

MODERN PORTFOLIO THEORY AND INVESTMENT ANALYSIS

NINTH EDITION

EDWIN J. ELTON

**Leonard N. Stern School of Business
New York University**

MARTIN J. GRUBER

**Leonard N. Stern School of Business
New York University**

STEPHEN J. BROWN

**Leonard N. Stern School of Business
New York University**

WILLIAM N. GOETZMANN

School of Management Yale University

WILEY

Contents

Part 1 INTRODUCTION 1

Chapter 1

INTRODUCTION 2

Outline of the Book 2

The Economic Theory of Choice: An
Illustration under Certainty 4

Conclusion 8

Multiple Assets and Risk 8

Questions and Problems 9

Bibliography 10

Chapter 2

FINANCIAL SECURITIES 11

Types of Marketable Financial Securities 11

The Return Characteristics of Alternative
Security Types 19

Stock Market Indexes 21

Bond Market Indexes 22

Conclusion 23

Chapter 3

FINANCIAL MARKETS 24

Trading Mechanics 24

Margin 27

Markets 30

Trade Types and Costs 36

Conclusion 38

Part 2 PORTFOLIO ANALYSIS 39

Section 1 MEAN VARIANCE PORTFOLIO THEORY 41

Chapter 4

THE CHARACTERISTICS OF THE
OPPORTUNITY SET UNDER RISK 42

Determining the Average Outcome 43

A Measure of Dispersion 44

Variance of Combinations of Assets 47

Characteristics of Portfolios in General 50

Two Concluding Examples 59

Conclusion 62

Questions and Problems 62

Bibliography 64

Examples and Applications 85

Three Examples 89

Conclusion 92

Questions and Problems 92

Bibliography 93

Chapter 6

TECHNIQUES FOR CALCULATING
THE EFFICIENT FRONTIER 95

Short Sales Allowed with Riskless
Lending and Borrowing 96

Short Sales Allowed: No Riskless
Lending and Borrowing 100

Riskless Lending and Borrowing
with Short Sales Not Allowed 100

No Short Selling and No Riskless
Lending and Borrowing 101

The Incorporation of Additional
Constraints 102

An Example 103

Conclusion 106

Chapter 5

DELINEATING EFFICIENT PORTFOLIOS 65

Combinations of Two Risky Assets
Revisited: Short Sales Not Allowed 65

The Shape of the Portfolio Possibilities
Curve 74

The Efficient Frontier with Riskless
Lending and Borrowing 81

| | |
|---|-----|
| Appendix A: An Alternative Definition of Short Sales | 106 |
| Appendix B: Determining the Derivative | 107 |
| Appendix C: Solving Systems of Simultaneous Equations | 111 |

Section 2 SIMPUFYING THE PORTFOLIO SELECTION PROCESS 125

Chapter 7

| | |
|--|-----|
| THE CORRELATION STRUCTURE OF SECURITY RETURNS—THE SINGLE-INDEX MODEL | 126 |
| The Inputs to Portfolio Analysis | 127 |
| Single-Index Models: An Overview | 128 |
| Characteristics of the Single-Index Model | 133 |
| Estimating Beta | 135 |
| The Market Model | 148 |
| <i>An Example</i> | 149 |
| Questions and Problems | 150 |
| Bibliography | 152 |

Chapter 8

| | |
|--|-----|
| THE CORRELATION STRUCTURE OF SECURITY RETURNS—MULTI-INDEX MODELS AND GROUPING TECHNIQUES | 155 |
| Multi-index Models | 156 |
| Average Correlation Models | 162 |
| Mixed Models | 163 |
| Fundamental Multi-index Models | 163 |
| Conclusion | 169 |
| Appendix A: Procedure for Reducing Any Multi-index Model to a Multi-index Model with <i>Orthogonal Indexes</i> | 169 |

Section 3 SELECTING THE OPTIMUM PORTFOUO 205

Chapter 10

| | |
|--|-----|
| ESTIMATING EXPECTED RETURNS | 206 |
| Aggregate Asset Allocation | 206 |
| Forecasting <i>Individual Security Returns</i> | 212 |
| Portfolio Analysis with Discrete Data | 214 |
| Appendix: The Ross Recovery Theorem—A New Approach to Using Market Data to Calculate Expected Return | 215 |
| Bibliography | 218 |

