

Contents

Part I: R and Finance

- Chapter 1 R Basics and Finance 101
 - 1.1 How to Download and Install R
 - 1.2 How to Launch R and Quit R
 - 1.3 R Basic Concepts and Functions
 - 1.4 List Function and Remove Function
 - 1.5 Next-Line Symbol (+) and Go Back to the R Prompt
 - 1.6 Finding Help
 - 1.7 Using R as a Calculator
 - 1.8 Using Arrow Keys to Recall the Previous Commands
 - 1.9 A General Formula for Finance 101
 - 1.10 Time Value of Money
 - 1.11 Review of Basic Finance Formulae
 - 1.12 NPV Rule
 - 1.13 IRR Rule
 - 1.14 Payback Rule
 - 1.15 Incremental Cash-Flow Method

- Chapter 2 Writing a Function in R
 - 2.1 Introduction
 - 2.2 Writing a Simple One-Line Function in R
 - 2.3 Input values: Positional Arguments, Keyword Arguments, and Mixed Ones
 - 2.4 Programs with Multiple Lines
 - 2.5 Well-Indented Codes Are More Readable
 - 2.6 Using Notepad as a Text Editor
 - 2.7 Extensions of R programs Are Not Critical
 - 2.8 How to Run an R Program
 - 2.9 Using Meaningful Variable Names and Using the Tab Key Magically
 - 2.10 Changing Our Working Directory
 - 2.11 Listing Files Under the Current Working Directory
 - 2.12 Default Value for an Input Argument
 - 2.13 Comparison Between Two Listing Functions
 - 2.14 Grouping Many Small Functions into One File
 - 2.15 Using R as a Financial Calculator
 - 2.16 Error Handling
 - 2.17 Changing Your Starting Working Directory

- Chapter 3 Black-Scholes-Merton Option Model
 - 3.1 Introduction
 - 3.2 One Input Argument Could Be a Vector
 - 3.3 A Simple Graph
 - 3.4 Payoff Function with a Graphical Presentation
 - 3.5 Profit/Loss Functions
 - 3.6 Black-Scholes-Merton Option Model on Nondividend-Paying Stocks
 - 3.7 Finding Option Values Using the Cumulative Normal Distribution Table
 - 3.8 R Function for the Cumulative Normal Distribution
 - 3.9 Hedge, Speculation, and Arbitrage

- 3.10 Various Trading Strategies
- 3.10 Greeks
- 3.11 Put-Call Parity
- 3.12 Using Excel to Get the Result from the Black-Scholes-Merton Model
- 3.13 Retrieving Publicly Available Options Data
- 3.14 Using R Package quantmod to Retrieve Option Data
- 3.15 Implied Volatility

Chapter 4 Financial-Statement Analysis

- 4.1 Introduction
- 4.2 Where to Get Data Related to Financial Statements
- 4.3 An Example of Current Ratio
- 4.4 Income Statement
- 4.5 Balance Sheet
- 4.6 Cash-Flow Statements
- 4.7 Common-Size Financial Statements
- 4.8 The Definitions of Key Ratios
- 4.9 Key Statistics from Yahoo Finance
- 4.10 Using R to Download Income Statements
- 4.11 Using R to Download Balance Sheets
- 4.12 Using R to Retrieve Cash-Flow Statements
- 4.13 Using R to Construct a Common-Size Financial Statement
- 4.14 Using R to Download/Save Financial Statements (for Excel)
- 4.15 Using R to Download Key Statistics from Yahoo
- 4.16 Three R Data Sets: is50, bs50, and cf50
- 4.17 Financial Analysts' Recommendation (Yahoo Briefing)
- 4.18 A Quick Introduction to R Package quantmod

