Preface

The goal of this book is to provide a reasonably self-contained introduction to combinatorics. For this reason, this book assumes no knowledge of combinatorics. It does however assume that the reader has been introduced to elementary proof techniques and mathematical reasoning. These modest prerequisites are typically developed at the late sophomore or early junior level. Students wishing to improve their skills in such areas are referred to *Mathematical Proofs: A Transition to Advanced Mathematics* by Chartrand et al. [14].

This text is aimed at the junior or senior undergraduate level. There is a strong emphasis on computation, problem solving, and proof technique. In particular, there is a particular emphasis on combinatorial proofs for reasons discussed in Sect. 1.6. In addition, this book is written as a "problem based" approach to combinatorics. In each section, specific problems are introduced. Students are then guided in finding the solution to not only the original problem, but a number of variations. Hence, there are a number of examples throughout each section. Often these examples require the student to not only apply the new material, but to implement information developed in previous sections. For this reason, students are generally expected to have a working mastery of the key concepts developed in previous sections before proceeding. In particular, the basic Principle of Inclusion and Exclusion and the Multiplication Principle are used repeatedly.

Intuitive descriptions of abstract concepts (such as generating functions) are provided. In addition, supplementary reading on several topics are suggested throughout the text. Hence, this text lends itself not only to a traditional combinatorics course, but also to honors classes or undergraduate research.

There are a number of exercises provided at the end of each section. These exercises range from simple computations (in other words, evaluate a formula for a given set of values) to more advanced proofs. Most of the exercises are modeled after examples in the book allowing the student to refer through the text for insight. However, other exercises require deeper problem solving skills. In particular, many of the exercises make use of the key ideas of the Principle of Inclusion and Exclusion and the Multiplication Principle. This helps to reinforce these skills.

The first seven chapters form the core of a typical one semester course in combinatorics. Of these chapters, Sects. 2.6, 2.7, 3.2, and 3.7 are not required for the

remainder of the first seven chapters. Instructors wishing to provide a more theoretical introduction may wish to include Chap. 8 on Pólya theory. In which case, Sect. 2.7 should be covered before introducing this material. Instructors wishing to provide a more applied introduction may wish to sprinkle material on probability from Chap. 9 throughout their course. Instructors may also wish to use the material on combinatorial designs (Chap. 10) to provide more applications. Instructors wishing to provide an introduction to graph theory (for instance, in a course on discrete mathematics) may wish to incorporate material from Chap. 11 as well.

The author welcomes any constructive suggestions on the improvement of future versions of this text.

East Tennessee State University, 2015. Robert A. Beeler, Ph.D.,

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