
Recursive Methods In Economic Dynamics

*Recursive Methods In
Economic Dynamics*

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Recursive Methods in Economic Dynamics *Harvard University Press*

This rigorous but brilliantly lucid book presents a self-contained treatment of modern economic dynamics. Stokey, Lucas, and Prescott develop the basic methods of recursive analysis and illustrate the many areas where they can usefully be applied.

Recursive Methods in Economic

Dynamics *Harvard University Press*

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Recursive Methods in Economic Dynamics

Develops the basic methods of recursive analysis, covers stochastic dynamic programming, and presents two fundamental theorems of welfare economics

Recursive Macroeconomic Theory, fourth edition *MIT Press*

The substantially revised fourth edition

of a widely used text, offering both an introduction to recursive methods and advanced material, mixing tools and sample applications. Recursive methods provide powerful ways to pose and solve problems in dynamic macroeconomics. Recursive Macroeconomic Theory offers both an introduction to recursive methods and more advanced material. Only practice in solving diverse problems fully conveys the advantages of the recursive approach, so the book provides many applications. This fourth edition features two new chapters and substantial revisions to other chapters that demonstrate the power of recursive methods. One new chapter applies the recursive approach to Ramsey taxation and sharply characterizes the time inconsistency of optimal policies. These

insights are used in other chapters to simplify recursive formulations of Ramsey plans and credible government policies. The second new chapter explores the mechanics of matching models and identifies a common channel through which productivity shocks are magnified across a variety of matching models. Other chapters have been extended and refined. For example, there is new material on heterogeneous beliefs in both complete and incomplete markets models; and there is a deeper account of forces that shape aggregate labor supply elasticities in lifecycle models. The book is suitable for first- and second-year graduate courses in macroeconomics. Most chapters conclude with exercises; many exercises and examples use Matlab or Python

computer programming languages.

Solutions Manual for Recursive Methods in Economic Dynamics

Harvard University Press

This solutions manual is a companion volume to the classic textbook *Recursive Methods in Economic Dynamics* by Nancy L. Stokey and Robert E. Lucas. Efficient and lucid in approach, this manual will greatly enhance the value of *Recursive Methods* as a text for self-study.

Recursive Methods in Economic Dynamics

Economic Dynamics in Discrete Time

MIT Press

A unified, comprehensive, and up-to-

date introduction to the analytical and numerical tools for solving dynamic economic problems. This book offers a unified, comprehensive, and up-to-date treatment of analytical and numerical tools for solving dynamic economic problems. The focus is on introducing recursive methods—an important part of every economist's set of tools—and readers will learn to apply recursive methods to a variety of dynamic economic problems. The book is notable for its combination of theoretical foundations and numerical methods. Each topic is first described in theoretical terms, with explicit definitions and rigorous proofs; numerical methods and computer codes to implement these methods follow. Drawing on the latest research, the book covers such cutting-

edge topics as asset price bubbles, recursive utility, robust control, policy analysis in dynamic New Keynesian models with the zero lower bound on interest rates, and Bayesian estimation of dynamic stochastic general equilibrium (DSGE) models. The book first introduces the theory of dynamical systems and numerical methods for solving dynamical systems, and then discusses the theory and applications of dynamic optimization. The book goes on to treat equilibrium analysis, covering a variety of core macroeconomic models, and such additional topics as recursive utility (increasingly used in finance and macroeconomics), dynamic games, and recursive contracts. The book introduces Dynare, a widely used software platform for handling a range of economic

models; readers will learn to use Dynare for numerically solving DSGE models and performing Bayesian estimation of DSGE models. Mathematical appendixes present all the necessary mathematical concepts and results. Matlab codes used to solve examples are indexed and downloadable from the book's website. A solutions manual for students is available for sale from the MIT Press; a downloadable instructor's manual is available to qualified instructors.

