

Contents

Preface

PART I Management Science

CHAPTER 1 Street Networks

Euler Circuits
Finding Euler Circuits
Circuits with Reused Edges
Circuits with More Complications

CHAPTER 2 Visiting Vertices

Strategies for Solving the Traveling
Salesman Problem
Minimum-Cost Spanning Trees
Critical-Path Analysis

CHAPTER 3 Planning and Scheduling

Scheduling Tasks
Independent Tasks
Critical-Path Schedules

ix	Bin Packing	58
	Cryptography	62
1	CHAPTER 4 Linear Programming	69
5	Mixture Problems	69
5	Graphing the Feasible Region	73
8	The Corner Principle	74
11	The Simplex Method	78
17	An Alternative to the Simplex Method	80
24	PART II Statistics: The Science of Data	87
28	CHAPTER 5 Collecting Data	89
30	Sampling	91
36	Random Sampling	92
	Sampling Variability	95
49	Experimentation	99
49	Statistical Evidence	103
53	Latin Squares	104
57	Statistics in Practice	106

CHAPTER 6 Describing Data	113	CHAPTER 11 Game Theory: The Mathematics of Competition	213
Describing a Single Variable	115	A Location Game	214
Displaying Relations Between Two Variables	121	A Duel Game	216
Graphics in Many Dimensions	126	Inspection Games	219
CHAPTER 7 Probability: The Mathematics of Chance	137	The Prisoners' Dilemma	220
What is Probability?	138	The Game of Chicken	222
Mathematical Description of Probability	139	CHAPTER 12 Fair Division and Apportionment	230
Sampling Distributions	142	The Continuous Case: Two Players	231
Normal Distributions	144	The Continuous Case: Multiple Players	232
The Central Limit Theorem	146	The Discrete Case	233
CHAPTER 8 Statistical Inference	155	Apportionment	233
Sampling Distributions and Confidence Intervals	156	Undesirable Outcomes	239
Statistical Process Control	159	Class Scheduling	240
The Perils of Data Analysis	163	Salary Increments	243
PART III Social Choice	171	PART IV On Size and Shape	251
CHAPTER 9 Social Choice: The Impossible Dream	174	CHAPTER 13 Patterns	253
Plurality Vote	177	Symmetry	253
Sequential Voting	179	Patterns and Tilings	259
Condorcet Winners	180	Regular Tilings	260
Bogus Amendments	182	What Other Regular Tilings Are There?	260
Everyone Wins	183	Nonperiodic Tilings	262
Approval Voting	185	The Penrose Tiles	263
CHAPTER 10 Weighted Voting Systems: How to Measure Power	191	Shechtman's Crystals and Barlow's Law	264
How Weighted Voting Works	194	CHAPTER 14 Growth and Form	270
Mathematical Notation for Weighted Voting	196	Geometric Similarity	270
The Banzhaf Power Index	197	Scaling Real Objects	272
A Pictorial View of Weighted Voting	199	How High Can a Mountain Be?	274
Computing the Power Index	201	The Tension Between Volume and Area	274
Applying the Banzhaf Index	206	Fatal Falls, Dives, Jumps, and Flights	276
		Keeping Cool (and Warm)	277
		Similarity and Growth	279
		Logarithmic Plots and Allometry	281

CHAPTER 15 The Size of Populations	285	Comparison of Algorithms	358
Geometric Growth and Financial Models	286	Complex Algorithms	363
Growth Models for Biological Populations	290	Some Unsolved Problems	363
Harvesting Renewable Resources	293	Concluding Comments	364
CHAPTER 16 Measurement	304	CHAPTER 19 Codes	367
Estimating Inaccessible Distances	306	Binary Codes	368
Digging Straight Tunnels	310	Computer Addition	372
Measuring the Earth	311	Errors and Error Correction	373
Measuring Astronomical Distances	312	Data Protection	375
CHAPTER 17 Measuring the Universe with Telescopes	320	CHAPTER 20 Computer Data Storage	379
From Greece to Galileo	320	Integers	379
Improving the Telescope	322	Representation of Positive Integers within Computers	380
Conic Sections	325	Representation of Negative Integers	382
Johannes Kepler	326	Word Size	385
Newton's Great Unification	330	Text Data	385
New Geometries to Measure a New Universe	331	Pointer Data	388
Hyperbolic Geometry	332	Data Organization	389
Elliptic Geometry	334	Concluding Comments	391
The Theory of Relativity	336	CHAPTER 21 Computer Graphics	395
PART V Computers	349	How Pictures Appear at a Display Device	396
CHAPTER 18 Computer Algorithms	351	Simple Geometric Objects	398
Algorithms	353	Transformations	403
Insertion Sort Algorithm	356	Windowing	406
Merge Sort Algorithm	356	Fractals	409
		Concluding Comments	411
		References	415
		Answers to Selected Exercises	421
		Index	443