Chapter 11

| | |
|---|-----|
| HOW TO SELECT AMONG THE PORTFOLIOS IN THE OPPORTUNITY SET | 220 |
|---|-----|

| | |
|--|-----|
| Appendix D: A General Solution | 114 |
| Appendix E: Quadratic Programming and Kuhn-Tucker Conditions | 118 |
| Questions and Problems | 121 |
| Bibliography | 122 |

| | |
|--|-----|
| Appendix B: Mean Return, Variance, and Covariance of a Multi-index Model | 170 |
| Questions and Problems | 172 |
| Bibliography | 173 |

Chapter 9

| | |
|---|-----|
| SIMPLE TECHNIQUES FOR DETERMINING THE EFFICIENT FRONTIER | 176 |
| The Single-index Model | 177 |
| Security Selection with a Purchasable Index | 188 |
| The Constant Correlation Model | 189 |
| Other Return Structures | 192 |
| <i>An Example</i> | 192 |
| Conclusion | 193 |
| Appendix A: Single-index Model—Short Sales Allowed | 194 |
| Appendix B: Constant Correlation Coefficient—Short Sales Allowed | 196 |
| Appendix C: Single-index Model—Short Sales Not Allowed | 197 |
| Appendix D: Constant Correlation Coefficient—Short Sales Not Allowed | 199 |
| Appendix E: Single-index Model, Short Sales Allowed, and a Market Asset | 201 |
| Questions and Problems | 201 |
| Bibliography | 202 |

| | |
|---|-----|
| Choosing Directly | 220 |
| An Introduction to Preference Functions | 221 |
| Risk Tolerance Functions | 224 |
| Safety First | 226 |
| Maximizing the Geometric Mean Return | 232 |
| <i>Value at Risk (VaR)</i> | 234 |
| Utility and the Equity Risk Premium | 235 |
| Optimal Investment Strategies with Investor Liabilities | 237 |
| Liabilities and Safety-First Portfolio Selection | 241 |
| <i>Simulations in Portfolio Choice</i> | 241 |

Conclusion **247**
 Appendix: The Economic Properties
 of Utility Functions **247**

Relative Risk Aversion and Wealth **249**
 Questions and Problems **249**
 Bibliography **250**

Section 4 WIDENING THE SELECTION UNIVERSE **255**

Chapter 12
 INTERNATIONAL DIVERSIFICATION **256**
 Historical Background **257**
 Calculating the Return on Foreign
 Investments **257**
 The Risk of Foreign Securities **261**
 Market Integration **267**
 Returns from International
 Diversification **268**
 The Effect of Exchange Risk **269**

Return Expectations and Portfolio
 Performance **270**
 Emerging Markets **272**
 Other Evidence on Internationally
 Diversified Portfolios **276**
 Sovereign Funds **278**
 Models for Managing
 International Portfolios **280**
 Conclusion **283**
 Questions and Problems **284**
 Bibliography **285**

Part 3 MODELS OF EQUILIBRIUM IN THE CAPITAL MARKETS **289**

Chapter 13
 THE STANDARD CAPITAL ASSET
 PRICING MODEL **290**
 The Assumptions Underlying the
 Standard Capital Asset Pricing Model
 (CAPM) **290**
 The CAPM **291**
 Prices and the CAPM **300**
 Conclusion **302**
 Appendix: Appropriateness of the
 Single-Period Asset Pricing
 Model **304**
 Questions and Problems **308**
 Bibliography **309**

Chapter 14
 NONSTANDARD FORMS OF CAPITAL
 ASSET PRICING MODELS **311**
 Short Sales Disallowed **312**
 Modifications of Riskless Lending
 and Borrowing **312**
 Personal Taxes **322**
 Nonmarketable Assets **324**
 Heterogeneous Expectations **326**
 Non-Price-Taking Behavior **327**
 Multiperiod CAPM **327**
 The Multi-beta CAPM **328**
 Consumption CAPM **328**
 Conclusion **330**
 Appendix: Derivation of the General
 Equilibrium with Taxes **331**
 Questions and Problems **333**
 Bibliography **334**

