
Preface

Enumerative combinatorics has seen an explosive growth over the last 50 years. The purpose of this text is to give a gentle introduction to this exciting area of research. So, rather than trying to cover many different topics, I have chosen to give a more leisurely treatment of some of the highlights of the field. My goal has been to write the exposition so it could be read by a student at the advanced undergraduate or beginning graduate level, either as part of a course or for independent study. The reader will find it similar in tone to my book on the symmetric group. I have tried to keep the prerequisites to a minimum, assuming only basic courses in linear and abstract algebra as background. Certain recurring themes are emphasized, for example, the existence of sum and product rules first for sets, then for ordinary generating functions, and finally in the case of exponential generating functions. I have also included some recent material from the research literature which, to my knowledge, has not appeared in book form previously, such as the theory of quotient posets and the connection between pattern avoidance and quasisymmetric functions.

Most of the exercises should be doable with a reasonable amount of effort. A few unsolved conjectures have been included among the problems in the hope that an interested student might wish to tackle one of them. They are, of course, marked as such.

A few words about the title are in order. It is in part meant to be a tip of the hat to Donald Knuth's influential series of books *The art of computer programming*, Volumes 1–3 [51–53], which, among many other things, helped give birth to the study of pattern avoidance through its connection with stack sorting; see Exercise 36 in Chapter 1. I hope that the title also conveys some of the beauty found in this area of mathematics, for example, the elegance of the Hook Formula (equation (7.10)) for the number of standard Young tableaux. In addition I should mention that, due to my own preferences, this book concentrates on the enumerative side of combinatorics and mostly ignores the important extremal and existential parts of the field. The reader interested in these areas can consult the books of Flajolet and Sedgewick [25] and of van Lint [95].

This book grew out of the lecture notes which I have compiled over years of teaching the graduate combinatorics course at Michigan State University. I would like to thank the students in these classes for all the feedback they have given me about the various topics and their presentation. I am also indebted to the following colleagues, some of whom taught from a preliminary version of this book, who provided me with suggestions as well as catching numerous typographical errors: Matthias Beck, Moussa Benoumhani, Andreas Blass, Seth Chaiken, Sylvie Corteel, Georges Grekos, Richard Hensch, Nadia Lafrenière, Duncan Levear, and Tom Zaslavsky. Darij Grinberg deserves special mention for providing copious comments and corrections as well as providing a number of interesting exercises. I also received valuable feedback from four anonymous referees. Finally, I wish to express my appreciation of Ina Mette, my editor at the American Mathematical Society. Without her gentle support and persistence, this text would never have seen the light of day. Because I typeset this document myself, all errors can be blamed on my computer.

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