

ABSTRACT ALGEBRA WITH GAP

Julianne G. Rainbolt and Joseph A. Gallian

PREFACE

There is a growing interest in the use of discovery based instruction in undergraduate mathematics courses. Although abstract algebra is primarily a course that emphasizes theory and proofs, students can benefit from the many computational aspects of the core concepts of groups and rings. In this volume and accompanying web site we provide exercises that are to be done using the software GAP. These exercises are designed to provide students with a convenient way to generate data with the intent of increasing understanding and enabling them to make and test conjectures. Most of the exercises do not require programming on the part of the students. We have included some exercises where students are asked to write their own programs modeled after ones that are given in the manual.

This manual grew out of lab exercises created by one of the authors, Julianne Rainbolt, to supplement the textbook “Contemporary Abstract Algebra” by Joseph A. Gallian. The chapters of this manual correspond to the seventh edition of this text. However, this manual has been revised in such a way that it does not have to be used with this text. It can instead be used to supplement most introductory courses in abstract algebra. There are four exceptions to this. Chapters 28, 30 and 31 assume the students are familiar with the notation and content of the corresponding chapters in Gallian’s book. Also Exercises 6 - 9 in Chapter 0 of the manual use material from Chapter 0 of Gallian’s book. These four exercises and three chapters of the manual can be skipped if Gallian’s book is not the textbook being used. For the situation where Gallian’s text is being used we have included references to this text. These references are provided within square brackets at the end of certain exercises, theorems and examples. We believe that “Abstract Algebra with GAP” offers students a convenient way to explore the basic concepts of groups and rings. No experience with GAP is assumed.

The authors would like to thank those who have provided us with ideas and suggestions for this manual. In particular, major parts of Chapters -1, 2, 3 and 5 come from Loren Larson at Saint Olaf College (retired) and Russell Blyth at Saint Louis University. The content of Chapter 25, is based on course material written by Christine Stevens at Saint Louis University. We would particularly like to thank Alexander Hulpke for his technical knowledge and helpful responses on questions we had about GAP. He also provided many suggestions which we have incorporated into this manual. In addition, comments made by Russell Blyth, Peter Brooksbank, Allen Hibbard, David Jackson, and Charles Wright have led to many improvements in this manual.