Chapter 5 Open Data

- 5.1 Introduction
- 5.2 Introduction to Yahoo Finance
- 5.3 Introduction to Google Finance
- 5.4 Getting Help Related to Yahoo Finance
- 5.5 Manually Downloading Historical Stock Data from Yahoo Finance
- 5.6 Estimating Returns from a CSV File Downloaded from Yahoo Finance
- 5.7 Generating a Variable Called date
- 5.8 Using R to Retrieve Data from Yahoo Finance Directly
- 5.9 Estimating Returns
- 5.10 Adding a New Variable Called ticker
- 5.11 Saving Our Data to a Text File
- 5.12 Saving an R Data Set
- 5.13 Retrieving Market Index Data from Yahoo Finance
- 5.14 Downloading Monthly Data from Yahoo Finance
- 5.15 Introduction to the Federal Reserve Data Library
- 5.16 Professor French's Data Library (Fama-French Factors and Others)
- 5.17 SEC Filings
- 5.18 Retrieving Data for Multiple Stocks from Yahoo Finance
- 5.19 Fine-Tuning
- 5.20 Using Monthly Returns or Daily Returns
- 5.21 Converting Daily Returns to Monthly or Annual Ones
- 5.22 A List of Functions from Various R Packages

5.23 An R Data Set Called MGR690webs.RData

Chapter 6 CAPM (Capital Asset Pricing Model)

- 6.1 Introduction
- 6.2 Formula for CAPM
- 6.3 How to retrieve Rstock, Rrisk-free, and Rmarket for CAPM
- 6.4 retDIBM, prcDIBM, and other R Data Sets
- 6.5 Percentage Returns vs. Log Returns
- 6.6 Using R to Run CAPM
- 6.7 A Few R Programs to Run CAPM
- 6.8 σ_{annual} , σ_{monthly} , and σ_{daily}
- 6.9 Moving (Rolling) Beta
- 6.10 Estimating Beta for Any Number of Stocks
- 6.11 Issues in Forecasting β
- 6.12 Scholes and Williams (1977) Adjustment for Beta
- 6.13 Portfolio β

Chapter 7 Fama-French Model, Sharpe Ratio, Treynor Ratio, Jensen's α

- 7.1 Fama-French Three-Factor Model
- 7.2 SMB (Small Minus Big)
- 7.3 HML (High Minus Low)
- 7.4 Generating R Data Sets for Fama-French Factors
- 7.5 R Codes for Fama-French Three-Factor Model
- 7.6 Momentum Strategy
- 7.7 Downloading the Momentum Factors
- 7.8 Sharpe Ratio
- 7.9 Treynor Ratio
- 7.10 retMIBM, prcMIDM, retM50, prcM50 R Data Sets
- 7.11 52-Week's High
- 7.12 Jensen's α , Rolling Beta, and Scholes and William's β
 - 7.12.1 Jensen's α
 - 7.12.2 Rolling Beta
 - 7.12.3 Scholes and William's β

Chapter 8 T-Test, F-Test, Durbin-Watson, Normality and Granger Causality Tests, Event Study

- 8.1 Introduction
- 8.2 Rule of Thumb for a T-Test
- 8.3 T-Test for a One-Time Series
- 8.4 Tests for Equal Means
- 8.5 Introduction to F-Test
- 8.6 Durbin-Watson Autocorrelation Test
- 8.7 Granger Causality Test
- 8.8 Wilcoxon Signed-Rank Test
- 8.9 Pearson Correlation and Spearman Rank Correlation
- 8.10 Normality Test
- 8.11 Event Study

Chapter 9 Monte Carlo Simulation

- 9.1 Simulation and Finance
- 9.2 A Normal Distribution
- 9.3 Concept of Seed

- 9.4 Q-Q Plot
- 9.5 Monte Carlo Simulation
- 9.6 Simulating Stock Prices (Paths)
- 9.7 Using the Monte Carlo Simulation to Replicate the Black-Scholes-Merton Model
- 9.8 Using the Monte Carlo Simulation to Price Asian Options
- 9.9 Correlated Random Sequences
- 9.10 Randomly Select n Stocks
- 9.11 Sobol Sequence
- 9.12 Shapiro-Wilk Normality Test
- 9.13 Time Used to Run a Simulation
- 9.14 What is Your Chance to Win a Lottery?

