Contents



Preface	vii	
To the Instructor		xvii
To the Stu	dent	xxiii

Chapter 1	Vect	ors 1	
Production Service & Competit MPS Limited Text Designer: Leorard Manny Covier Designer: Chris Miller Covier S Interior design trage Text PdF Kill BRNO Lokace & 1201A2	1.0 1.1 1.2 1.3	Introduction: The Racetrack Game 1 The Geometry and Algebra of Vectors 3 Length and Angle: The Dot Product 18 Exploration: Vectors and Geometry 32 Lines and Planes 34 Exploration: The Cross Product 48 Writing Project: The Origins of the Dot Product and Cross Product Applications 50 Force Vectors 50 Chapter Review 55	49
Chapter 2	Syste	ems of Linear Equations 57	
	2.0 2.1 2.2	Introduction: Triviality 57 Introduction to Systems of Linear Equations 58 Direct Methods for Solving Linear Systems 64 Writing Project: A History of Gaussian Elimination 82 Explorations: Lies My Computer Told Me 83 Partial Pivoting 84 Counting Operations: An Introduction to the Analysis of Algorithms 85	
	2.3 2.4	Spanning Sets and Linear Independence 88 Applications 99 Allocation of Resources 99 Balancing Chemical Equations 101 Network Analysis 102 Electrical Networks 104 Linear Economic Models 107 Finite Linear Games 109 Vignette: The Global Positioning System 121	
	2.5	Iterative Methods for Solving Linear Systems 124 Chapter Review 134	

Chapter 3	Matrices 136 approximation and approximation of the matrices and approxima
42	3.0 Introduction: Matrices in Action 136 3.1 Matrix Operations 138
	3.2 Matrix Algebra 154
	3.3 The Inverse of a Matrix 163
	3.4 The <i>LU</i> Factorization 180
	3.5 Subspaces, Basis, Dimension, and Rank 191
	3.6 Introduction to Linear Transformations 211
	Vignette: Robotics 226
	3.7 Applications 230
	Markov Chains 230
	Linear Economic Models 235
	Population Growth 239
	Graphs and Digraphs 241
	Chapter Review 251
<u> </u>	
Chapter 4	Eigenvalues and Eigenvectors 253
	4.0 Introduction: A Dynamical System on Graphs 253
	4.1 Introduction to Eigenvalues and Eigenvectors 254
	4.2 Determinants 263
	Writing Project: Which Came First: The Matrix or the Determinant? 283
	Vignette: Lewis Carroll's Condensation Method 284
	Exploration: Geometric Applications of Determinants 286
	Eigenvalues and Eigenvectors of $n \times n$ Matrices 292
	Writing Project: The History of Eigenvalues 301
	4.4 Similarity and Diagonalization 301
	4.5 Iterative Methods for Computing Eigenvalues 311
	4.6 Applications and the Perron-Frobenius Theorem 325
	Markov Chains 325
	Population Growth 330
	The Perron-Frobenius Theorem 332
	Linear Recurrence Relations 335
	Systems of Linear Differential Equations 340
	Discrete Linear Dynamical Systems 348 Vignette: Ranking Sports Teams and Searching the Internet 356
	Chapter Review 364
A	Chapter Review 304
Chapter 5	Orthogonality 366
et hods of Proof. Al	5.0 Introduction: Shadows on a Wall 366
321 10012 10 10014	5.1 Orthogonality in \mathbb{R}^n 368
	5.2 Orthogonal Complements and Orthogonal Projections 378
	5.3 The Gram-Schmidt Process and the <i>QR</i> Factorization 388
	Explorations: The Modified QR Factorization 396
	Approximating Eigenvalues with the QR Algorithm 398
	5.4 Orthogonal Diagonalization of Symmetric Matrices 400
	5.5 Applications 408
	Quadratic Forms 408
	Graphing Quadratic Equations 415
	Chapter Review 425

Chapter 6	Vector Spaces 427
	6.0 Introduction: Fibonacci in (Vector) Space 427 6.1 Vector Spaces and Subspaces 429 Writing Project: The Rise of Vector Spaces 443
	6.2 Linear Independence, Basis, and Dimension 443
	Exploration: Magic Squares 460 6.3 Change of Basis 463
	6.4 Linear Transformations 472
	6.5 The Kernel and Range of a Linear Transformation 481
	6.6 The Matrix of a Linear Transformation 497
	Exploration: Tilings, Lattices, and the Crystallographic Restriction 515 6.7 Applications 518
	6.7 Applications 518 Homogeneous Linear Differential Equations 518
	Chapter Review 527
	162 welvoll religion [] 1.0 Introduction: The Racetrack Game 1.4
Chapter 7	Distance and Approximation 529
	7.0 Introduction: Taxicab Geometry 529
	7.1 Inner Product Spaces 531
	Explorations: Vectors and Matrices with Complex Entries 543 Geometric Inequalities and Optimization Problems 547
	7.2 Norms and Distance Functions 552
	7.3 Least Squares Approximation 568
	7.4 The Singular Value Decomposition 590
	Vignette: Digital Image Compression 607
	7.5 Applications 610
	Approximation of Functions 610 Chapter Review 618
	2.0 OCE Introduction of the continue of the co
Chapter 8	Codes Online only 620
	8.1 Code Vectors 620
	Vignette: The Codabar System 626
	8.2 Error-Correcting Codes 627
	8.3 Dual Codes 632
	8.4 Linear Codes 639 The Minimum Distance of a Code 644
	8.5 The Minimum Distance of a Code 644
	APPENDIX A Mathematical Notation and Methods of Proof A1
	APPENDIX B Mathematical Induction B1
	APPENDIX C Complex Numbers C1
	APPENDIX D Polynomials D1
	APPENDIX E Technology Bytes Online only
	Answers to Selected Odd-Numbered Exercises ANS1
	Index I1
	Quadratic Forting 1 408