

# Contents

<b>Preface</b>	<b>ix</b>
<b>Glossary of Notation</b>	<b>xi</b>
<b>1 Vectors and Matrices</b>	<b>1</b>
1.1 Vectors	2
1.2 Matrices	17
1.3 Matrix Multiplication	25
1.4 Introduction to Linear Transformations	35
1.5 Chapter Review	58
<b>2 Linear Systems</b>	<b>60</b>
2.1 Systems of Linear Equations	62
2.2 Elementary Matrices and the Geometry of Linear Systems	77
2.3 Matrix Inverse	87
2.4 Applications of Linear Systems and Matrix Factorizations	98
2.5 Chapter Review	114
<b>3 Determinants</b>	<b>116</b>
3.1 Cofactor Expansions	116
3.2 Applications of Determinants	130
3.3 Chapter Review	140
<b>4 Vector Spaces</b>	<b>142</b>
4.1 Vector Spaces	142
4.2 Subspaces	151
4.3 Linear Independence	163
4.4 Basis and Dimension	176
4.5 Coordinates	191

4.6	Rank and Nullity	206
4.7	Chapter Review	216
<b>5</b>	<b>Linear Transformations</b>	<b>218</b>
5.1	Linear Transformations in General Vector Spaces	218
5.2	Kernel and Range	225
5.3	Matrices of Linear Transformations	237
5.4	Chapter Review	252
<b>6</b>	<b>Orthogonality and Projections</b>	<b>254</b>
6.1	Orthogonality	254
6.2	Orthogonal Projections and Orthogonal Complements	261
6.3	Gram-Schmidt Process and Least Squares Approximation	276
6.4	Introduction to Singular Value Decomposition	284
6.5	Chapter Review	294
<b>7</b>	<b>Eigenvalues and Singular Values</b>	<b>296</b>
7.1	Eigenvalues and Eigenvectors	296
7.2	Diagonalization	311
7.3	Applications of Eigenvalues and Eigenvectors	325
7.4	Singular Value Decomposition	340
7.5	Chapter Review	360
<b>A</b>	<b>Answers to Selected Odd-Numbered Exercises</b>	<b>362</b>
<b>B</b>	<b>Recurring References to Selected Transformations in <math>R^2</math></b>	<b>377</b>
<b>C</b>	<b>Twelve Equivalent Statements</b>	<b>379</b>
	<b>Index</b>	<b>381</b>