

---

# **Mathematics for Economics**

third edition

**Michael Hoy**  
**John Livernois**  
**Chris McKenna**  
**Ray Rees**  
**Thanasis Stengos**

The MIT Press  
Cambridge, Massachusetts  
London, England

© 2011 Massachusetts Institute of Technology

All rights reserved. No part of this book may be reproduced in any form by any electronic or mechanical means (including photocopying, recording, or information storage and retrieval) without permission in writing from the publisher.

This book was set in Helvetica and Times Roman by Westchester Book Group.  
Printed and bound in the United States of America.

Library of Congress Cataloging-in-Publication Data

Mathematics for economics / Michael Hoy . . . [et al.]. — 3rd ed.

p. cm.

Includes index.

ISBN 978-0-262-01507-3 (hbk. : alk. paper) — ISBN 978-0-262-51622-8

(pbk. : alk. paper) 1. Economics, Mathematical. I. Hoy, Michael, 1953 Sept. 22–

HB135 . M3698 2011

511'.8—dc22

2010022679

10 9 8 7 6 5 4 3 2

# Preface

---

A major challenge in writing a book on mathematics for economists is to select the appropriate mathematical topics and present them with the necessary clarity. Another challenge is to motivate students of economics to study these topics by convincingly demonstrating their power to deal with economic problems. All this must be done without sacrificing anything in terms of the rigor and correctness of the mathematics itself.

A problem lies in the difference between the logic of the development of the mathematics and the way in which economics progresses from models of individual consumer and firm, through market models and general equilibrium, to macroeconomic models. The primary building blocks, the models of consumer and firm behavior, are based on methods of constrained optimization that, mathematically speaking, are already relatively advanced. In this book we have chosen instead to follow the logic of the mathematics. After a review of fundamentals, concerned primarily with sets, numbers, and functions, we pay careful attention to the development of the ideas of limits and continuity, moving then to the calculus of functions of one variable, linear algebra, multivariate calculus, and finally, dynamics. In the treatment of the mathematics our goal has always been to give the student an understanding of the mathematical concepts themselves, since we believe this understanding is required if he or she is to develop the ability and confidence to tackle problems in economic analysis. We have very consciously sought to avoid a “cookbook” approach.

We have tried to develop the student’s problem-solving skills and motivation by working through a large number of examples and economic applications, far more than is usual in this type of book. Although the selection of these, and the order in which they are presented, was determined by the logic of the development of the mathematics rather than that of an economics course, in the end the student will have covered virtually all of the standard undergraduate mathematical economics syllabus.

Many people helped us in the preparation of this book and it is a pleasure to acknowledge our debt to them here. The following individuals read early versions of the manuscript and offered helpful suggestions, a large number of which were freely used:

|                     |  |
|---------------------|--|
| Richard Anderson    | Texas A&M University                   |
| Paul Anglin         | University of Guelph                   |
| Walter Bossert      | University of Waterloo                 |
| Zhiqi Chen          | Carleton University                    |
| Peter Coughlin      | University of Maryland at College Park |
| Swapan DasGupta     | Dalhousie University                   |
| Eric Davis          | Carleton University                    |
| Allan DeSerpa       | Arizona State University               |
| Richard Fowles      | University of Utah                     |
| Ian Irvine          | Concordia University                   |
| Roger Latham        | York University                        |
| Chenghu Ma          | McGill University                      |
| Catherine Schneider | Boston College                         |
| Paul Segerstrom     | Michigan State University              |
| James A. Stephenson | Iowa State University                  |
| Ruqu Wang           | Queen's University                     |
| Steven Williams     | University of Illinois                 |

Drafts of the book, at various stages, have been used in classes at the University of Guelph. We thank the many students involved for their cooperation in finding their way around incomplete manuscripts, and we thank Louise Grenier for helping them do just that. For assistance in preparing answers to the exercises and for helpful comments on the text, we would like to thank Mattias Polborn, Mathias Kifmann, Markus Wagner, Erich Kolger, Tina Färber, Ursula Bachmann, and Andreas Wildermuth.

A number of individuals who used the first edition suggested many useful changes and we thank them for that. We especially thank Nancy Bower and Asha Sadanand for their numerous contributions.