Contents

Acknowledgements **xiii**

0 Introduction **1**
0.1 To the instructor . . . 2
0.2 To the student . . . 2
0.3 How to construct those proofs . . . 4
0.4 Using LaTeX to write mathematics . . . 8
0.5 Notation . . . 11
0.6 The journey begins . . . 12

1 Symbolic logic **15**
1.1 Statements . . . 16
1.2 Compound statements and logical connectives . . . 18
1.3 Proof via truth table . . . 22
1.4 Implications . . . 23
1.5 Quantifiers . . . 27
1.6 Compound quantifiers . . . 31

2 Proof methods **35**
2.1 Variable names . . . 40
2.2 Parity and divisibility . . . 41
2.3 Negations . . . 46
2.4 Proof methods . . . 48

3 Mathematical induction **49**
3.1 Geometric tilings . . . 49
3.2 Induction versus deduction . . . 53
3.3 Strong Induction . . . 61

4 Set theory **63**
4.1 Notation and definitions 64
4.2 Venn diagrams 70
4.3 General proofs with sets 72
4.4 Set operations 74
4.5 Deeper thinking 77
4.6 Set products 78
4.7 Power sets 80
4.8 Index sets and set operations 81
4.9 Spaciousness 86

5 Functions and relations **87**
5.1 Relations 87
5.2 Partitions 94
5.3 Order relations 98
5.4 Functions 99
5.5 Throwing some math around 102

6 Counting **109**
6.1 A (very) brief history of infinity 109
6.2 Finite sets 110
6.3 The Pigeonhole Principle 112
6.4 A foundation for infinity 114
6.5 Can we go beyond infinity? 118

7 Axiomatics **123**
7.1 LSAT axiomatics 124
7.2 Charles Dodgson's axiomatic looking-glass 128
7.3 Shiny hidden people 128

A Mathematical writing **131**

B Comments on Style **133**

C The Structure of a LaTeX Document **135**
C.1 A sample LaTeX document 136
C.2 The Preamble 136
C.3 The Text 138
C.4 Formatting text 139
C.5 Typesetting mathematics 140

C.6 LaTeX codes for common mathematical symbols 141
C.7 Tables 145
C.8 Arrays with reasons 146
C.9 Making lists (Checking them twice is a good idea.) 148
C.10 An example of a homework assignment in LaTeX 149
C.11 TeX Source Code for the example 149

Index **155**

About the Authors **161**