Chapter 10 Portfolio Theory

- 10.1 Introduction
- 10.2 Variance, Standard Deviation, and Correlation
- 10.3 Markowitz Mean-Variance Efficiency
- 10.4 Single-Period Portfolio Optimization
- 10.5 Return Matrix
- 10.6 Portfolio Returns
- 10.7 Portfolio Volatility for a Two-Stock Portfolio
- 10.8 Portfolio Volatility for an n-Stock Portfolio
- 10.9 Variance-Covariance Matrix
- 10.10 Correlation Matrix
- 10.11 A Simple Example of a Minimum-Risk Portfolio for a Two-Stock Portfolio
- 10.12 Minimization `optim()`
- 10.13 Quadratic Optimization
- 10.14 A List of R Packages Related to Portfolio Theory
- 10.15 Finding Manuals Related to Those R Packages
- 10.16 Data Sets Included in Various R Packages
- 10.17 Examples of Using Various Functions
 - 10.17.1 Using the `risk.attribution()` Function
 - 10.17.2 Setting a Target Return to Minimize Portfolio Risk
 - 10.17.3 Portfolio Optimization
 - 10.17.4 Efficient Portfolio of a Two-Stock Portfolio
 - 10.17.5 A Minimum-Variance Portfolio
- 10.18 Portfolio Insurance (Hedging the Portfolio with a Target Beta)

Chapter 11 VaR (Value at Risk)

- 11.1 Introduction to VaR
- 11.2 A Normal Distribution and Its Graph Presentation
- 11.3 Confidence Level vs. Left Tail (Percentage Tail)
- 11.4 Estimating VaR Based on the Normality Assumption
- 11.5 A Trivial Issue: Sign
- 11.6 One-Day VaR vs. n-Day VaR
- 11.7 VaR Based on Sorted Historical Returns
- 11.8 Mean, Standard Deviation, Skewness, and Kurtosis
- 11.9 Modified VaR (mVaR)
- 11.10 VaR of a Portfolio
- 11.11 Expected Shortfall
- 11.12 R Package `PerformanceAnalytics`
- 11.13 Basel Requirement on a Bank's Capital

Chapter 12 Credit Risk

- 12.1 Introduction
- 12.2 Basic Concepts of Default
- 12.3 Credit Spread (Default-Risk Premium)
- 12.4 Getting Current Yield of T-Bill, T-Note, and T-Bond
- 12.5 Bond Yields for AAA- and AA-Rated Bonds
- 12.6 Moody's Historical Yields for Corporate Bonds
- 12.7 Credit Rating
- 12.8 Credit-Migration (Transition) Matrices
- 12.9 Credit Rating and DP (Default Probability)
- 12.10 Recovery-Rate Given Default
- 12.11 Recovery Rate and LGD (Loss Given Default)
- 12.12 Altman's Z-Score
- 12.13 Estimate Market Value and Its Volatility for KMV Model
- 12.14 R Codes for Estimating Total Assets and Its Volatility
- 12.15 Nonlinear Minimization
- 12.16 R Codes for a KMV Model with nlm()
- 12.17 Distance to Default
- 12.18 R Data Set Called credit.RData
- 12.19 CreditMetrics in R
- 12.20 Credit Default Swap (CDS)
- 12.21 R Package crp.CSFP (CreditRisk+Portfolio Model)

Chapter 13 Bid-Ask Spread and Transaction Costs

- 13.1 Introduction
- 13.2 Roll Spread (1984)
- 13.3 Corwin and Schultz's (2011) High-Low Spread
- 13.4 Spread Estimated Based on High-Frequency Data
- 13.5 Chung and Zhang (2009)

Chapter 14 Liquidity Measures

- 14.1 Introduction
- 14.2 Size of a Firm
- 14.3 Turnover
- 14.4 Trading Volume
- 14.5 Dollar-Trading Volume
- 14.6 Impact of Trading on Price/Return
- 14.7 Amihud Illiquidity (2002)
- 14.8 Pastor and Stambaugh's (2003) Measure
- 14.9 Liu (2006)
- 14.10 Firm's Liquidity Divided by the Market Liquidity
- 14.11 Bid-Ask Spread from High-Frequency Data

Chapter 15 Using R to Process TAQ (High-Frequency data)

- 15.1 Introduction to High-Frequency Data
- 15.2 TAQ (NYSE Trade and Quote Data)
- 15.3 One Day's Data (Four Data Sets)
- 15.4 Setup and Global Variables: idx.T, idx.Q, bin.T, and bin.Q
- 15.5 Two Data Sets for CT
- 15.6 Sequential and Random Access
- 15.7 Time Format of H:M:S