Chapter 15
 EMPIRICAL TESTS OF EQUILIBRIUM
 MODELS **340**
 The Models—Ex Ante Expectations
 and Ex Post Tests **340**
 Empirical Tests of the CAPM **341**
 Testing Some Alternative Forms of
 the CAPM Model **352**
 Testing the Posttax Form of the
 CAPM Model **353**
 Some Reservations about Traditional Tests
 of General Equilibrium Relationships
 and Some New Research **356**
 Conclusion **358**
 Questions and Problems **359**
 Bibliography **360**

Chapter 16
 THE ARBITRAGE PRICING MODEL
 APT—A MULTIFACTOR APPROACH
 TO EXPLAINING ASSET PRICES **364**
 APT—What Is It? **364**
 Estimating and Testing APT **369**
 APT and CAPM **381**
 Recapitulation **382**
 Term Structure Factor **392**
 Credit Risk Factor **392**
 Foreign Exchange (FX) Carry **393**
 Value Factor **393**
 Size Factor **393**
 Momentum Factor **393**
 Volatility Factor **394**
 Liquidity Factor **394**

| | |
|---------------------------------|-----|
| Inflation Factor | 395 |
| GDP Factor | 395 |
| Equity Risk Premium | 396 |
| Limitations of Factor Investing | 396 |
| Factor Investing Summary | 397 |
| Conclusion | 397 |

| | |
|--|-----|
| Appendix A: A Simple Example of Factor Analysis | 397 |
| Appendix B: Specification of the APT with an Unobserved Market Factor | 399 |
| Questions and Problems | 400 |
| Bibliography | 401 |

Part 4 SECURITY ANALYSIS AND PORTFOLIO THEORY 409

Chapter 17

| | |
|---------------------------------------|-----|
| EFFICIENT MARKETS | 410 |
| Early Development | 411 |
| The Next Stages of Theory | 412 |
| Recent Theory | 414 |
| Some Background | 415 |
| Testing the EMH | 416 |
| Tests of <i>Return Predictability</i> | 417 |
| Tests on Prices and Returns | 417 |
| Monthly Patterns | 419 |
| Announcement and Price Return | 431 |
| Methodology of Event Studies | 432 |
| Strong-Form Efficiency | 437 |
| Market Rationality | 440 |
| <i>Conclusion</i> | 442 |
| Questions and Problems | 442 |
| Bibliography | 443 |

Chapter 18

| | |
|-------------------------------------|-----|
| THE VALUATION PROCESS | 454 |
| Discounted Cash Flow Models | 455 |
| Cross-Sectional Regression Analysis | 467 |
| <i>An Ongoing System</i> | 471 |
| Conclusion | 476 |
| Questions and Problems | 476 |
| Bibliography | 477 |

Chapter 19

| | |
|---|-----|
| EARNINGS ESTIMATION | 481 |
| The Elusive Number Called Earnings | 481 |
| The Importance of Earnings | 484 |
| Characteristics of Earnings and Earnings Forecasts | 487 |
| Conclusion | 495 |
| Questions and Problems | 496 |
| Bibliography | 496 |

Chapter 20

| | |
|---|-----|
| BEHAVIORAL FINANCE. INVESTOR DECISION MAKING, AND ASSET PRICES | 499 |
| Prospect Theory and Decision Making under Uncertainty | 499 |

| | |
|--|-----|
| Biases from Laboratory Experiments | 502 |
| Summary of Investor Behavior | 505 |
| Behavioral Finance and Asset Pricing Theory | 506 |
| Bibliography | 513 |

Chapter 21

| | |
|---|-----|
| INTEREST RATE THEORY AND THE PRICING OF BONDS | 517 |
| An Introduction to Debt Securities | 518 |
| The Many Definitions of Rates | 519 |
| Bond Prices and Spot Rates | 526 |
| Determining Spot Rates | 528 |
| The Determinants of Bond Prices | 530 |
| Collateral Mortgage Obligations | 546 |
| The Financial Crisis of 2008 | 547 |
| Conclusion | 549 |
| Appendix A: Special Considerations in Bond Pricing | 549 |
| Appendix B: Estimating Spot Rates | 550 |
| Appendix C: Calculating Bond Equivalent Yield and Effective Annual Yield | 552 |
| Questions and Problems | 552 |
| Bibliography | 553 |