Dynamic Macroeconomic Theory *Harvard University Press*

The tasks of macroeconomics are to interpret observations on economic aggregates in terms of the motivations and constraints of economic agents and to predict the consequences of

alternative hypothetical ways of administering government economic policy. General equilibrium models form a convenient context for analyzing such alternative government policies. In the past ten years, the strengths of general equilibrium models and the corresponding deficiencies of Keynesian and monetarist models of the 1960s have induced macroeconomists to begin applying general equilibrium models. This book describes some general equilibrium models that are dynamic, that have been built to help interpret time-series of observations of economic aggregates and to predict the consequences of alternative government interventions. The first part of the book describes dynamic programming, search theory, and real dynamic capital pricing

models. Among the applications are stochastic optimal growth models, matching models, arbitrage pricing theories, and theories of interest rates, stock prices, and options. The remaining parts of the book are devoted to issues in monetary theory; currency-in-utility-function models, cash-in-advance models, Townsend turnpike models, and overlapping generations models are all used to study a set of common issues. By putting these models to work on concrete problems in exercises offered throughout the text, Sargent provides insights into the strengths and weaknesses of these models of money. An appendix on functional analysis shows the unity that underlies the mathematics used in disparate areas of rational expectations economics. This

book on dynamic equilibrium macroeconomics is suitable for graduate-level courses; a companion book, *Exercises in Dynamic Macroeconomic Theory*, provides answers to the exercises and is also available from Harvard University Press.

Economic Dynamics

Theory and Computation *MIT Press*

A rigorous and example-driven introduction to topics in economic dynamics, with an emphasis on mathematical and computational techniques for modeling dynamic systems. This text provides an introduction to the modern theory of economic dynamics, with emphasis on mathematical and computational

techniques for modeling dynamic systems. Written to be both rigorous and engaging, the book shows how sound understanding of the underlying theory leads to effective algorithms for solving real world problems. The material makes extensive use of programming examples to illustrate ideas. These programs help bring to life the abstract concepts in the text. Background in computing and analysis is offered for readers without programming experience or upper-level mathematics. Topics covered in detail include nonlinear dynamic systems, finite-state Markov chains, stochastic dynamic programming, stochastic stability and computation of equilibria. The models are predominantly nonlinear, and the emphasis is on studying nonlinear systems in their original form,

rather than by means of rudimentary approximation methods such as linearization. Much of the material is new to economics and improves on existing techniques. For graduate students and those already working in the field, *Economic Dynamics* will serve as an essential resource.

The Economics of Inaction

Stochastic Control Models with Fixed Costs *Princeton University Press*
In *The Economics of Inaction*, leading economist Nancy Stokey shows how the tools of stochastic control can be applied to dynamic problems of decision making under uncertainty when fixed costs are present. Stokey provides a self-contained, rigorous, and clear treatment

of two types of models, impulse and instantaneous control. She presents the relevant results about Brownian motion and other diffusion processes, develops methods for analyzing each type of problem, and discusses applications to price setting, investment, and durable goods purchases."--Pub. desc.

Exercises in Dynamic Macroeconomic Theory *Harvard University Press*

This book is a companion volume to *Dynamic Macroeconomic Theory* by Thomas J. Sargent. It provides scrimmages in dynamic macroeconomic theory--precisely the kind of drills that people will need in order to learn the techniques of dynamic programming and its applications to economics. By doing

these exercises, the reader can acquire the ability to put the theory to work in a variety of new situations, build technical skill, gain experience in fruitful ways of setting up problems, and learn to distinguish cases in which problems are well posed from cases in which they are not. The basic framework provided by variants of a dynamic general equilibrium model is used to analyze problems in macroeconomics and monetary economics. An equilibrium model provides a mapping from parameters of preferences, technologies, endowments, and "rules of the game" to a probability model for time series. The rigor of the logical connections between theory and observations that the mapping provides is an attractive feature of dynamic equilibrium, or

"rational expectations," models. This book gives repeated and varied practice in constructing and interpreting this mapping.

Frontiers of Business Cycle Research *Princeton University Press*

This introduction to modern business cycle theory uses a neoclassical growth framework to study the economic fluctuations associated with the business cycle. Presenting advances in dynamic economic theory and computational methods, it applies concepts to t

Numerical Methods in Economics *MIT Press*

To harness the full power of computer technology, economists need to use a broad range of mathematical

techniques. In this book, Kenneth Judd presents techniques from the numerical analysis and applied mathematics literatures and shows how to use them in economic analyses. The book is divided into five parts. Part I provides a general introduction. Part II presents basics from numerical analysis on $\mathbb{R}^n$, including linear equations, iterative methods, optimization, nonlinear equations, approximation methods, numerical integration and differentiation, and Monte Carlo methods. Part III covers methods for dynamic problems, including finite difference methods, projection methods, and numerical dynamic programming. Part IV covers perturbation and asymptotic solution methods. Finally, Part V covers applications to dynamic equilibrium

analysis, including solution methods for perfect foresight models and rational expectation models. A website contains supplementary material including programs and answers to exercises.