- 15.8 Several Small Programs
- 15.9 Two Data Sets Related to CQ
- 15.10 Adding Filters
- 15.11 How to Merge Trade with Quote
- 15.12 Five-Second Rule, Two-Second Rule, and Ten-Second Rule
- 15.13 Who Initiated a Trade?
- 15.14 Lee and Ready Function in an R Package of RTAQ
- 15.15 Using a Quote Test in an R Package of FinAsym
- 15.16 Mean Spread, Relative Spread, Realized Spread
- 15.17 PIN (Probability of Informed Trading)
- 15.18 One Day vs. Multiple Years
- 15.19 How to Make Our Search More Efficient
- 15.20 A More Efficient Way to Find Trading Directions

Chapter 16 Two Dozen R Packages Related to Finance

- 16.1 Introduction
- 16.2 About Two Dozen Packages for Finance
- 16.3 Download and Install Packages Listed by Finance View
- 16.4 Package fImport
- 16.5 Finding the Manual for the R Package fImport
- 16.6 Package quantmod
- 16.7 Package pdfetch
- 16.8 Package metafolio
- 16.9 Package fOptions
- 16.10 Package fAsianOptions
- 16.11 Package fExoticOptions
- 16.12 Package fBasics
- 16.13 Package fBonds
- 16.14 Package termstrc (Term Structure of Interest Rate)
- 16.15 Package of YieldCurve
- 16.16 Package of CreditMetrics
- 16.17 Package of timeDate
- 16.18 Package of tseries
- 16.19 Package fAssets
- 16.20 Package zoo
- 16.21 Package TTR (Technical Trading Rule)
- 16.22 Package ttrTests (Standard Back Tests for Technical Trading Rules in Financial Data)
- 16.23 Package stockPortfolio
- 16.24 Package XML
- 16.25 Package PerformanceAnalytics
- 16.26 Package RQuantLib
- 16.27 Package MASS
- 16.28 No Updated Packages Available

[Part II: R]

Chapter 17 R Basics

- 17.1 Installation of R
- 17.2 Starting and Quitting R
- 17.3 R Basics
- 17.4 Finding Help
- 17.5 Using R as an Ordinary Calculator

Chapter 18 Simple Value Assignment

- 18.1 Several Ways to Assign a Value to a Variable
- 18.2 Viewing Objects Using the ls() Function
- 18.3 The seq() Function
- 18.4 Position and Keyword Approaches
- 18.5 Inputting Data via scan()
- 18.6 Getting Data from an Excel File
- 18.7 Precision of R

Chapter 19 Inputting Data from External Sources

- 19.1 Reading Data from a Text File Using read.table()
- 19.2 Reading in the First Ten Rows to Explore
- 19.3 Adding Column Names Using colnames() and col.names()
- 19.4 Reading a CSV File
- 19.5 Reading from a Clipboard
- 19.6 Input from a Delimited Input File
- 19.7 Input from a Fixed Width File
- 19.8 load() an R Data Set
- 19.9 Extension .RData of an R Data Set Is Not Critical
- 19.10 Reading from an Internet File
- 19.11 Reading from canisius.edu/~yany
- 19.12 Finding Help for Inputting Data from an External File
- 19.13 Some R Data Sets from the Internet
- 19.14 Inputting Files with Irregular Formats

Chapter 20 Simple Data Manipulation

- 20.1 The Functions head() and tail ()
- 20.2 The Function summary()
- 20.3 Function ls() vs. ls(pattern='my pattern')
- 20.4 Types of Variables
- 20.5 The Function is.vector() and Similar Functions
- 20.6 Functions length() vs. dim()
- 20.7 Function cbind()
- 20.8 Converting a Vector into a Matrix
- 20.9 Adding Column Names Using colnames()
- 20.10 Getting Specific Rows
- 20.11 Retrieving a Subset Based on Certain Conditions
- 20.12 Row Names
- 20.13 Converting a List into a Matrix
- 20.14 Combining Two Matrices By Row

Chapter 21 R Loops

- 21.1 For Loop
- 21.2 Using Modulus Function to Shape the Output Format
- 21.3 Double Loops
- 21.4 While Loop
- 21.5 How to Stop (Cancel) an Execution
- 21.6 Stopping After Detecting an Error
- 21.7 Length of a Vector vs. Dimension of a Matrix

Chapter 22 If-Else, Logic OR, and Logic AND

- 22.1 Introduction
- 22.2 The if() Function
- 22.3 If-Else Function
- 22.4 If-Else-If-Else Function
- 22.5 The if() and stop() Pair
- 22.6 Logic OR
- 22.7 Logic AND
- 22.8 Going to the Next Line After Every Ten Numbers
- 22.9 Combination of Various Conditions

