

Preface

In recent years there has been no shortage of applications of mathematics to economics, mainly through the use of methods from statistics, probability and risk analysis. It is much harder to find significant applications of abstract algebra to the area. However, the rise of the information sciences has clearly displayed the opportunities for applying what used to be considered the purest of pure mathematics. It is now commonplace for students of computer science to take the time to acquire a basic knowledge of algebra. It is not hard to see why algebra should be enjoying popularity: in the analysis of complex systems of all kinds the power and precision of algebraic concepts, and sometimes just algebraic notation, can be an enormous aid. On the other hand, one can search the literature in accounting theory and find few attempts to make use of algebra, and what there is tends to be at quite a modest level.

The object of the present work is to make the case for applying algebra to the study of accounting systems by finding algebraic concepts which are able to reflect accurately the workings of real life systems. The benefits of such a study are diverse: the demand of algebra for precision compels us to question and make exact everyday ideas and processes in order to express them in abstract form. It also serves to provide tools to analyze accounting systems.

The concepts which appear most frequently in the present study are: column vectors with zero sum, the so called *balance vectors*, which reflect the perfect balance of an accounting system; *directed graphs* to show the flow of value through the system; *automata* to model the computational aspects of accounting. These in turn lead to further algebraic concepts such as monoids, subaccounting systems and quotient systems. All of these notions provide valuable ways of looking at and understanding the operation of accounting systems.

In a further departure from previous attempts to inject algebraic ideas into accounting, we emphasize the role of rigorous proofs – this is, after all, the only way to achieve any kind of certainty. In addition, where it seems of mathematical interest, we have not hesitated to follow up on mathematical questions that are suggested by accounting concepts, sometimes in the form of combinatorial problems.

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The current work had its origin in the Ph.D. dissertation of the third author at the University of Illinois at Urbana-Champaign in 1988 and in a subsequent article in collaboration with the fourth author. In addition, the introduction of automata into the study of accounting owes much to an article by the first two authors. This book is a greatly expanded version of these works. The first chapter contains an extended account of previous approaches to accounting theory by diverse authors, the object being to provide a setting and historical background for the current enterprise.

While every effort has been made to keep the book self contained, inevitably it is necessary to assume that the reader has a certain level of mathematical sophistication, roughly what one would expect of a student who has taken at least a first course on discrete mathematics. However, abstract structures such as monoid and automaton are fully explained: a reader who would like to have more background in abstract algebra should consult one of the innumerable texts on the subject, for example [7] or [8].

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