ABSTRACT

MASH: A COMPUTER SYSTEM FOR MICROANALYTIC SIMULATION FOR POLICY EXPLORATION

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The dissertation describes the design and construction of a computer-based system for the construction and execution of microanalytic models. The specific models for which MASH is optimized are models of the household sector which are embedded in a larger macroeconomic framework. The dissertation includes an analysis of the problems in constructing initial microanalytic simulation states, and describes the creation of two such initial population states from Census machine readable microdata sources.

The subject of both microanalytic model and computer system specification are addressed at several different levels. For the microanalytic model builder, the dissertation includes a discussion of the creation of initial populations, specification of both microanalytic and macroeconomic models, and the substantive characteristics of solutions obtained. For the computer specialist; discussions of the computing environment in which the system was implemented, the strategy underlying the system design and implementation process, and the syntax and semantics of the command language, including its implementation, are included.

This work was performed primarily under Guy Orcutt at the Urban Institute during the period 1970-1977. A companion document, *Policy Exploration Through Microanalytic Simulation,* has been published by the Urban Institute and describes the use of this work in embodying current microanalytic knowledge of the household sector and in exploring a variety of public policy options with respect to it.

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PREFACE

This dissertation describes the design, implementation, and use of a large computer-based applications system for supporting microanalytic simulation processes. The work reported upon here was done in conjunction with and under the direction of Professor Guy H. Orcutt at the Urban Institute in Washington, and was done in parallel with the microanalytic model construction described in [05] that generated the demand for this work.

Chapter 1 is introductory and describes briefly the motivation for creating the microanalytic model, contains a description of the system designed for solving such models, and discusses the use of an interactive computing environment for implementing the system. Chapter 2 is oriented to the user of this system. It describes the user-oriented features of the system, including many of the commands that are available to support simulation and related activities. Chapter 3 describes how microanalytic models are implemented within the system and suggests an approach to the management of structural information describing such models. Chapter 4 contains a technical exposition of the implementation strategy, program and data structures, and execution modalities of the system. Finally, chapter 5 presents a summary and assessment of experience with the system to date, and suggests possible strategies for future development. The appendices contain technical information describing the creation of two initial micropopulations for simulation, the exact syntax of the MASH command structure, the machine readable codebook content and structure, and the structure of subagendas for microsimulation.

My interest in the study of economics beyond the undergraduate level was stimulated in 1961 by the discovery of the volume, *Microanalysis of Socioeconomic Systems: A Simulation Study*. There was an exciting fascination derived from the application of the power of computing machinery to microanalytic models. It is both fitting and professionally satisfying that the original fascination has not diminished and has led to this effort under Professor Orcutt.

The design and construction of this simulation system would have been impossible without substantial contributions -- both intellectual and material -- from many individuals. Early work with Charles Berry on analyzing demand for medical services was an important event in learning about the potential of simulation modelling applied to economic analysis, in no small part due to Berry's capacity to innovate and transmit the excitement of his work. My first direct application of computer-based microsimulation to economic analysis, performed for the U.S. Treasury Department to analyze what became

the Revenue Act of 1964, further excited my appreciation for the power of this methodology. My intellectual horizons were substantially further broadened by a provocative course on gaming and simulation taught by Martin Shubik.

Throughout the period during which this work was performed, Guy Orcutt, Harold Guthrie, and Richard Wertheimer provided direction, encouragement, and leadership that was of substantial assistance. The many helpful discussions that I have had with Richard Ruggles, Ben Okner, and Joseph Pechman convinced me of the substantial usefulness of microeconomic modelling. Many of the system design concepts that have been included in the system have resulted from continuing dialogue with Jon Peck and Stephen Kidd. Jon Peck, Allen Shapiro, and John Pendray contributed substantially to the evolution of the machine readable codebook concept and its use. Discussions with Roger Bakeman regarding data structure and design goals were very helpful. As initial users of the system, John Bossons, Roberta Carey and Sheila Rafferty offered valuable suggestions.

Material aid in the form of programming came from several individuals. Beverley Sharp designed and programmed the attribute library manager auxiliary system. Roger Bakeman evolved the algorithms for efficient byte storage allocation of microdata, as well as contributing the nucleus of the text formatting system that has greatly eased the burden of documenting the system. David Jefferson revised the dictionary routines substantially, which allowed the dictionary to grow in size several orders of magnitude beyond my expectations. Sheila Rafferty and Roberta Carey provided the programming assistance that implemented the initial set of operating characteristics. Christine de Fontenay provided excellent programming support to members of the research staff in formulating those characteristics. Reginald Monroe designed and programmed the writeable overlay control program. Helpful discussions were held with and advice obtained from Svein Nordbotten, Robert Pugh, James Schulz and Robert Teitel.

My dissertation committee, consisting of Professors Orcutt, Ruggles, and Shubik, were instrumental in guiding my development of this topic. Each of them has contributed in his own important way to my appreciation of the role of dynamic simulation in microeconomic modelling, and to my ability to contribute to such work as represented by the content of this dissertation.

I owe a major debt to Kenneth Jacobs, who has assumed responsibility for the continual growth and evolution of MASH. His suggestions and advice have been perceptive and both his intellectual and his operational contributions to the system have been substantial. He has been a most helpful and stimulating colleague with whom to work.

The above persons have contributed much to the developments reported in this volume. The responsibility for proper and effective use of their assistance, as well as any remaining errors or problems, remains mine.

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