

# Financial Modeling using Excel

## --in an R assisted learning environment<sup>1</sup>

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Chapter 1: R installation/Excel basics(I)

- 1.1 R installation
  - 1.2 Excel is a two-dimensional spread sheet
  - 1.3 What does =A1 mean?
  - 1.4 Relative vs. absolute addresses
  - 1.5 +, -, /, and \* have their normal meanings
  - 1.6 How to format a cell
  - 1.7 round(), sqrt(), count(), counta() functions
  - 1.8 A string variable
  - 1.9 Pairs of exp() and ln(), pow() and log()
  - 1.10 Pairs of 10^x, power(x, 10), log10(), and log(x)
  - 1.11 max(), min(), floor(), ceiling() and int() functions
  - 1.12 True/False, isnumber(), istext() functions
  - 1.13 Change the name of spreadsheet and more
  - 1.14 Make a copy of our existing spreadsheet
  - 1.15 Save as an Excel file
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- 2.1 Time line
  - 2.2 Future value
  - 2.3 Excel sign convention
  - 2.4 Present value
  - 2.5 Concept of due
  - 2.6 Definition of NPV and NPV rule
  - 2.7 A true NPV function
  - 2.8 Definition of IRR and IRR rule
  - 2.9 Definition of Payback period and its rule
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- 3.2 What is Balance-Sheets
- 3.3 What is income statements
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- 3.5 Download financial statements from Yahoo!Finance, Google Finance
- 3.6 Ratio analysis

3.7 DuPont identity  
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- 4.1 Definitions of returns
  - 4.2 Arithmetic mean vs. geometric mean
  - 4.3 Time-weighted vs. dollar-weighted
  - 4.4 Definitions of risk
  - 4.5 Total risk vs. market risk
  - 4.6 Excel functions to calculate  $\sigma^2$  and  $\sigma$
  - 4.7 Annualizing  $\sigma^2$  and  $\sigma$
  - 4.8 Daily returns to weekly/monthly/annual ones
  - 4.9 Tradeoff (I): Sharpe ratio
  - 4.10 Tradeoff (II): Treynor ratio
  - 4.11 Tradeoff (II): LPSD and Sortino ratio
  - 4.12 Tradeoff (IV): a utility function
  - 4.13 Concept of an indifference curve
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  - 5.2 Impact of size, sample vs. population, sample statistics
  - 5.3 Review of three concepts
  - 5.4 Two important values: 2 for a T-test and 5% for a p-value
  - 5.5 T-test, critical value, decision rule
  - 5.6 F-test for equal variance, decision rule and critical value
  - 5.7 Chi square distribution, normality test, test for a special distribution
  - 5.8 How to run a single factor linear regression?
  - 5.9 Event study using Excel
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- 6.1 Introduction
- 6.2 2-step approach for effective rate conversion
- 6.3 Review: present value of perpetuity and present value of growing perpetuity
- 6.4 Review: present value of annuity

- 6.5 How to estimate YTM
- 6.6 How to price bond
- 6.7 Definition of duration
- 6.8 hedging by duration
- 6.9 pricing stock: one-period model
- 6.10 pricing stock: n-period model
- 6.11 Pricing stock: using multiples
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Chapter 7: CAPM (a single-factor linear model)

- 7.1 Introduction
- 7.2 How to run a linear regression using Excel
- 7.3 download data from Yahoo!Finance, Google Finance
- 7.4 Download data by using `.getdata`
- 7.5 introduction to market indices, such as S&P500
- 7.6 value-weighted, equal-weighted, price-weighted indices
- 7.7 How to estimate market risk for IBM
- 7.8 How to adjusted beta
- 7.9 Beta adjustment, Dimson (1972)
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- 7.11 Beta of a portfolio
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- 8.2 Prof. French's Data Library
- 8.3 Download data from French's Data Library
- 8.4 Alternative way to get data: `.getdata`
- 8.5 Running Fama-French 3-factor model
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- 9.3 standard normal vs. cumulative standard normal distribution

- 9.4 Normality tests
- 9.5 Uniform distribution
- 9.6  $\chi^2$  distribution
- 9.7 Poisson distribution
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- 10.2 Payoff and profit/loss functions
- 10.3 Hedge, speculation and arbitrage
- 10.4 Various trading strategies involving options
- 10.5 Density distribution vs. cumulative density distribution
- 10.6 Review: standard normal vs. cumulative standard normal distribution
- 10.7 An easy way to remember the logic behind Black-Scholes-Merton option model
- 10.8 Black-Scholes-Merton option model
- 10.9 VBA for call and put
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- 10.11 Option Greeks
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#### Chapter 12: VaR (Value at Risk)

- 12.1 Definition of VaR

- 12.2 Review of a normal distribution
- 12.3 Generating n-day returns
- 12.4 Estimating VaR based on the normality assumption
- 12.5 Conversion of  $\sigma$  between frequencies
- 12.6 Estimating VaR based on sorted returns
- 12.7 Modified VaR
- 12.8 Portfolio VaR
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#### Chapter 13: Portfolio Theory