Robustness *Princeton University Press*

The standard theory of decision making under uncertainty advises the decision maker to form a statistical model linking outcomes to decisions and then to choose the optimal distribution of outcomes. This assumes that the decision maker trusts the model completely. But what should a decision maker do if the model cannot be trusted? Lars Hansen and Thomas Sargent, two leading macroeconomists, push the field forward as they set about answering this question. They adapt

robust control techniques and apply them to economics. By using this theory to let decision makers acknowledge misspecification in economic modeling, the authors develop applications to a variety of problems in dynamic macroeconomics. Technical, rigorous, and self-contained, this book will be useful for macroeconomists who seek to improve the robustness of decision-making processes.

Dynamic Economics

Quantitative Methods and Applications *MIT Press*

An integrated approach to the empirical application of dynamic optimization programming models, for students and researchers. This book is an effective,

concise text for students and researchers that combines the tools of dynamic programming with numerical techniques and simulation-based econometric methods. Doing so, it bridges the traditional gap between theoretical and empirical research and offers an integrated framework for studying applied problems in macroeconomics and microeconomics. In part I the authors first review the formal theory of dynamic optimization; they then present the numerical tools and econometric techniques necessary to evaluate the theoretical models. In language accessible to a reader with a limited background in econometrics, they explain most of the methods used in applied dynamic research today, from the estimation of probability in a coin flip

to a complicated nonlinear stochastic structural model. These econometric techniques provide the final link between the dynamic programming problem and data. Part II is devoted to the application of dynamic programming to specific areas of applied economics, including the study of business cycles, consumption, and investment behavior. In each instance the authors present the specific optimization problem as a dynamic programming problem, characterize the optimal policy functions, estimate the parameters, and use models for policy evaluation. The original contribution of *Dynamic Economics: Quantitative Methods and Applications* lies in the integrated approach to the empirical application of dynamic optimization programming

models. This integration shows that empirical applications actually complement the underlying theory of optimization, while dynamic programming problems provide needed structure for estimation and policy evaluation.

Dynamic Economics

Optimization by the Lagrange Method *Oxford University Press on Demand*

This work presents the optimization framework for dynamic economics and treats a number of topics in economics, including growth, macroeconomics, microeconomics, finance and dynamic games. The book also teaches by examples, using concepts to solve

simple problems, moving on to general propositions.

**Solutions Manual for
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Methods in Economic
Dynamics{/i{u203A}}**

This solutions manual is a companion volume to the classic textbook *Recursive Methods in Economic Dynamics* by Nancy L. Stokey and Robert E. Lucas. Efficient and lucid in approach, this manual will greatly enhance the value of *Recursive Methods* as a text for self-study.

Economic Dynamics

Phase Diagrams and Their Economic Application *Cambridge University Press*

Table of contents

Macroeconomic Theory *Academic Press Incorporated*

Include chapters such as: The Consumption Function, Government Debt and Taxes, and Dynamic Optimal Taxation. This book also features chapters dealing with difference equations, stochastic difference equations, and investment under uncertainty.

An Introduction to the Theory of Mechanism Design *Oxford University Press*

What is the best way to auction an asset? How should a group of people organize themselves to ensure the best provision of public goods? How should

exchanges be organized? In *An Introduction to the Theory of Mechanism Design*, Tilman Börgers addresses these questions and more through an exploration of the economic theory of mechanism design. Mechanism design is reverse game theory. Whereas game theory takes the rules of the game as a given and makes predictions about the behavior of strategic players, the theory of mechanism design goes a step further and selects the optimal rules of the game. A relatively new economic theory, mechanism design studies the instrument itself as well as the results of the instrument. *An Introduction to the Theory of Mechanism Design* provides rigorous but accessible explanations of classic results in the theory of mechanism design, such as Myerson's

theorem on expected revenue maximizing auctions, Myerson and Satterthwaite's theorem on the impossibility of ex post efficient bilateral trade with asymmetric information, and Gibbard and Satterthwaite's theorem on the non-existence of dominant strategy voting mechanisms. Börgers also provides an examination of the frontiers of current research in the area with an original and unified perspective that will appeal to advanced students of economics.

