

Contents

<i>Preface</i>	xiii
<i>Acknowledgments</i>	xix
UNIT 1 Descriptive Statistics	1
CHAPTER 1 Basic Descriptive Statistics	3
1.1 Types of Biological Data	3
1.2 Summary of Descriptive Statistics of Data Sets	4
1.3 Matlab Skills	9
1.4 Exercises	11
CHAPTER 2 Visual Display of Data	14
2.1 Introduction	14
2.2 Frequency Distributions	15
2.3 Bar Charts and Histograms	16
2.4 Scatter Plots	23
2.5 Matlab Skills	24
2.6 Exercises	27
CHAPTER 3 Bivariate Data and Linear Regression	30
3.1 Introduction to Linear Regression	30
3.2 Bivariate Data	31
3.3 Linear Analysis of Data	32
3.4 Correlation	37
3.5 Matlab Skills	41
3.6 Exercises	43
CHAPTER 4 Exponential and Logarithmic Functions	46
4.1 Exponential and Logarithmic Functions in Biology	46
4.2 Review of Exponential and Logarithm Properties	47

4.3 Allometry	54
4.4 Rescaling Data: Log-Log and Semilog Graphs	55
4.5 Matlab Skills	62
4.6 Exercises	67
UNIT 1 Student Projects	71
UNIT 2 Discrete Time Modeling	79
CHAPTER 5 Sequences and Discrete Difference Equations	84
5.1 Sequences	85
5.2 Limit of a Sequence	87
5.3 Discrete Difference Equations	90
5.4 Geometric and Arithmetic Sequences	92
5.5 Linear Difference Equation with Constant Coefficients	93
5.6 Introduction to Pharmacokinetics	97
5.7 Matlab Skills	100
5.8 Exercises	102
CHAPTER 6 Vectors and Matrices	107
6.1 Vector Structure: Order Matters!	108
6.2 Vector Algebra	110
6.3 Dynamics: Vectors Changing over Time	112
6.4 Matlab Skills	120
6.5 Exercises	120
CHAPTER 7 Matrix Algebra	123
7.1 Matrix Arithmetic	123
7.2 Applications	129
7.3 Matlab Skills	133
7.4 Exercises	138
CHAPTER 8 Long-Term Dynamics or Equilibrium	141
8.1 Notion of an Equilibrium	142
8.2 Eigenvectors	142
8.3 Stability	147
8.4 Matlab Skills	149
8.5 Exercises	149
CHAPTER 9 Leslie Matrix Models and Eigenvalues	152
9.1 Leslie Matrix Models	153
9.2 Long-Term Growth Rate (Eigenvalues)	156
9.3 Long-Term Population Structure (Corresponding Eigenvectors)	163
9.4 Matlab Skills	165
9.5 Exercises	168
UNIT 2 Student Projects	171
UNIT 3 Probability	175
CHAPTER 10 Probability of Events	177
10.1 Sample Spaces and Events	178
10.2 Probability of an Event	181

10.3	Combinations and Permutations	186
10.4	Binomial Experiments	188
10.5	Matlab Skills	189
10.6	Exercises	198
CHAPTER 11	Probability of Compound Events	201
11.1	Compound Events	201
11.2	Finding the Probability of a Compound Event	204
11.3	Probability Viewed as Darts Tossed at a Dart Board	209
11.4	Matlab Skills	210
11.5	Exercises	213
CHAPTER 12	Conditional Probability	216
12.1	Conditional Probability	217
12.2	Independence	220
12.3	Matlab Skills	225
12.4	Exercises	230
CHAPTER 13	Sequential Events	233
13.1	Partition Theorem	233
13.2	Bayes' Theorem	238
13.3	Exercises	242
CHAPTER 14	Population Genetics Models	246
14.1	Hardy-Weinberg Equilibrium	247
14.2	Hardy-Weinberg Selection Model	250
14.3	Exercises	253
UNIT 3	Student Projects	255
UNIT 4	Limits and Continuity	259
CHAPTER 15	Limits of Functions	261
15.1	Limit of a Function	262
15.2	Limit Properties	266
15.3	Matlab Skills	274
15.4	Exercises	277
CHAPTER 16	Limits of Continuous Functions	282
16.1	Right and Left Limits	283
16.2	Continuity	284
16.3	Intermediate Value Theorem	290
16.4	Matlab Skills	292
16.5	Exercises	295
UNIT 4	Student Projects	299
UNIT 5	Derivatives	303
CHAPTER 17	Rates of Change	305
17.1	Average Rate of Change	306
17.2	Estimating Rates of Change for Data	308
17.3	Velocity	309

