Preface

The title of this book is called *Financial Modeling using Excel --in an R-assisted learning environment*. The phrase "R-assisted" distinguishes this book from other books applying Excel to Financial Modeling. There are several reasons why this feature is critical. First, R is free software, downloadable at http://r-project.org. Second, readers are not required to learn R. In short, we try to reap the benefits generated by R without requiring readers spending any time on R. In addition, a potential instructor who adopts this book as his/her text book don't need to know R as well. All that readers, students or instructors need to remember is just one R code, shown below.

```
> source("http://datayyy.com/fme.R")
```

where ">" is the R prompt. In the first chapter, we explain the meaning of this one-line code. Below are the main features of our brand new approach to apply Excel to Financial Modeling at various business schools.

Starting from scratch

From this book, a reader learns basic Excel skills and apply them to finance. It is a beginner's book. In other words, it does not require readers to have any prior Excel knowledge or skills. On the other hand, in terms of finance, readers should possess basic finance knowledge.

Using R without learning it

Readers are not required to learn R and this book will not teach R. In Chapter 16: R Basics, some preliminary concepts are introduced. Even for this 8-page long chapter, it is optional!

Using tons of public data

This book uses a huge amount of publicly available data for economics, finance and accounting. After typing `.getdata`, the following menu would pop up.

```
> .getdata
function(){
"
 *-----------------------------------------------------------------------*
 * .getdata                                                              *
 *-----------------------------------------------------------------------*
 *  Economics/Accounting                    Finance                      *
 *-----------------------------------------------------------------------*
 * .show_usGDPannual        .showff3Monthly        .show_ct1day          *
 * .show_usGDPquarterly     .showff3Daily          .show_cq1day          *
 * .show_usUnemployRate     .showffc4Monthly       .show_ct3month        *
 * .show_usDebt_annual      .showffc4Daily         .copy2Excel           *
 * .show_usCPI_annual       .showff5Monthly        .show_cq3month        *
 * .show_usCPI_monthly      .showff5Daily          .show_sp500monthly    *
 * .show_euroDollar_1m      .showAaaYieldDaily     .getCIKgivenTicker    *
 * .show_dollarIndexMonthly .showBaaYieldMonthly   .show_sp500daily      *
 * .show_goldPrice          .showBaaYieldDaily     .show_bondSpread      *
 * .show_fedFundRate        .showTradingDaysDaily   .show_ibmMonthly     *
 * .show_vix                .showTradingDaysMonthly .show_wmtMonthly     *
 * .getBS20                                                              *
 * .getIS20                 .getDailyYanWeb                              *
 * .getCF20                 .getMonthlyYanWeb                            *
 * .getBSannual                                    .copy2Excel           *
 * .getISannual                                    .saveYan              *
 * .getCFannual                                    .saveFinStatement     *
 *-----------------------------------------------------------------------*
 * >.show_usGDPannual      # find the usage of this function             *
 * >.getdata              # back to this menu                            *
 * >.fm                   # back to the main menu                        *
 *-----------------------------------------------------------------------*
```

All functions are self-explanatory. After typing the name of a function, we see its objective, formula used (if any), the meaning of an input/inputs and a few examples. For example, the following image is the result of typing `.show_usGDPannual`.

```
> .show_usGDPannual
function(n=2){
"Objective : show US annual GDP value
        n    : number of observations (default is 2)
              n > 0 for the first n obs
              n < 0 for the last  n obs
              n = 0 for all obs

     source:  http://www.usgovernmentspending.com/download_raw
     Unit   : billion


Example 1:> .show_usGDPannual()
             DATE GDP_CURRENT GDP2009DOLLAR
          1 1929        104.6         1056.6
          2 1930         92.2          966.7

Example 2:> .show_usGDPannual(-3)
              DATE GDP_CURRENT GDP2009DOLLAR
          85 2013       16663.2        15583.3
          86 2014       17348.1        15961.7
          87 2015       17947.0        16348.9


Example 3:> x=.show_usGDPannual(0)
           Launch Excel and paste
```

An efficient way to retrieve data

How efficient is our method to retrieve data? 3 second for each time series! For example, to download quarterly GDP, monthly CPI, historical daily IBM's price data, daily S&P500 index data and IBM's latest 3 years' balance-sheets, income statements and daily Fama-French factors, it should take less than 2 minute. Below is an example of retrieving monthly Fama-French 3 factors and saving them for further analysis by using Excel.

```
> x=.showff3Monthly(0)
  Launch Excel and paste
```

In total, we have just two lines of commands. The first command line would retrieve all observations and assign them to a variable called x. The second line saves x to an external file. The last line serves as a reminder of where our data file is located.