Dynamic General Equilibrium Modeling

Computational Methods and Applications *Springer Science & Business Media*

Modern business cycle theory and growth theory uses stochastic dynamic general equilibrium models. In order to solve these models, economists need to use many mathematical tools. This book presents various methods in order to compute the dynamics of general equilibrium models. In part I, the representative-agent stochastic growth model is solved with the help of value function iteration, linear and linear quadratic approximation methods, parameterised expectations and projection methods. In order to apply these methods, fundamentals from numerical analysis are reviewed in detail. In particular, the book discusses issues that are often neglected in existing work on computational methods, e.g. how to find a good initial

value. In part II, the authors discuss methods in order to solve heterogeneous-agent economies. In such economies, the distribution of the individual state variables is endogenous. This part of the book also serves as an introduction to the modern theory of distribution economics. Applications include the dynamics of the income distribution over the business cycle or the overlapping-generations model. In an accompanying home page to this book, computer codes to all applications can be downloaded.

Business Cycle Dynamics

Models and Tools *Springer Science & Business Media*

Business cycle theory has been one of

the fastest growing fields in modern nonlinear economic dynamics. This book presents new mathematical methods for global analysis which have not previously been available in this easily accessible form. In addition it contains a presentation of full analyses of several models left open in the 1950s when the tools then available did not permit more systematic analysis.

Student Solutions Manual to Accompany Economic Dynamics in Discrete Time *MIT Press*

This manual includes solutions to the odd-numbered exercises in Economic Dynamics in Discrete Time. Some exercises are purely analytical, while others require numerical methods. Computer codes are provided for most

problems. Many exercises ask the reader to apply the methods learned in a chapter to solve related problems, but some exercises ask the reader to complete missing steps in the proof of a theorem or in the solution of an example in the book.

Handbook on Optimal Growth 1

Discrete Time *Springer Science & Business Media*

The problem of efficient or optimal allocation of resources is a fundamental concern of economic analysis. This book provides surveys of significant results of the theory of optimal growth, as well as the techniques of dynamic optimization theory on which they are based. Armed with the results and methods of this

theory, a researcher will be in an advantageous position to apply these versatile methods of analysis to new issues in the area of dynamic economics.

Real Analysis with Economic Applications *Princeton University Press*

There are many mathematics textbooks on real analysis, but they focus on topics not readily helpful for studying economic theory or they are inaccessible to most graduate students of economics. *Real Analysis with Economic Applications* aims to fill this gap by providing an ideal textbook and reference on real analysis tailored specifically to the concerns of such students. The emphasis throughout is on topics directly relevant to economic theory. In addition to addressing the usual topics of real analysis, this book

discusses the elements of order theory, convex analysis, optimization, correspondences, linear and nonlinear functional analysis, fixed-point theory, dynamic programming, and calculus of variations. Efe Ok complements the mathematical development with applications that provide concise introductions to various topics from economic theory, including individual decision theory and games, welfare economics, information theory, general equilibrium and finance, and intertemporal economics. Moreover, apart from direct applications to economic theory, his book includes numerous fixed point theorems and applications to functional equations and optimization theory. The book is rigorous, but accessible to those who are

relatively new to the ways of real analysis. The formal exposition is accompanied by discussions that describe the basic ideas in relatively heuristic terms, and by more than 1,000 exercises of varying difficulty. This book will be an indispensable resource in courses on mathematics for economists and as a reference for graduate students working on economic theory.

Mathematical Methods and Models for Economists *Cambridge University Press*

A textbook for a first-year PhD course in mathematics for economists and a reference for graduate students in economics.