Chapter 22

| | |
|--|-----|
| THE MANAGEMENT OF BOND PORTFOLIOS | 557 |
| Duration | 557 |
| Protecting against Term Structure Shifts | 565 |
| Bond Portfolio Management of Yearly Returns | 569 |
| Swaps | 578 |
| Appendix A: Duration Measures | 580 |
| <i>Appendix B: Exact Matching Programs</i> | 584 |
| Appendix C: Bond-Swapping Techniques | 586 |
| Appendix D: Convexity | 587 |
| Questions and Problems | 588 |
| Bibliography | 589 |

Chapter 23

| | |
|-----------------------|-----|
| OPTION PRICING THEORY | 592 |
| Types of Options | 592 |

| | |
|--|-----|
| Some Basic Characteristics of Option Values | 598 |
| Valuation Models | 603 |
| Artificial or Homemade Options | 614 |
| Uses of Options | 615 |
| Conclusion | 618 |
| Appendix A: Derivation of the Binomial Formula | 618 |
| Appendix B: Derivation of the Black-Scholes Formula | 621 |
| Questions and Problems | 623 |
| Bibliography | 624 |

Part 5 EVALUATING THE INVE:

Chapter 25

| | |
|------------------------------|-----|
| MUTUAL FUNDS | 648 |
| Open-End Mutual Funds | 649 |
| Closed-End Mutual Funds | 652 |
| Exchange-Traded Funds (ETFs) | 655 |
| Conclusion | 658 |
| Bibliography | 658 |

Chapter 26

EVALUATION OF PORTFOLIO PERFORMANCE 660

| | |
|---|-----|
| Evaluation Techniques | 661 |
| A Manipulation-Proof Performance Measure | 669 |
| Timing | 670 |
| Holding Measures of Timing | 674 |
| Multi-index Models and Performance Measurement | 675 |
| Using Holdings Data to Measure Performance Directly | 678 |
| Time-Varying Betas | 679 |
| Conditional Models of Performance Measurement, Bayesian Analysis, and Stochastic Discount Factors | 679 |
| Bayesian Analysis | 680 |
| Stochastic Discount Factors | 681 |
| Whats a Researcher to Do? | 681 |
| Measuring the Performance of Active Bond Funds | 682 |
| The Performance of Actively Managed Mutual Funds' | 682 |

Chapter 24

| | |
|--|-----|
| THE VALUATION AND USES OF FINANCIAL FUTURES | 630 |
| Description of Financial Futures | 630 |
| Valuation of Financial Futures | 634 |
| The Uses of Financial Futures | 639 |
| Nonfinancial Futures and Commodity Funds | 643 |
| Questions and Problems | 644 |
| Bibliography | 645 |

JT PROCESS 647

| | |
|---|-----|
| How Have Mutual Funds Done? | 682 |
| The Persistence of Performance | 684 |
| Persistence | 684 |
| Appendix: The Use of APT Models to Evaluate and Diagnose Performance | 689 |
| Questions and Problems | 693 |
| Bibliography | 693 |

Chapter 27

| | |
|---|-----|
| EVALUATION OF SECURITY ANALYSIS | 699 |
| Why the Emphasis on Earnings? | 700 |
| The Evaluation of Earnings Forecasts | 701 |
| Evaluating the Valuation Process | 708 |
| Conclusion | 711 |
| Questions and Problems | 712 |
| Bibliography | 712 |

Chapter 28

PORTFOLIO MANAGEMENT REVISITED 714

| | |
|--|-----|
| Managing Stock Portfolios | 715 |
| Active Management | 718 |
| Passive Versus Active | 719 |
| International Diversification | 720 |
| Bond Management | 720 |
| Bond and Stock Investment with a Liability Stream | 723 |
| Bibliography | 728 |

Index 731