Beck,[9] which we strongly recommend to interested readers. We hope that our article will add additional insight to the use of Markov modelling in economic evaluation. The paper is divided into 3 main sections. The

Economic Modelling An Introduction

Joacim Rocklöv

Economic Modelling An Introduction:

Spatial Economic Modelling Stefano Colombo,2025-06-24 This textbook provides an accessible introduction to spatial competition models in economics It shows students how to understand and apply spatial models to analysis of market design structure competition and pricing The book aims to provide a step by step guide to learning and implementing spatial modelling It provides a concise history of the spatial approach and a self contained primer chapter on the key game theory tools required to undertake spatial analysis It then provides a comprehensive explanation of the key traditions and models including the Hotelling model and related Salop circle model and demonstrates their various applications to consumer firm and market interactions Topics covered in the book include product differentiation the physical location of firms spatial price discrimination oligopolistic competition non uniform distributions of consumers political competition and the basic Downs model and the application of spatial models to marketing and management This book will be a valuable resource for undergraduate students in microeconomics and applied economics particularly on industrial organization courses

Economic Modelling Donald A. R. George,1987   **Introduction to Estimating Economic Models** Atsushi Maki,2010-12-14 The book s comprehensive coverage on the application of econometric methods to empirical analysis of economic issues is impressive It uncovers the missing link between textbooks on economic theory and econometrics and highlights the powerful connection between economic theory and empirical analysis perfectly through examples on rigorous experimental design The use of data sets for estimation derived with the Monte Carlo method helps facilitate the understanding of the role of hypothesis testing applied to economic models Topics covered in the book are consumer behavior producer behavior market equilibrium macroeconomic models qualitative response models panel data analysis and time series analysis Key econometric models are introduced specified estimated and evaluated The treatment on methods of estimation in econometrics and the discipline of hypothesis testing makes it a must have for graduate students of economics and econometrics and aids their understanding on how to estimate economic models and evaluate the results in terms of policy implications   **INTRODUCTION TO ECONOMIC MODELING** DIANA LOUBAKI,2012-08-11 The aim of this book is the development of a universal economic theory We mean a theory based on economic problems relate to growth and development We highlight appropriate analytical tools able to unify economic study of both poor and rich countries The analysis shows first it can be established a link between growth and development economics through a well being collective criteria which guarantee a positive evolution of the economic systems over time Therefore it becomes possible to control economic paths towards their long run locus Second the analysis begins on poverty and under development dilemmas in order to highlight the mechanics which link growth and development The purpose of the analysis is the rise of standard economic development theory Hirschman 1958 Rostow 1960 Lewis 1954 which fall in the mid 1970s Krugman 1994 through its introduction in the growth literature which began with Smith 1776   **An Introduction to Economic Dynamics**