17.4	Photosynthesis	311
17.5	Other Examples of Rates of Change	315
17.6	Definition of a Derivative at a Point	316
17.7	Matlab Skills	316
17.8	Exercises	320
CHAPTER 18	Derivatives of Functions	324
18.1	Concept of a Derivative	324
18.2	Limit Definition of a Derivative of a Function	326
18.3	Derivatives of Exponential Functions	330
18.4	Derivatives of Trigonometric Functions	334
18.5	Derivatives and Continuity	336
18.6	Derivatives of Logarithmic Functions	341
18.7	Matlab Skills	345
18.8	Exercises	349
CHAPTER 19	Computing Derivatives	352
19.1	Derivatives of Frequently Used Functions	353
19.2	The Chain Rule for the Composition of Functions	354
19.3	Quotient and Reciprocal Rules	359
19.4	Exponential Models	362
19.5	Higher Derivatives	369
19.6	Exercises	372
CHAPTER 20	Using Derivatives to Find Maxima and Minima	376
20.1	Maxima and Minima	377
20.2	First Derivative Test	377
20.3	Mean Value Theorem	382
20.4	Concavity	385
20.5	Optimization Problems	394
20.6	Matlab Skills	402
20.7	Exercises	404
UNIT 5	Student Projects	410
UNIT 6	Integration	413
CHAPTER 21	Estimating the Area under a Curve	414
21.1	The Area under a Curve	415
21.2	Increasing the Accuracy of the Area Estimation	426
21.3	Area below the Horizontal Axis	430
21.4	Matlab Skills	433
21.5	Exercises	436
CHAPTER 22	Antiderivatives and the Fundamental Theorem of Calculus	440
22.1	Definition of an Integral	441
22.2	Antiderivatives	442
22.3	Fundamental Theorem of Calculus	444
22.4	Antiderivatives and Integrals	446

22.5	Average Values	450
22.6	Matlab Skills	453
22.7	Exercises	456
CHAPTER 23	Methods of Integration	459
23.1	Substitution Method	459
23.2	Integration by Parts	465
23.3	Exercises	469
CHAPTER 24	Applications of Integrals to Area and Volume	471
24.1	The Area between Two Curves	472
24.2	The Volume of a Solid of Revolution	477
24.3	Density Functions	482
24.4	Exercises	485
CHAPTER 25	Probability in a Continuous Context	489
25.1	Expected Value and Median Value	493
25.2	Normal Distribution	495
25.3	Waiting Times	498
25.4	Matlab Skills	500
25.5	Exercises	507
UNIT 6	Student Projects	510
UNIT 7	Introduction to Differential Equations	513
CHAPTER 26	Separation of Variables	515
26.1	Separation of Variables Method	518
26.2	Matlab Skills	522
26.3	Exercises	527
CHAPTER 27	Equilibria and Limited Population Growth	529
27.1	Models of Limited Population Growth	531
27.2	Equilibria and Stability	535
27.3	Homeostasis	539
27.4	Exercises	541
CHAPTER 28	Implicit Differentiation and Related Rates	543
28.1	Explicitly and Implicitly Defined Functions	544
28.2	Implicit Differentiation	544
28.3	Related Rates	549
28.4	Exercises	551
UNIT 7	Student Projects	555
<i>Bibliography</i>		557
<i>Appendix A</i>		561
<i>Appendix B</i>		571
<i>Answers to Selected Problems</i>		579
<i>Index</i>		597