High frequency trading data

This may be a perfect example to show how to use data. To our best knowledge, no instructors have ever shown high-frequency data to their undergraduates. When one of the authors was a doctoral student at McGill, he heard professors talking about high-frequency data and read a few market Microstructure related papers. However, nobody showed doctoral students high-frequency data. Only many years after his graduation, he could access the TAQ (NYSE Trade and Quote) database. Using our methodology, viewing and retrieving several small sets of high-frequency trading data are trivial, shown below.

```
> .show_ct1day
function(n=2){
" Objective: show CT data
        n  : n > 0 for the first n obs (default is 2)
             n < 0 for the last  n obs
             n = 0 for all observations

 Example 1: > .show_ct1day()
                 SYMBOL      DATE     TIME PRICE  SIZ g127 COND TSEQ EX
             1      AC 19910131 9:35:31 17.25  600    40 2068 N
             2      AC 19910131 9:42:45 17.25 2700    40 2070 N

 Example 2: > .show_ct1day(-3)
           SYMBOL      DATE     TIME PRICE   SIZ g127 COND   TSEQ   EX
      14813    ZNT 19910131 13:16:59 12.5 10000    0          237889 N
      14814    ZNT 19910131 14:51:52 12.5   100    0          237891 N
      14815    ZNT 19910131 14:52:27 12.5  3600    0    Z     0      T

 Example 3:> x=.show_ct1day(0)
             Launch Excel and paste
```

The 1st example above shows the first 2 lines of CT (Consolidated Trade). The 2nd example shows the first 3 lines of CQ (Consolidated Quote), while the last example shows the last 5 lines of CQ. The latter retrieves all observations of this day's CQ data and saves them to an external CSV file for further analysis using Excel (the first several lines from the output file are shown below).

	A	B	C	D	E	F	G	H	I	J
1	SYMBOL	DATE	TIME	BID	OFR	BIDSIZ	OFRSIZ	MODE	QSEQ	EX
2	AC	19901101	9:30:44	12.875	13.125	32	5	10	1586	N
3	AC	19901101	9:30:47	12.75	13.25	1	1	12	0	M
4	AC	19901101	9:30:51	12.75	13.25	1	1	12	0	B
5	AC	19901101	9:30:52	12.75	13.25	1	1	12	0	X
6	AC	19901101	10:40:13	12.75	13.125	2	2	12	0	M
7	AC	19901101	13:36:15	12.875	13	32	10	12	1593	N
8	AC	19901101	13:36:17	12.75	13.125	1	1	12	0	B
9	AC	19901101	13:36:21	12.75	13.125	1	1	12	0	X
10	AC	19901101	13:40:03	12.875	13	32	8	12	1594	N
11	AC	19901101	13:46:17	12.875	13	24	8	12	1596	N
12	AC	19901101	13:46:20	12.875	13	24	5	12	1597	N
13	AC	19901101	13:55:22	12.875	13.125	24	5	12	1599	N
14	AC	19901101	13:55:24	12.75	13.25	1	1	12	0	B

Again, assigning all observations to a variable and saving it only takes a few seconds. With this data set, students could calculate spread and relative spread. For advanced topics, students could learn how to merge CT with CQ and estimate who would initiate a trade by applying Lee and Ready (1991) methodology.