- 13.1 Review of basic concepts
- 13.2 Markowitz mean-variance efficiency
- 13.3 Converting monthly returns to annual ones
- 13.4 How to generate a return matrix
- 13.5 Estimating portfolio returns
- 13.6 Estimating portfolio risk for a 2-stock portfolio
- 13.7 Estimating variance-covariance/correlation matrices
- 13.8 Portfolio variance for an n-stock portfolio
- 13.9 Finding an optimal portfolio for 2 stocks
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- 13.13 Simulating future portfolio distribution
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- 14.1 Why liquidity matters and how to measure it
- 14.2 Aminud (2002) illiquidity measure
- 14.3 Is liquidity a risk factor?
- 14.4 Pastor and Stambaugh (2003) liquidity measure
- 14.5 Getting High-frequency data
- 14.6 Roll spread (1984)
- 14.7 Introduction to high-frequency data
- 14.8 CT (Consolidated Trade) data
- 14.9 CQ (Consolidated Quote) data
- 14.10 How to merge CT and CQ?
- 14.11 Who initiated trade? (Lee and Ready methodology, 1991)

## Exercises

### Chapter 15: Credit Risk Analysis

- 15.1 Introduction
- 15.2 default spread
- 15.3 Credit rating
- 15.4 Rating migration matrix
- 15.5 Credit rating vs. default probability
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- 15.7 Hedging credit risk
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- 16.1 R installation
- 16.2 How to launch R
- 16.3 How to quit R
- 16.4 R is case sensitive
- 16.5 One-line R code for this course
- 16.6 Three ways to assign a value
- 16.7 Choosing a meaningful variable name
- 16.8 ls() function to list variables and functions
- 16.9 rm() function to remove unnecessary variables/functions
- 16.10 using R as a calculator
- 16.11 Using up-arrow/down-arrow keys
- 16.12 Some commonly used functions
- 16.13 How to list all three-letter functions
- 16.14 How to find help about a specific function
- 16.15 How to write a one-line R function
- 16.16 How to add a comment
- 16.17 Using source() function
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### Chapter 17: Excel basics (II)

- 17.1 average(), geomean(), min() and max()
- 17.2 power() function and ^
- 17.3 string manipulation: upper(), lower(), len() and substitute()

- 17.4 round(), roundup() and rounddown()
- 17.5 count(), and counta()
- 17.6 stdev(), stdev.s(), stdev.p(), var.s(), and var.p()
- 17.7 if() function
- 17.8 pv() and fv()
- 17.9 Excel sign convention
- 17.10 rate(), effect() , and nper()
- 17.11 year(), month(), and day()
- 17.12 npv() and IRR() functions
- 17.13 isodd(), iseven() and the like
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#### Chapter 18: Sources of open data

- 18.1 Open data for economics
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- 19.2 Menu for retrieving data, .getdata
- 19.3 Menu for in-class exercises, .ice
- 19.4 Menu for showing all functions, .showFormula
- 19.5 Menu for a free financial calculator, .fincal
- 19.6 Menu for mimic Excel .mimicExcel
- 19.7 Menu for data cases, .dataCases
- 19.8 Menu for term projects, .termProjects
- 19.9 Menu for interactive mode, .interactive
- 19.10 Menu for useful link, .usefulLinks
- 19.11 Menu for YouTube, .youtube
- 19.12 Menu for visual finance. .visual
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#### Chapter 20: Issues with Excel

- 20.1 Excel sign convention



- 20.2 Meaning of a blank cell
- 20.3 Excel NPV() function actually is a PV() function
- 20.4 Inconsistency [stdev.s(), stdev()] vs. [ covariance.s, covar()]
- 20.5 No formula for present (future) value for a growing annuity
- 20.6 No explanation when we have #NUM
- 20.7 no formula for converting effective rates
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#### Chapter 21: vlookup and solver

- 21.1 if Excel solver is not available on the menu bar
- 21.2 what is the usage of solver
- 21.3 examples of using solver
- 21.4 Why should we care about vlookup?
- 21.5 The first example for using Excel vlookup()
- 21.6 vlookup() meaning of range\_lookup
- 21.7 Return the left column using vlookup
- 21.8 vlookup() for text
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- 22.1 copy and paste
- 22.2 input from a text file
- 22.3 input from a csv (comma separated value)
- 22.4 input data with a fixed width
- 22.5 text to columns
- 22.6 retrieve different data sets into the same excel file
- 22.7 retrieve data from web
- 22.8 generate a true date variable
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#### Chapter 23: Data manipulation

- 23.1 If 'data analysis' is not available on your menu bar
- 23.2 sort data
- 23.3 Remove plank lines
- 23.4 add a date variable, year(), month(), day() functions
- 23.5 find out the last row of our data set