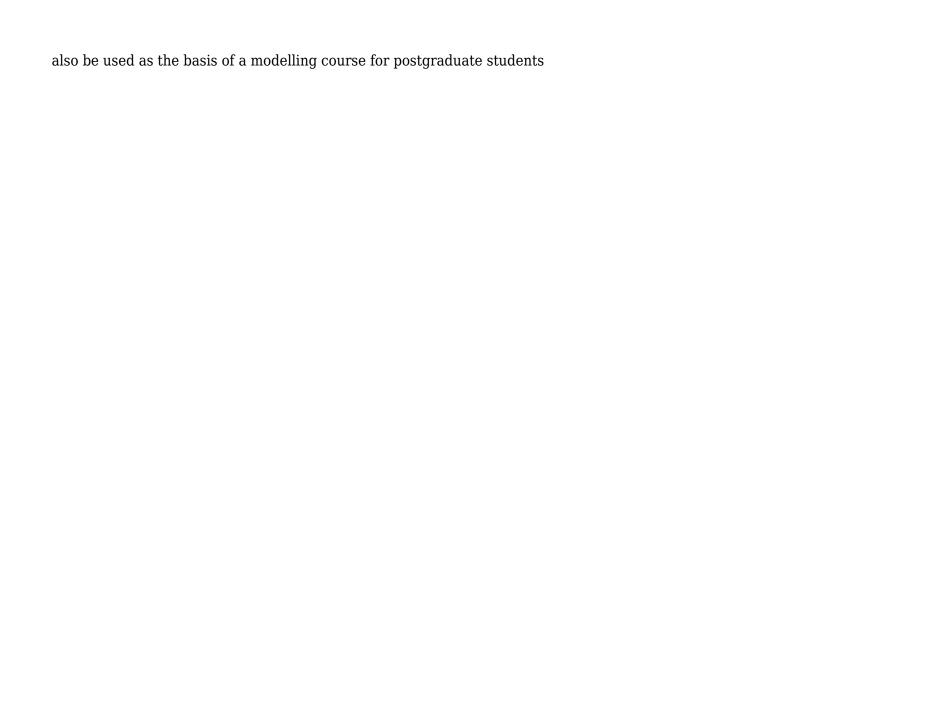
Srinivas Raghavendra,Petri T. Piiroinen,2023-03-31 An Introduction to Economic Dynamics provides a framework for students to appreciate and understand the basic intuition behind economic models and to experiment with those models using simulation techniques in MATLAB This book goes beyond the often limited scope of other texts on economic models which have largely focused on elucidating static equilibrium models Comparative static analysis inhibits students from asking how the equilibrium position is achieved from an initial out of equilibrium position and limits their understanding of the dynamics that underlie such analysis In this textbook readers are introduced to ten well established macroeconomic models including Keynesian multiplier models Samuelson s multiplier and Solow s growth model and guided through the dynamical systems behind each model Every chapter begins with an overview of the economic problem which the model is designed to help solve followed by an explanation of the mathematics of the model Solutions are provided using simulation and visualisation techniques in MATLAB which are interwoven organically with the analysis and are introduced in a step by step fashion to guide the reader along the way Appendices provide an introduction to MATLAB along with all the necessary codes The book is ideally suited for courses in economic dynamics macroeconomic modelling and computational economics as well as for students of finance mathematics and engineering who are interested in economic models **Introduction to Computable General Equilibrium Models** Mary E. Burfisher,2017-02-01 This book provides an accessible undergraduate level introduction to computable general equilibrium CGE models a class of model that has come to play an important role in government policy decisions The book uses a graphical approach to explain the economic theory that underlies a CGE model and provides results from simple small scale CGE models to illustrate the links between theory and model outcomes The book includes eleven guided hands on exercises that introduce modeling techniques that are applied to real world economic problems Students will learn how to integrate their separate fields of economic study into a comprehensive general equilibrium perspective as they develop their skills as producers or consumers of CGE based analysis *Spatial Economic Modelling* Stefano Colombo,2025-05-31 This textbook provides an accessible introduction to spatial competition models in economics It shows students how to understand and apply spatial models to analysis of market design structure competition and pricing The book aims to provide a step by step guide to learning and implementing spatial modelling It provides a concise history of the spatial approach and a self contained primer chapter on the key game theory tools required to undertake spatial analysis It then provides a comprehensive explanation of the key traditions and models including the Hotelling model and related Salop circle model and demonstrates their various applications to consumer firm and market interactions Topics covered in the book include product differentiation the physical location of firms spatial price discrimination oligopolistic competition non uniform distributions of consumers political competition and the basic Downs model and the application of spatial models to marketing and management This book will be a valuable resource for undergraduate students in microeconomics and applied economics particularly on industrial organization courses