In class exercises

The best way to learn Excel is via hands-on. For this reason, we have developed about 60 in-class-exercises. For each class, students will do at least 2 of them, shown by the list below:

```
'> .ice
function(i){
"
  i  Description                                        i  Description
  -  -----------                                        -  -------------
  1    =A1 What does it mean?                           41  Black-Scholes-Merton call explanation
  2    Type =is to see all related functions            42  Black-Scholes-Merton call pricing hands-on
  3    N minus 1                                        43  VBA for Black-Scholes-Merton call option
  4    PVIF (Present value interest factor) table       44  VBA for Black-Scholes-Merton put option
  5    Conditional formatting                           45  Generate random numbers
  6    Percentage vs. log returns, solver()             46  Using rand() function to estimate pi
  7    Ctrl-a,Ctrl-b, Ctrl-d (record your macros)       47  String manipulation
  8    Usages of pv(), fv(), rate(), etc.               48  Simple macro
  9    Date related functions                           49  Simple macro (2)
  10   All functions related to Date & time             50  hit Ctrl-a to call a macro
  11   A true NPV function: NPVyan                       51  VBA   =todayPrice('ibm')
  12   SEC filings                                       52  Slot machine (2) linking with pictures
  13   CIK-ticker mapping                                53  normal distribution
  14   VBA 4 geometric mean                             54  help, print instruction and var-cor matrix
  15   VBA for durationYan                               55  Simulate stock price from t to t+1
  16   VBA for LPSD                                      56  Simulate terminal stock price sT
  17   Is IBM's daily mean return zero?                 57  pricing a call (put) by using simulation
  18   Test for equal-mean and equal-variance          58  Asian options
  19   Benford law example                              59  Powerball Simulation
  20   IMB daily returns follow a normal distribution?  60  VaR (assume a normal distribution)
  21   Excel rate() vs. yield() function                61  VBA for variance-covariance matrix
  22   Usage of logRet                                  62  correlated random numbers and efficient frontier
  23   All combinations with Ctrl                       63  Benford law (2),IBM last three year balance sheets
  24   Generate a table/choose a name from a list       64  January effect
  25   Return the 'left column' using Vlookup() function 65  Excel matrix manipulations
  26   Simple Event study (just one)                    66  spread estimation using high-frequency data
  27   named range and named cell                       67  Auto fill
  28   logic: IF, AND, OR, NOT                          68  Benford law (1)
  29   simple graph (x vs. y)                           69  How many eggs do we have?
  30   pv of growing annuity without a formula          70  T-value and F-value
  31   VBA for present value of a growing annuity       71  draw a term-structure of interest rate
  32   enter T1, T2, to T500000 (fill -> Series ->...)  72  Converting daily returns to weekly/10-day/monthly/annual one$
  33   Slot machine (1)                                 73  vlookup()
  34   index() function                                 74  When developer is not available
  35   index() and match() functions                   75  showFormula function
  36   Randomly choose a cell from a range              76  generate ransom numbers with a seed
  37   Find one C from many O's                         77  find out all functions
  38   which party indicator                            78  Do Walmart daily returns follow a normal distribution?
  39   Vlookup() range lookup function
  40   tests of equal means and equal variances

Example 1:>.ice        # show all exercises
Example 2:>.ice(1)     # see the first one
```

A free financial calculator

A financial calculator, written in R, is available. For each function, we could see its formula, the input definitions and a few examples. In addition, we have generated several functions not available on Excel, such as `.pvGrowingAnnuity()` and `.rateYan()`. After typing `.fincal`, the following menu would pop up.

```
*------------------------------------------------*
* Financial calculator 6/2/18, yany@canisius.edu *
*------------------------------------------------*
* .pv_f              .npv_f                       *
* .pvPerpetuity      .pmtExcel                    *
* .pvPerpetuityDue   .nperExcel                   *
* .pvAnnuity         .rateYan                     *
* .pvAnnuityDue      .duration                    *
* .pvGrowingAnnuity  .modifiedDuration            *
* .bondPrice                                      *
* .fv_f                                           *
* .fvAnnuity                                      *
*------------------------------------------------*
* >.pv_f             # see the usage              *
* >.fincal           # back to this menu          *
* >.fm               # back to the main menu       *
*------------------------------------------------*
```

After typing `.rateYan`, we would see the following image:

```
> .rateYan
function(APR,method){
"Objective  : from one APR to another APR and effective rate
        APR : value of the given Annual Percentage Rate
     method : Converting method, e.g., 's2a', 's2q', 's2c'
                  a for annual
                  s for semi-annual
                  q for quarterly
                  m for monthly
                  d for daily
                  c for continuously

 Example 1: > .rateYan(0.1,'s2a')
                                  Two rates
             effective annual rate    0.1025
             APR                      0.1025

 Example 2: > .rateYan(0.1,'s2q')
                                  Two rates
             effective quarterly rate 0.02469508
             APR                      0.09878031
```

Mimic Excel

To new Excel learners, its sign convention is really confusing. To help students understand its implications, numerous functions are developed. Just typing `.mimicExcel` output many associated functions with/without such a sign convention, as shown below.

```
*--------------------------------------------------*
* Mimic Excel      by yany@canisius.edu  3/27/2018  *
*--------------------------------------------------*
* Function         Utility                          *
*--------------------------------------------------*
* .pvExcel         .pvExcelNoSignConvention         *
* .fvExcel         .fvExcelNoSignConvention         *
* .pmtExcel        .pmtExcelNoSignConvention        *
* .nperExcel       .nperExcelNoSignConvention       *
* .rateExcel       .rateExcelNoSignConvention       *
* .npvExcel        .npv_f                           *
* .effectExcel     .effectYan                       *
* .days360Excel                                     *
* .priceExcel                                       *
* .yieldExcel                                       *
*--------------------------------------------------*
* >.pvExcel        # find out the usage of pvExcel  *
* >.mimicExcel     # back to this menu              *
* >.fm             # back to the main menu          *
*--------------------------------------------------*
```