Essential Microeconomics *Cambridge*

University Press

"PRICES AND OPTIMIZATION 1.1 SUPPORTING PRICES 1.2 SHADOW PRICES 1.3 THE ENVELOPE THEOREM 1.4 FOUNDATIONS OF CONSTRAINED OPTIMIZATION 1.5 APPLICATION: MONOPOLY PRICING WITH JOINT COSTS 1.1 SUPPORTING PRICES Key ideas: convex and non-convex production sets, price based incentives, Supporting Hyperplane Theorem Pursuit of self-interest is central to economics. Thus a deep understanding of the theory of maximization is essential to effective theorizing. In particular, the theory of constrained maximization is so crucial that we explore it in this first chapter. In contrast to a purely mathematical exposition, the emphasis here is on prices"--

A First Course in Optimization Theory *Cambridge University Press*

This book, first published in 1996, introduces students to optimization theory and its use in economics and allied disciplines. The first of its three parts examines the existence of solutions to optimization problems in R^n , and how these solutions may be identified. The second part explores how solutions to optimization problems change with changes in the underlying parameters, and the last part provides an extensive description of the fundamental principles of finite- and infinite-horizon dynamic programming. Each chapter contains a number of detailed examples explaining both the theory and its applications for first-year master's and graduate students.

'Cookbook' procedures are accompanied by a discussion of when such methods are guaranteed to be successful, and, equally importantly, when they could fail. Each result in the main body of the text is also accompanied by a complete proof. A preliminary chapter and three appendices are designed to keep the book mathematically self-contained.

The Theory of Industrial Organization *MIT Press*

The Theory of Industrial Organization is the first primary text to treat the new industrial organization at the advanced-undergraduate and graduate level. Rigorously analytical and filled with exercises coded to indicate level of difficulty, it provides a unified and modern treatment of the field with

accessible models that are simplified to highlight robust economic ideas while working at an intuitive level. To aid students at different levels, each chapter is divided into a main text and supplementary section containing more advanced material. Each chapter opens with elementary models and builds on this base to incorporate current research in a coherent synthesis. Tirole begins with a background discussion of the theory of the firm. In Part I he develops the modern theory of monopoly, addressing single product and multi product pricing, static and intertemporal price discrimination, quality choice, reputation, and vertical restraints. In Part II, Tirole takes up strategic interaction between firms, starting with a novel treatment of the Bertrand-

Cournot interdependent pricing problem. He studies how capacity constraints, repeated interaction, product positioning, advertising, and asymmetric information affect competition or tacit collusion. He then develops topics having to do with long term competition, including barriers to entry, contestability, exit, and research and development. He concludes with a "game theory user's manual" and a section of review exercises. Important Notice: The digital edition of this book is missing some of the images found in the physical edition.

Microeconomic Foundations I

Choice and Competitive Markets
Princeton University Press

Provides a rigorous treatment of some of the basic tools of economic modeling and reasoning, along with an assessment of the strengths and weaknesses of these tools.

Dynamic Optimization, Second Edition

The Calculus of Variations and Optimal Control in Economics and Management *Courier Corporation*

Since its initial publication, this text has defined courses in dynamic optimization taught to economics and management science students. The two-part treatment covers the calculus of variations and optimal control. 1998 edition.

The ABCs of RBCs

An Introduction to Dynamic Macroeconomic Models *Harvard University Press*

The ABCs of RBCs is the first book to provide a basic introduction to Real Business Cycle (RBC) and New-Keynesian models. These models argue that random shocks—new inventions, droughts, and wars, in the case of pure RBC models, and monetary and fiscal policy and international investor risk aversion, in more open interpretations—can trigger booms and recessions and can account for much of observed output volatility. George McCandless works through a sequence of these Real Business Cycle and New-Keynesian dynamic stochastic general

equilibrium models in fine detail, showing how to solve them, and how to add important extensions to the basic model, such as money, price and wage rigidities, financial markets, and an open economy. The impulse response functions of each new model show how the added feature changes the dynamics. The ABCs of RBCs is designed to teach the economic practitioner or student how to build simple RBC models. Matlab code for solving many of the models is provided, and careful readers should be able to construct, solve, and use their own models. In the tradition of the “freshwater” economic schools of Chicago and Minnesota, McCandless enhances the methods and sophistication of current macroeconomic modeling.