Stochastic Optimization and Economic Models Jati Sengupta,2013-03-09 This book presents the main applied aspects of stochas tic optimization in economic models Stochastic processes and control theory are used under optimization to illustrate the various economic implications of optimal decision rules Unlike econometrics which deals with estimation this book emphasizes the decision theoretic basis of uncertainty specified by the stochastic point of view Methods of ap plied stochastic control using stochastic processes have now reached an exciti g phase where several disciplines like systems engineering operations research and natural reso ces interact along with the conventional fields such as mathematical economics finance and control systems Our objective is to present a critical overview of this broad terrain from a multidisciplinary viewpoint In this attempt we have at times stressed viewpoints other than the purely economic one We believe that the economist would find it most profitable to learn from the other disciplines where stochastic optimization has been successfully applied It is in this spirit that we have discussed in some detail the following major areas A Portfolio models in finance B Differential games under uncertainty c Self tuning regulators D Models of renewable resources under uncertainty and ix x PREFACE E Nonparametric methods of efficiency measurement Stochastic processes are now increasingly used in economic models to understand the various adaptive behavior implicit in the formulation of expectation and its application in decision rules which are optimum in some sense   **System-Theoretic Methods in Economic Modelling II** S. Mittnik,2014-06-28 System Theoretic Methods in Economic Modelling II complements the editor s earlier volume bringing together current research efforts integrating system theoretic concepts with economic modelling processes The range of papers presented here goes beyond the long accepted control theoretic contributions in dynamic optimization and focuses on system theoretic methods in the construction as well as the application stages of economic modelling This volume initiates new and intensifies existing debate between researchers and practitioners within and across the disciplines involved with the objective of encouraging interdisciplinary research The papers are split into four sections estimation filtering and smoothing problems in the context of state space modelling applying the state space concept to financial modelling modelling rational expectation and a miscellaneous section including a follow up case study by Tse and Khilnani on their integrated system model for a fishery management process which featured in the first volume   **A Comparison of Econometric Models** United States. Congress. Joint Economic Committee,1978   **Economic Modelling at the Banque de France** Michel Boutillier,Jean Cordier,2003-09-02 Economic Modelling at the Banque de France examines the various models of the French economy used at its central bank   Economic Modelling in the OECD Countries Homa Motamen-Scobie,2012-12-06 among the 159 member countries of the United Nations Organization which are treated as country units while smaller countries are grouped together in regions The number of equations used is approximately 13 700 while the number of software steps for computation is approximately 100000 Computation including tabulation can nevertheless be performed very rapidly and only about 20 minutes is required to make forecasts from the present up to the

year 2000 The FUGI model is at present being used by the Projections and Perspectives Studies Branch Department of International Economic and Social Affairs of the United Nations for simulations of United Nations medium and long term international development strategies while the Project LINK model is being used for short term forecasts Onishi 1985 Stimulated by our latest joint research with the United Nations University on a global early warning system for displaced persions we have felt the need for our FUGI model to go beyond its present capacities centred on an economic model in the rather traditional restricted sense of the term and to develop into a model that can in the future analyse global problematiques or global complexes of symptoms and complicated questions including various types of environmental problems and the sorts of displaced persons issues to which we are now directing our attention We are thus expanding the scope of our fifth generation FUGI model presently under development to deal with such issues **Theory and Implementation of Economic Models for Sustainable Development** J.C. van den Bergh,M.W. Hofkes,1998-06-30 There is widespread concern for long term environmental issues in relation to economic processes and developments Among the concerned scientists are economists who have taken up the challenge to apply economic insights and tools for the study of long term environment economy interactions and to give the concept of sustainable development economic hands and feet This book presents a pluralistic perspective on efforts problems and successes in this area This collection of papers was originally prepared for an international symposium titled Economic Modelling of Sustainable Development Between Theory and Practice which was hosted by the Vrije Universiteit in Amsterdam on December 20th 1996 The main motivation for this symposium was that the usefulness of the concept of sustainable development for theoretical and applied modelling is still being debated growth theorists resource economists ecological economists policy makers and many others are trying to deal with the concept in various and sometimes conflicting ways The aim of the symposium was to bring together different theoretical and implementational perspectives on modelling for sustainable development We hope that this volume will inform a wide audience about the perspectives and progress in this important area of research as well as stimulate further research notably on applied modelling and practical methods for the analysis of sustainable development at various spatial scales The papers have in due course been revised several times based on comments made by discus sants referees and the editors *Qualitative Theory of Dynamical Systems, Tools and Applications for Economic Modelling* Gian Italo Bischi,Anastasiia Panchuk,Davide Radi,2016-06-02 The book presents the lectures delivered during a short course held at Urbino University in summer 2015 on qualitative theory of dynamical systems included in the activities of the COST Action IS1104 The EU in the new economic complex geography models tools and policy evaluation It provides a basic introduction to dynamical systems and optimal control both in continuous and discrete time as well as some numerical methods and applications in economic modelling Economic and social systems are intrinsically dynamic characterized by interdependence nonlinearity and complexity and these features can only be approached using a qualitative analysis based on the study of

