Contents

Preface to the Second Edition *page* ix
Preface xi
Introduction 1

1 Sentential Logic 8
1.1 Deductive Reasoning and Logical Connectives 8
1.2 Truth Tables 14
1.3 Variables and Sets 26
1.4 Operations on Sets 34
1.5 The Conditional and Biconditional Connectives 43

2 Quantificational Logic 55
2.1 Quantifiers 55
2.2 Equivalences Involving Quantifiers 64
2.3 More Operations on Sets 73

3 Proofs 84
3.1 Proof Strategies 84
3.2 Proofs Involving Negations and Conditionals 95
3.3 Proofs Involving Quantifiers 108
3.4 Proofs Involving Conjunctions and Biconditionals 124
3.5 Proofs Involving Disjunctions 136
3.6 Existence and Uniqueness Proofs 146
3.7 More Examples of Proofs 155

4 Relations 163
4.1 Ordered Pairs and Cartesian Products 163
4.2 Relations 171
4.3 More About Relations 180

4.4 Ordering Relations 189
4.5 Closures 202
4.6 Equivalence Relations 213

5 Functions 226
5.1 Functions 226
5.2 One-to-one and Onto 236
5.3 Inverses of Functions 245
5.4 Images and Inverse Images: A Research Project 255

6 Mathematical Induction 260
6.1 Proof by Mathematical Induction 260
6.2 More Examples 267
6.3 Recursion 279
6.4 Strong Induction 288
6.5 Closures Again 300

7 Infinite Sets 306
7.1 Equinumerous Sets 306
7.2 Countable and Uncountable Sets 315
7.3 The Cantor–Schröder–Bernstein Theorem 322

Appendix 1: Solutions to Selected Exercises 329
Appendix 2: Proof Designer 373
Suggestions for Further Reading 375
Summary of Proof Techniques 376
Index 381