



Table of Contents

■ Chapter 1 MATRICES AND GAUSSIAN ELIMINATION 1

1.1	Introduction	1
1.2	The Geometry of Linear Equations	3
1.3	An Example of Gaussian Elimination	11
1.4	Matrix Notation and Matrix Multiplication	19
1.5	Triangular Factors and Row Exchanges	32
1.6	Inverses and Transposes	45
1.7	Special Matrices and Applications	58
Review Exercises: Chapter 1		65

■ Chapter 2 VECTOR SPACES 69

2.1	Vector Spaces and Subspaces	69
2.2	Solving $Ax = 0$ and $Ax = b$	77
2.3	Linear Independence, Basis, and Dimension	92
2.4	The Four Fundamental Subspaces	102
2.5	Graphs and Networks	114
2.6	Linear Transformations	125
Review Exercises: Chapter 2		137

■ Chapter 3 ORTHOGONALITY 141

3.1	Orthogonal Vectors and Subspaces	141
3.2	Cosines and Projections onto Lines	152
3.3	Projections and Least Squares	160
3.4	Orthogonal Bases and Gram–Schmidt	174
3.5	The Fast Fourier Transform	188
Review Exercises: Chapter 3		198

■ Chapter 4 DETERMINANTS 201

4.1	Introduction	201
4.2	Properties of the Determinant	203
4.3	Formulas for the Determinant	210
4.4	Applications of Determinants	220
Review Exercises: Chapter 4		230

 Chapter 5	EIGENVALUES AND EIGENVECTORS	233
5.1	Introduction	233
5.2	Diagonalization of a Matrix	245
5.3	Difference Equations and Powers A^k	254
5.4	Differential Equations and e^{At}	266
5.5	Complex Matrices	280
5.6	Similarity Transformations	293
	Review Exercises: Chapter 5	307
<hr/>		
 Chapter 6	POSITIVE DEFINITE MATRICES	311
6.1	Minima, Maxima, and Saddle Points	311
6.2	Tests for Positive Definiteness	318
6.3	Singular Value Decomposition	331
6.4	Minimum Principles	339
6.5	The Finite Element Method	346
<hr/>		
 Chapter 7	COMPUTATIONS WITH MATRICES	351
7.1	Introduction	351
7.2	Matrix Norm and Condition Number	352
7.3	Computation of Eigenvalues	359
7.4	Iterative Methods for $Ax = b$	367
<hr/>		
 Chapter 8	LINEAR PROGRAMMING AND GAME THEORY	377
8.1	Linear Inequalities	377
8.2	The Simplex Method	382
8.3	The Dual Problem	392
8.4	Network Models	401
8.5	Game Theory	408
<hr/>		
 Appendix A	INTERSECTION, SUM, AND PRODUCT OF SPACES	415
 Appendix B	THE JORDAN FORM	422
	<i>Solutions to Selected Exercises</i>	428
	<i>Matrix Factorizations</i>	474
	<i>Glossary</i>	476
	<i>MATLAB Teaching Codes</i>	481
	<i>Index</i>	482
	<i>Linear Algebra in a Nutshell</i>	488