invariant sets equilibrium points limit cycles and more complex attractors together with the boundaries of their basins of attraction which requires a trade off between analytical geometrical and numerical methods Even though the early steps of the qualitative theory of dynamical systems have been in continuous time models in economic and social modelling discrete time is often used to describe event driven often decision driven evolving systems The book is written for Ph D and master s students post doctoral fellows and researchers in economics or sociology and it only assumes a basic knowledge of calculus However it also suggests some more advanced topics   Econometric Model of India Ramgopal Agarwala,2013-10-23 First Published in 1970 Econometric model building on the other hand has been largely confined to the advanced industrialised countries In the few cases where macro models have been built for underdeveloped countries e g the Narasimham model 112 for India the underlying assumptions have been largely of the Keynesian type and thus in the authors opinion unconnected with the theory of economic development This study is a modest attempt at econometric model building on the basis of a model of development of an underdeveloped country   **Agent-Based Modelling in Economics** Lynne Hamill,Nigel Gilbert,2016-01-19 Agent based modelling in economics Lynne Hamill and Nigel Gilbert Centre for Research in Social Simulation CRESS University of Surrey UK New methods of economic modelling have been sought as a result of the global economic downturn in 2008 This unique book highlights the benefits of an agent based modelling ABM approach It demonstrates how ABM can easily handle complexity heterogeneous people households and firms interacting dynamically Unlike traditional methods ABM does not require people or firms to optimise or economic systems to reach equilibrium ABM offers a way to link micro foundations directly to the macro situation Key features Introduces the concept of agent based modelling and shows how it differs from existing approaches Provides a theoretical and methodological rationale for using ABM in economics along with practical advice on how to design and create the models Each chapter starts with a short summary of the relevant economic theory and then shows how to apply ABM Explores both topics covered in basic economics textbooks and current important policy themes unemployment exchange rates banking and environmental issues Describes the models in pseudocode enabling the reader to develop programs in their chosen language Supported by a website featuring the NetLogo models described in the book Agent based Modelling in Economics provides students and researchers with the skills to design implement and analyze agent based models Third year undergraduate master and doctoral students faculty and professional economists will find this book an invaluable resource   **Introductory Econometrics** Hamid Seddighi,2013-03-01 This book constitutes the first serious attempt to explain the basics of econometrics and its applications in the clearest and simplest manner possible Recognising the fact that a good level of mathematics is no longer a necessary prerequisite for economics financial economics undergraduate and postgraduate programmes it introduces this key subdivision of economics to an audience who might otherwise have been deterred by its complex nature   Dynamic Linear Economic Models James L. Kenkel,2018-04-09 Originally published in 1974 This book provides a rigorous and detailed