Income and Nutritional Effects of the Commercialization of Agriculture in Southwestern Kenya

Intl Food Policy Res Inst

Evaluation of the effects of a shift from maize to sugarcane on agricultural production, income, expenditures, consumption, and health and nutritional status

Reshaping Agriculture for Nutrition and Health *Intl Food Policy Res Inst*

The fundamental purpose of agriculture is not just to produce food and raw materials, but also to grow healthy, well-nourished people. One of the sector’s most important tasks then is to provide food of sufficient quantity and quality to feed and nourish the world’s population sustainably so that all people can lead

healthy, productive lives. Achieving this goal will require closer collaboration across the sectors of agriculture, nutrition, and health, which have long operated in separate spheres with little recognition of how their actions affect each other. It is time for agriculture, nutrition, and health to join forces in pursuit of the common goal of improving human well-being. In *Reshaping Agriculture for Nutrition and Health*, leading experts, practitioners, and policymakers explore the links among agriculture, nutrition, and health and identify ways to strengthen related policies and programs. The chapters in this book were originally commissioned as background papers or policy briefs for the conference “Leveraging Agriculture for Improving Nutrition and Health,”

facilitated by the International Food Policy Research Institute’s 2020 Vision Initiative in New Delhi, India, in February 2011.

An Introduction to Economic Dynamics *Cambridge University Press*

This is an examples-driven treatment of introductory economic dynamics for students with a basic familiarity of spreadsheets. Shone approaches the subject with the belief that true understanding of a subject can only be achieved by students themselves setting out a problem and manipulating it experimentally. Although all economics students now have access to spreadsheets, they are often used for little more than graphing economic data. This book encourages students to go

several stages further and set up and investigate simple dynamic models. A web-site for students and instructors is included that contains an additional 100 questions for students and 100 for instructors.

Are Malawian Diets Changing? An assessment of nutrient consumption and dietary patterns using household-level evidence from 2010/11 and 2016/17 *Intl Food Policy Res Inst*

This paper provides an updated analysis of the dietary patterns of Malawian households and their consumption of select nutrients - calories, protein, iron, vitamin A, zinc, and folate - using data from the third (2010/11) and fourth (2016/17) rounds of the Malawi

Integrated Household Survey (IHS). Changes in food and nutrient consumption patterns between the two survey periods are examined across household wealth categories and across regions. Dietary diversity and patterns of food and nutrient consumption are found to differ significantly between rural and urban areas. Whereas urban households largely saw slightly increased or stable nutrient consumption between 2010/11 and 2016/17, most households in rural areas saw declines over this period. We also document small shifts in the relative amounts of foods consumed over this six-year period in both rural and urban households, with increased consumption of fish and pulses, legumes, and nuts, and decreases in meat, fruit, dairy, and root and tuber consumption. The

contribution of animal-source foods as a share of total protein consumption remains low at between 10 and 20 percent, depending on the region, with the overall share of protein from animal-source foods falling slightly between the two surveys. With regards to adequacy of household diets for meeting nutrient requirements, in the absence of nutrient supplementation, many individuals will be subject to iron, vitamin A, and folate inadequacies. Of particular concern, the poorest households have very low nutrient consumption per person and have diets that rely on only a few foods from a small number of food groups. For all six nutrients, nationally just over half of the total amount of nutrient consumed came from food that was purchased. While we would expect this

for urban households, even for rural households more than half of all calories and protein consumed came from foods that were purchased. For micronutrients consumed by rural households, between 40 and 50 percent came from purchased foods. While in the past, own production of food may have provided most Malawian households with most of the nutrients they consumed, this is no longer the case. For most Malawian households, including in rural communities, their food security and dietary nutritional needs now are equally tied to the market as to their own farming, if not more so. Drawing lessons from the analysis here for improving the food consumption data collected in the IHS surveys, more detailed and further disaggregated data would be beneficial,

particularly to help estimate nutrients derived from fortified and processed foods. Additional information on how food is shared within households would also allow for a better understanding of nutrient inadequacies at the individual level. Collecting more information on the content of the meals that household members eat away from home would also be helpful in removing some uncertainty in the nutrient consumption estimates made from the data. Finally, additional information on food gifts received could clarify aspects of household coping strategies, the performance of formal social safety nets, and food choice.

Game Theory *MIT Press*

This advanced text introduces the

principles of noncooperative game theory in a direct and uncomplicated style that will acquaint students with the broad spectrum of the field while highlighting and explaining what they need to know at any given point. This advanced text introduces the principles of noncooperative game theory—including strategic form games, Nash equilibria, subgame perfection, repeated games, and games of incomplete information—in a direct and uncomplicated style that will acquaint students with the broad spectrum of the field while highlighting and explaining what they need to know at any given point. The analytic material is accompanied by many applications, examples, and exercises. The theory of noncooperative games studies the

behavior of agents in any situation where each agent's optimal choice may depend on a forecast of the opponents' choices. "Noncooperative" refers to choices that are based on the participant's perceived selfinterest. Although game theory has been applied to many fields, Fudenberg and Tirole focus on the kinds of game theory that have been most useful in the study of economic problems. They also include some applications to political science. The fourteen chapters are grouped in parts that cover static games of complete information, dynamic games of complete information, static games of incomplete information, dynamic games of incomplete information, and advanced topics.