Chapter 23 Outputting to a File

- 23.1 Writing to a Text File
- 23.2 The Function write.table()
- 23.3 Writing a CSV (Comma-Separate Value) File
- 23.4 The write.csv() Function
- 23.5 The write() Function
- 23.6 Writing and Loading an R Data Set
- 23.7 Appending Data to an Existing Text File
- 23.8 The dot-Rdata File (.Rdata)
- 23.9 Using cat()
- 23.10 Writing a Binary File
- 23.11 Saving a PDF File
- 23.12 Writing Data to a Clipboard
- 23.13 Row Names and Column Names
- 23.14 The sink() Function
- 23.15 Temporary File tempfile()

Chapter 24 Data Frame and List

- 24.1 Introduction
- 24.2 The data.frame() Function
- 24.3 Recycling Rule Apply
- 24.4 Adding Column Names
- 24.5 Using attach() to Make Columns Accessible Directly
- 24.6 The Data Type of the Data Frame is List
- 24.7 Reading Data from an Input File
- 24.8 Converting a Data Frame into a Data Matrix
- 24.9 Generating a List
- 24.10 Length and Size of a List
- 24.11 Calling Elements of a List
- 24.12 Difference Between x[1] and x[[1]] When x Is a List
- 24.13 Adding More Data to an Existing List

- 24.14 Long Names and Their Minimum Numbers of Distinguishable Letters
- 24.15 Adding More to the Top Level
- 24.16 The class() Function
- 24.17 Concatenating Lists

Chapter 25 Subsetting

- 25.1 Introduction
- 25.2 Scalar, Vector, and Matrix
- 25.3 Getting a Subset from a Vector
- 25.4 Getting a Subset from a Matrix
- 25.5 Getting a Specific Year's Data

Chapter 26 Combine and Merge Data Sets

- 26.1 Introduction
- 26.2 Combining Columns Using cbind()
- 26.3 Recycling Rule When Using cbind()
- 26.4 Removing the Recycling Rule
- 26.5 Adding Rows
- 26.6 Merging Two Data Sets with One Common Variable
- 26.7 Keeping All Cases for merge()
- 26.8 Merging Three Data Sets
- 26.9 Merging Two Data Sets with One Common Variable with Different Names in Two Data Sets
- 26.10 Merging with Two Common Variables

Chapter 27 Date Variable

- 27.1 Converting a String into a Date Variable Using as.Date()
- 27.2 Converting an Integer into a Date
- 27.3 Defining a Date Variable as an Integer
- 27.4 Defining a Date Variable as an Ordinary String
- 27.5 Retrieving Year, Month, and Day from an as.Date()-Defined Variable
- 27.6 Converting a Character Variable into an Integer or a Real Number
- 27.8 Converting a String into an Integer
- 27.9 Converting a String into a Date as an Integer
- 27.10 Choosing Many Dates Before date1 and date2
- 27.11 Choosing the Last Day of Each Month
- 27.12 Choosing Specific Weekdays
- 27.13 The Function cbind() vs. data.frame()
- 27.14 The Function seq(as.Date())
- 27.15 R Package timeDate

Chapter 28 Matrix and Its Manipulation

- 28.1 Combining Vectors into a Matrix Using cbind()
- 28.2 Recycling Rule
- 28.3 Same Type in a Matrix
- 28.4 Converting a Vector into a Matrix
- 28.5 Double Loop for a Matrix
- 28.6 Converting a List (Date Frame) into a Matrix Using as.matrix() and is.matrix()
- 28.7 Subset of a Matrix
- 28.8 Adding Column Names to a Matrix
- 28.9 Using the Name of the Columns

- 28.10 Solving a Linear Equation
- 28.11 Inverse of a Matrix
- 28.12 Testing Different Types of Data Format

Chapter 29 Simple Plot and Graph

- 29.1 Plot for a Single Graph
- 29.2 Adding Labels on Horizontal and Vertical Axes
- 29.3 Shading Certain Areas
- 29.4 Putting Several Graphs Together
- 29.5 Greek Letters
- 29.6 Saving a PDF File