introductory treatment of the theory of difference equations and their applications in the construction and analysis of dynamic economic models It explains the theory of linear difference equations and various types of dynamic economic models are then analysed Including plenty of examples of application throughout the text it will be of use to those working in macroeconomics and econometrics *Econometric Modelling with Time Series* Vance Martin,Stan Hurn,David Harris,2012-12-28 This book provides a general framework for specifying estimating and testing time series econometric models Special emphasis is given to estimation by maximum likelihood but other methods are also discussed including quasi maximum likelihood estimation generalised method of moments estimation nonparametric estimation and estimation by simulation An important advantage of adopting the principle of maximum likelihood as the unifying framework for the book is that many of the estimators and test statistics proposed in econometrics can be derived within a likelihood framework thereby providing a coherent vehicle for understanding their properties and interrelationships In contrast to many existing econometric textbooks which deal mainly with the theoretical properties of estimators and test statistics through a theorem proof presentation this book squarely addresses implementation to provide direct conduits between the theory and applied work *Approaches to Geo-mathematical Modelling* Alan G. Wilson,2016-09-26 Geo mathematical modelling models from complexity science Sir Alan Wilson Centre for Advanced Spatial Analysis University College London Mathematical and computer models for a complexity science tool kit Geographical systems are characterised by locations activities at locations interactions between them and the infrastructures that carry these activities and flows They can be described at a great variety of scales from individuals and organisations to countries Our understanding often partial of these entities and in many cases this understanding is represented in theories and associated mathematical models In this book the main examples are models that represent elements of the global system covering such topics as trade migration security and development aid together with examples at finer scales This provides an effective toolkit that can not only be applied to global systems but more widely in the modelling of complex systems All complex systems involve nonlinearities involving path dependence and the possibility of phase changes and this makes the mathematical aspects particularly interesting It is through these mechanisms that new structures can be seen to emerge and hence the current notion of emergent behaviour The range of models demonstrated include account based models and biproportional fitting structural dynamics space time statistical analysis real time response models Lotka Volterra models representing war agent based models epidemiology and reaction diffusion approaches game theory network models and finally integrated models Geo mathematical modelling Presents mathematical models with spatial dimensions Provides representations of path dependence and phase changes Illustrates complexity science using models of trade migration security and development aid Demonstrates how generic models from the complexity science tool kit can each be applied in a variety of situations This book is for practitioners and researchers in applied mathematics geography economics and interdisciplinary fields such as regional science and complexity science It can

also be used as the basis of a modelling course for postgraduate students

Economic Modelling An Introduction: Bestsellers in 2023 The year 2023 has witnessed a remarkable surge in literary brilliance, with numerous engrossing novels captivating the hearts of readers worldwide. Lets delve into the realm of bestselling books, exploring the captivating narratives that have captivated audiences this year. Economic Modelling An Introduction : Colleen Hoovers "It Ends with Us" This poignant tale of love, loss, and resilience has captivated readers with its raw and emotional exploration of domestic abuse. Hoover expertly weaves a story of hope and healing, reminding us that even in the darkest of times, the human spirit can succeed. Uncover the Best : Taylor Jenkins Reids "The Seven Husbands of Evelyn Hugo" This captivating historical fiction novel unravels the life of Evelyn Hugo, a Hollywood icon who defies expectations and societal norms to pursue her dreams. Reids compelling storytelling and compelling characters transport readers to a bygone era, immersing them in a world of glamour, ambition, and self-discovery. Economic Modelling An Introduction : Delia Owens "Where the Crawdads Sing" This captivating coming-of-age story follows Kya Clark, a young woman who grows up alone in the marshes of North Carolina. Owens spins a tale of resilience, survival, and the transformative power of nature, captivating readers with its evocative prose and mesmerizing setting. These bestselling novels represent just a fraction of the literary treasures that have emerged in 2023. Whether you seek tales of romance, adventure, or personal growth, the world of literature offers an abundance of engaging stories waiting to be discovered. The novel begins with Richard Papen, a bright but troubled young man, arriving at Hampden College. Richard is immediately drawn to the group of students who call themselves the Classics Club. The club is led by Henry Winter, a brilliant and charismatic young man. Henry is obsessed with Greek mythology and philosophy, and he quickly draws Richard into his world. The other members of the Classics Club are equally as fascinating. Bunny Corcoran is a wealthy and spoiled young man who is always looking for a good time. Charles Tavis is a quiet and reserved young man who is deeply in love with Henry. Camilla Macaulay is a beautiful and intelligent young woman who is drawn to the power and danger of the Classics Club. The students are all deeply in love with Morrow, and they are willing to do anything to please him. Morrow is a complex and mysterious figure, and he seems to be manipulating the students for his own purposes. As the students become more involved with Morrow, they begin to commit increasingly dangerous acts. The Secret History is a brilliant and gripping novel that will keep you wondering until the very end. The novel is a cautionary tale about the dangers of obsession and the power of evil.

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