Estimating the economic costs of COVID-19 in Nigeria *Intl Food Policy Res Inst*

In this paper we analyze the economic impacts of the COVID-19 pandemic and the policies adopted to curtail the spread of the disease in Nigeria. We carry out simulations using a multiplier model based on the 2018 Social Accounting Matrix (SAM) for Nigeria, which includes supply-use tables for 284 goods and services. The pandemic's global reach and impact on the global economy combined with the response policies in Nigeria represent a large, sudden shock to the country's economy. The SAM multiplier model is well-suited for measuring the short-term direct and indirect results of this type of shock because the SAM represents both the

structure of the economy and the interactions among economic actors via commodity and factor markets. Our analysis focuses on the five-week lockdown implemented by the federal government across the Federal Capital Territory of Abuja and Lagos and Ogun states from late March to early May 2020, the federal lockdown for Kano from mid-April, and the state-level lockdowns that were implemented from mid-April for around seven weeks in Akwa Ibom, Borno, Ekiti, Kwara, Osun, Rivers, and Taraba states. We estimate that during the lockdown periods Nigeria's GDP suffered a 34.1 percent loss due to COVID-19, amounting to USD 16 billion, with two-thirds of the losses coming from the services sector. The agriculture sector, which serves as the

primary means of livelihood for most Nigerians, suffered a 13.1 percent loss in output (USD 1.2 billion). Although primary agricultural activities were excluded from the direct restrictions on economic activities imposed in the lockdown zones, the broader agri-food system was affected indirectly because of its linkages with the rest of the economy. We estimate that households lost on average 33 percent of their incomes during the period, with the heaviest losses occurring for rural non-farm and for urban households. The economic impacts of COVID-19 include a 14-percentage point temporary increase in the poverty headcount rate for Nigeria, implying that 27 million additional people fell below the poverty line during lockdown. Lastly, we consider

economic recovery scenarios as the COVID-19 policies are being relaxed during the latter part of 2020. Our findings have implications for understanding the direct and indirect impacts of COVID-19, for policy design during the recovery period, and for planning future disease prevention measures while protecting livelihoods and maintaining economic growth.

Asset Pricing

Revised Edition *Princeton University Press*

Winner of the prestigious Paul A. Samuelson Award for scholarly writing on lifelong financial security, John Cochrane's *Asset Pricing* now appears in a revised edition that unifies and brings

the science of asset pricing up to date for advanced students and professionals. Cochrane traces the pricing of all assets back to a single idea--price equals expected discounted payoff--that captures the macro-economic risks underlying each security's value. By using a single, stochastic discount factor rather than a separate set of tricks for each asset class, Cochrane builds a unified account of modern asset pricing. He presents applications to stocks, bonds, and options. Each model--consumption based, CAPM, multifactor, term structure, and option pricing--is derived as a different specification of the discounted factor. The discount factor framework also leads to a state-space geometry for mean-variance frontiers and asset pricing models. It puts payoffs

in different states of nature on the axes rather than mean and variance of return, leading to a new and conveniently linear geometrical representation of asset pricing ideas. Cochrane approaches empirical work with the Generalized Method of Moments, which studies sample average prices and discounted payoffs to determine whether price does equal expected discounted payoff. He translates between the discount factor, GMM, and state-space language and the beta, mean-variance, and regression language common in empirical work and earlier theory. The book also includes a review of recent empirical work on return predictability, value and other puzzles in the cross section, and equity premium puzzles and their resolution.

Written to be a summary for academics and professionals as well as a textbook, this book condenses and advances recent scholarship in financial economics.

Advanced Econometrics *Harvard University Press*

The main features of this text are a thorough treatment of cross-section models--including qualitative response models, censored and truncated regression models, and Markov and duration models--and a rigorous presentation of large sample theory, classical least-squares and generalized least-squares theory, and nonlinear simultaneous equation models.