

Preface

One might wonder why it is necessary to study inequalities. Many applied science and engineering problems can be pursued without their explicit mention. Nevertheless, a facility with inequalities is required to understand much of mathematics at intermediate and higher levels. Inequalities serve a natural purpose of comparison. They can provide indirect routes of reasoning or problem solving when more direct routes seem inconvenient or unavailable. Unfortunately, they are much neglected in the typical Western engineering curricula.

This small guide to inequalities was originally written with engineers and applied scientists in mind. Comments from mathematicians who saw the first edition lead us to hope that some mathematicians will find the applications interesting, and that students of mathematics will also find the book useful. A Japanese translation of the first edition, rendered by Satoshi Kaizu of Ibaraki University, was published by Morikita Shuppan in 2004.

The book is intended to help fill the gap between “college algebra” treatments of inequalities and the treatises that exist in the mathematics literature. Unlike classic books on inequalities, it considers topics such as continuity and max–min problems in some detail; although these are traditional topics in calculus, we wish to emphasize that they are based on the solution of inequalities. Important techniques are reinforced through problems at the end of each chapter, and hints are included to expedite the reader’s progress. We review a few topics from calculus, but make no attempt at a thorough review. In order to simplify the discussion, we use hypotheses stronger than necessary in some of the statements or proofs of theorems and in some of the problems. For a review of calculus, we recommend the fine classic by Landau [45]. Among the many good books on analysis, we can recommend Stromberg [86].

Two new chapters were added for the second edition. Chapter 6 presents certain inequalities that play important roles in the study of differential equations and the boundary value problems of mechanics. Chapter 7 offers an introduction to interval analysis, a branch of mathematics that provides (among other things) a powerful way of automating work with inequalities. In addition, Chap. 1 has been restructured and new examples and problems appear throughout the book.

We offer our deepest gratitude to Ramon E. Moore, founder of interval analysis, for contributing the Foreword, providing feedback on Chaps. 1 and 7, furnishing the example on automatic differentiation in Chap. 5, and letting us reproduce an example from [32]. We would like to thank Vivian Hutson, Edward Rothwell, Val Drachman, and Natasha Lebedeva for their kind encouragement, and Beth Lannon-Cloud for her critique of the figures. We owe a substantial debt to our Springer editors Eve Mayer, Marc Strauss, Kaitlin Leach, and Ina Lindemann. We want to thank Glen Anderson, Mavina Vamanamurthy, and Matti Vuorinen for their generous help, in particular for pointing out the importance of l'Hôpital's monotone rule and for suggesting several related problems. Dennis Nyquist offered some beneficial comments on the electrical examples in Chap. 1. Finally, we wish to thank Carl Ganser for many valuable discussions and suggestions and for generously agreeing to read the first edition manuscript.

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