Chapter 30 String Manipulation

- 30.1 Assuming a String Variable
- 30.2 Checking Whether a Variable Is a Character
- 30.3 Capital vs. Lowercase toupper() and tolower()
- 30.4 The Length of a String nchar()
- 30.5 Choosing Part of a String Using substr() and substring()
- 30.6 Combining Two Strings Together Using paste()
- 30.7 Removing Leading or Trailing Blanks from a String
- 30.8 Repeating Indicator *, +, ?, and .
- 30.9 Convert a Number into a Character Variable Using as.character()
- 30.10 Converting a String Variable into a Numerical One Using as.numeric()
- 30.11 String Matching
- 30.12 Logic OR []
- 30.13 Logic NOT (^)
- 30.14 Existence of a Pattern
- 30.15 Converting a String into an Integer Using strtol()
- 30.16 The Names of Vectors (Matrix) Are Strings
- 30.17 Two Predetermined Data Sets of letters and LETTERS
- 30.18 Using Short Names with abbreviate()

Chapter 31 Introduction to R Package

- 31.1 Introduction
- 31.2 Loaded vs. Preinstalled Packages
- 31.3 The Second Way to Install a Package
- 31.4 The Third Way to Install a Package
- 31.5 Can't Install an R Package
- 31.6 Using the .libPaths() Function
- 31.7 Three Ways to Load a Package
- 31.8 Finding the Manual for a Specific Package
- 31.9 Most Used Commands Related to Packages

Chapter 32 Reading and Writing Binary Data in R

- 32.1 Writing and Reading a Binary
- 32.2 Comparison of Speed
- 32.3 Writing a Binary File Using writeBin()
- 32.4 Reading a Binary File Using readBin()
- 32.5 Writing a Binary Data File
- 32.6 Reading a Binary Data File

Chapter 33 Excel and R

- 33.1 Installation of Several Excel-Related R Packages
- 33.2 Manuals for Excel-Related Packages
- 33.3 Retrieving Data from Excel
 - 33.3.1 Using read.table('clipboard')
 - 33.3.2 Using the read.table() and read.csv() Functions
 - 33.3.3 Using the readWorksheetFromFile() Function
 - 33.3.4 Using a Region Instead of the Whole Spreadsheet
- 33.4 Writing Data to Excel
 - 33.4.1 Using write.table('clipboard')
 - 33.4.2 Writing a CSV File First
 - 33.4.3 Using the write.xlsx() Function
 - 33.4.4 Using the xl.save.file() Function
 - 33.4.5 Using the Write.XLS() Function
 - 33.4.6 Using the writeNameRegion() Function
- 33.5 Using Demo Files with system.file()
- 33.6 Getting Data from Excel with readNamedRegionFromFile()
- 33.7 When the Data Set Is Huge

Chapter 34 Encryption

- 34.1 Blanks Are Kept
- 34.2 R Program for the Shift Scheme
- 34.3 Simple Letter Substitution
- 34.4 Letter Frequency
- 34.5 Five Letters to Represent Twenty-Six Letters
- 34.6 Using Six Letters to Represent A to Z and 0 to 9

Chapter 35 Reading a Zip File from R

- 35.1 Downloading a Zip Software
- 35.2 Finding the Location of Our 7-Zip Software
- 35.3 How to Use 7-Zip
- 35.4 Generating a Zip File
- 35.5 Viewing the Contents of a Zip File
- 35.6 Reading from a Zip File
- 35.7 Retrieving Data from a Zip File
- 35.8 Example of Corporate Bond Rate Zip File (from the Federal Reserve Bank Data Library)
- 35.9 Finding the Number of Files
- 35.10 Downloading a Zip File from R Using download.file()

Chapter 36 Small-Program-Oriented Programming

- 36.1 A Small Program (Function) Is Easy to Write
- 36.2 A Small Program Is Easy to Modify
- 36.3 A Small Program Is Easy to Understand
- 36.4 Small Programs Save Time Since We Can Reuse Them Many Times
- 36.5 It Is Easy to Share a Small Program
- 36.6 It Is Easy to Maintain a Small Program
- 36.7 Making Our Main Program Easy to Understand

Chapter 37 Automation Using R

- 37.1 Getting the Time Stamp of an Existing File
- 37.2 Checking Your Schedule Whenever R Is Launched

37.3 Automatically Updating a Link