- 23.6 name our return matrix
- 23.7 log return vs. percentage return
- 23.8 Converting daily returns to weekly, 10-day, monthly, quarterly and annual ones
- 23.9 Generating T1, T2, ..... T50000
- 23.10 Conditional formatting
- 23.11 Merge different data set by date, year and month
- 23.12 Randomly select 10 stocks from 200 stocks
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#### Chapter 24: Data output

- 24.1 some types of output formats
- 24.2 why we care about the output formats?
- 24.3 Difference between ASCII text and Unicode text
- 24.4 Save as a file with an extension of (\*.xlsx)
- 24.5 Save as an Macro-Enabled Workbook (\*.xlsm)
- 24.6 Save as a csv file (\*.csv)
- 24.7 Save as a text file (\*.txt)
- 24.8 Copy and paste
- 24.9 Save as an Excel Binary Workbook (\*.xlsb)
- 24.10 Save as Excel 97-2003 Workbook (\*.xls)
- 24.11 Save as an XML Data format (\*.xml)
- 24.12 Save as a pdf file (\*.pdf)
- 24.13 Save as an Excel Add-in (\*.xlam)
- 24.14 Save as an XPS Document (\*.xps)
- 24.15 Save as a 97-2003 Add-in (\*.xla)
- 24.16 Save an a Unicode Text (\*.txt)
- 24.17 csv file when we have comma
- 24.18 output an image using snipper
- 24.19 output an image using Ctrl-Print
- 24.20 use paint software after hitting Ctrl-Print
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#### Chapter 25: Simple graph

- 25.1 A simple x, y graph
- 25.2 Column
- 25.3 Line

- 25.4 Pie and Bar
- 25.5 histogram
- 25.6 Area
- 25.7 (x,y) scatter
- 25.8 stock chart
- 25.9 Present your data in a surface chart
- 25.10 Doughnut
- 25.11 Present your data in a bubble chart
- 25.12 Present your data in a radar chart
- 25.13 Other charts
- 25.14 Win/loss
- 25.15 one graph with two sets of lines (x,y) and (a,b)
- 25.16 Macro 4 pie
- 25.17 Macro 4 x,y
- 25.18 Macro 4 more.....
- 25.19 Two ways to output our images
- Exercises

#### Chapter 26: Matrix manipulation

- 26.1 What is a matrix?
- 26.2 Row, column vs. matrix
- 26.3 Dimension requirement for matrix manipulation
- 26.4 hit ctrl-shift-Enter 3 keys simultaneously
- 26.5 Convert a row (row) to a column (column)
- 26.6 Transpose an  $n \times m$  matrix to an  $m \times n$  matrix
- 26.7 for a large data set, how to find its last row?
- 26.8 for a large data set, how to highlight it?
- 26.9 Explanation of matrix multiplication
- 26.10 Excel `mmult()` function
- 26.11 Using excel `mmult()` function for the 1st time
- 26.12 one row times a column will be one number
- 26.13 one column ( $n \times 1$ ) times a row ( $1 \times m$ ) will be a matrix ( $n \times m$ )
- 26.14 one row times the transpose of itself
- 26.15 one row times the transpose of another row
- 26.16 one column times the transpose of itself
- 26.17 one column times the transpose of another column
- 26.18 If 'Developer' is not available on your menu bar

26.19 VBA for estimating variance-covariance matrix

26.20 VBA for estimating correlation matrix

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Chapter 27: Simple Macro: record Macros

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27.2 Recording our first macro

27.3 How to view/edit our recorded Macro

27.4 Copy and paste others’ Macros

27.5 Three ways to run our Macro

27.6 Linking a button to a Macro

27.8 Assigning a short-cut key an existing macro

27.9 Ctrl-a, Ctrl-b, Ctrl-c and Ctrl-d

27.10 Generating a message box

27.11 Calling a Macro(s) from another Macro

27.12 A set of one-line codes

27.13 A list of 3-dozen macros

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Chapter 28: Simple VBA: copy-and-paste

28.1 The simplest VBA

28.2 Data Analysis is not available

28.3 correct extension: x.xlsm

28.4 How to copy-and-paste others’ VBA

28.5 A list of 3-dozen VBAs

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Chapter 29: Pivotal table

29.1 What is pivotal table

29.2 The simplest example

29.3 Converting daily returns into monthly and annual ones

29.4 More examples

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Chapter 30: Term projects

30.1 How important of a term project

30.2 A list of 40 term projects

30.3 Which party could manage economy better

- 30.4 What is the market risk for IBM, C and WMT
- 30.5 What is the VaR for three stocks based on two methods?
- 30.6 Which model is the best, CAPM, FF3, FFC4 or FF4?
- 30.7 Benford law and accounting fraud
- 30.8 Test of January effect and weekday effect
- 30.9 Event study using Excel
- 30.10 Replicating a slot machine by using simulation

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