

# Contents

<b>Preface</b>	<b>ix</b>
<b>What's New in the Second Edition</b>	<b>xi</b>
<b>Acknowledgments</b>	<b>xiii</b>
<b>CHAPTER 1</b>	
<b>Some Basic Math</b>	<b>1</b>
Logarithms	1
Log Returns	2
Compounding	3
Limited Liability	4
Graphing Log Returns	5
Continuously Compounded Returns	6
Combinatorics	8
Discount Factors	9
Geometric Series	9
Problems	14
<b>CHAPTER 2</b>	
<b>Probabilities</b>	<b>15</b>
Discrete Random Variables	15
Continuous Random Variables	15
Mutually Exclusive Events	21
Independent Events	22
Probability Matrices	22
Conditional Probability	24
Problems	26
<b>CHAPTER 3</b>	
<b>Basic Statistics</b>	<b>29</b>
Averages	29
Expectations	34
Variance and Standard Deviation	39
Standardized Variables	41
Covariance	42

Correlation	43
Application: Portfolio Variance and Hedging	44
Moments	47
Skewness	48
Kurtosis	51
Coskewness and Cokurtosis	53
Best Linear Unbiased Estimator (BLUE)	57
Problems	58
<b>CHAPTER 4</b>	
<b>Distributions</b>	<b>61</b>
Parametric Distributions	61
Uniform Distribution	61
Bernoulli Distribution	63
Binomial Distribution	65
Poisson Distribution	68
Normal Distribution	69
Lognormal Distribution	72
Central Limit Theorem	73
Application: Monte Carlo Simulations	
Part I: Creating Normal Random Variables	76
Chi-Squared Distribution	77
Student's $t$ Distribution	78
$F$ -Distribution	79
Triangular Distribution	81
Beta Distribution	82
Mixture Distributions	83
Problems	86
<b>CHAPTER 5</b>	
<b>Multivariate Distributions and Copulas</b>	<b>89</b>
Multivariate Distributions	89
Copulas	97
Problems	111
<b>CHAPTER 6</b>	
<b>Bayesian Analysis</b>	<b>113</b>
Overview	113
Bayes' Theorem	113
Bayes versus Frequentists	119
Many-State Problems	120
Continuous Distributions	124
Bayesian Networks	128
Bayesian Networks versus Correlation Matrices	130
Problems	132

<b>CHAPTER 7</b>	
<b>Hypothesis Testing and Confidence Intervals</b>	<b>135</b>
Sample Mean Revisited	135
Sample Variance Revisited	137
Confidence Intervals	137
Hypothesis Testing	139
Chebyshev's Inequality	142
Application: VaR	142
Problems	152
<b>CHAPTER 8</b>	
<b>Matrix Algebra</b>	<b>155</b>
Matrix Notation	155
Matrix Operations	156
Application: Transition Matrices	163
Application: Monte Carlo Simulations	
Part II: Cholesky Decomposition	165
Problems	168
<b>CHAPTER 9</b>	
<b>Vector Spaces</b>	<b>169</b>
Vectors Revisited	169
Orthogonality	172
Rotation	177
Principal Component Analysis	181
Application: The Dynamic Term Structure of Interest Rates	185
Application: The Structure of Global Equity Markets	191
Problems	193
<b>CHAPTER 10</b>	
<b>Linear Regression Analysis</b>	<b>195</b>
Linear Regression (One Regressor)	195
Linear Regression (Multivariate)	203
Application: Factor Analysis	208
Application: Stress Testing	211
Problems	212
<b>CHAPTER 11</b>	
<b>Time Series Models</b>	<b>215</b>
Random Walks	215
Drift-Diffusion Model	216
Autoregression	217
Variance and Autocorrelation	222
Stationarity	223
Moving Average	227

Continuous Models	228
Application: GARCH	230
Application: Jump-Diffusion Model	232
Application: Interest Rate Models	232
Problems	234
<b>CHAPTER 12</b>	
<b>Decay Factors</b>	<b>237</b>
Mean	237
Variance	243
Weighted Least Squares	244
Other Possibilities	245
Application: Hybrid VaR	245
Problems	247
<b>Appendix A</b>	
<b>Binary Numbers</b>	<b>249</b>
<b>Appendix B</b>	
<b>Taylor Expansions</b>	<b>251</b>
<b>Appendix C</b>	
<b>Vector Spaces</b>	<b>253</b>
<b>Appendix D</b>	
<b>Greek Alphabet</b>	<b>255</b>
<b>Appendix E</b>	
<b>Common Abbreviations</b>	<b>257</b>
<b>Appendix F</b>	
<b>Copulas</b>	<b>259</b>
<b>Answers</b>	<b>263</b>
<b>References</b>	<b>303</b>
<b>About the Author</b>	<b>305</b>
<b>About the Companion Website</b>	<b>307</b>
<b>Index</b>	<b>309</b>