Instant access to over 40 formulae

Finance is labeled as a quantitative subject since many formulae are used. After typing `.showFormula` or `.sf` for a short name, we would see a list of 40 formulae. Typing `.sf(2)` would print the 2nd formula instantly on our screens. This is extremely convenient since students and instructors could check any formula on his/her will.

```
function(i){
"Objective: show formula
  i  NAME                                   i  NAME
 --- ------------------------------------  -- -----------------------------
  1  Install png package                   26 Percentage vs. log returns
  2  2-stock variance                      27 Portfolio beta
  3  Adjusted beta                         28 Portfolio return
  4  Annualized Variance/standard deviation 29 Portfolio variance
  5  APR to another APR                    30 Present value of annuity
  6  APR to EAR                            31 Present value of annuity due
  7  APR to Rc                             32 Present value of growing annuity
  8  Bond price                            33 Present value of growing perpetuity
  9  Call and put options                  34 Present value of one future value
 10  CAPM (Capital Asset Pricing Model)    35 Present value of perpetuity
 11  Covariance                            36 Profitability ratios
 12  Cumulative standard normal distribution 37 ROA vs. ROE
 13  Distribution of a normal distribution 38 Sharpe ratio
 14  Distribution of a standard normal     39 Sortino ratio
 15  DuPont identity                       40 Total returns with two components
 16  Fama-French 3-factor model            41 Treynor ratio
 17  Financial leverage ratios             42 Variance
 18  Free cash flows
 19  Future value of annuity
 20  Future value of annuity due
 21  Future value of growing annuity
 22  Future value of one present value
 23  Geometric Mean with just 3 values
 24  Liquidity ratio (accounting)
 25  Nominal vs. real rates


Example #1>.sf       # see this list
Example #2>.sf(1)    # how to install png
Example #2>.sf(2)    # see the fv formula
```

Data cases

Based on our teaching experience, students benefit more by doing various data cases than simply solving end-of-chapter problems. This book offers about 10 data cases by using real world data. For a one-semester course, students are given around 5 to 7 data cases depending on the length of the semester (see a partial list after typing .datacases).

```
> .datacases
function(i){
" i    Data cases
  -    ------------------------------------
  1    Estimation of an Enterprise value
  2    Financial Statement Analysis (ratio analysis)
  3    Sharpe and Treynor ratios
  4    LPSD (Lower Partial Standard Deviation) and Sortino ratio
  5    Which political party, Democratic or Republican, manages the economy better?
  6    Several stocks' beta
  7    Accounting fraud detection and Benford Law
  8    From daily returns to 10-day, weekly, monthly or annula ones
  9    VaR (Value at Risk) estimation
 10    FF3, FFC4 and FF5 models
 11    Simulating a Black-Scholes call option
 12    Simulating Asian options
 13    Slot machine simulation
 14    Number of stocks vs. portfolio risk
 15    Constructing an efficient frontier
 16    Links

Example 1:>.dc          # show all exercises
Example 2:>.dc(1)       # see the first data case
```

Paperless

When taking this course, it is paperless. For the mid-term and final exams, all questions are written in a text file. For example, for a final term, students can just type `.final` (see the image below):

```
> .final
function(){
"
  *------------------------------------------------*
  * Final Exam                       12/13/2018  *
  *------------------------------------------------*
  * Instruction                                   *
  *                                               *
  *  1) There are two parts                       *
  *  2) Part  I: 20 questions (1 point each)      *
  *  3) Part II: 2  problems plus one bonus       *
  *             a) 5 points for each problem      *
  *             b) 2 points for the bonus         *
  *             c) you can switch one problem     *
  *                   with the bonus              *
  *                                               *
  *   submit an Excel file to the dropbox on D2L  *
  *          first_name_last_name.xlsx            *
  *------------------------------------------------*
  * >.p1(1)    # for the 1st question in Part I   *
  * >.p2(2)    # for the 2nd problem  in part II  *
  * >.final    # back to this menu                *
  *------------------------------------------------*
```

All data cases and term projects work the same way, where students submit an Excel file to the Drop Box designated by their instructors.

Term projects

We firmly believe that a good term project summarizes what students have learnt by reading a book or taking a course. One chapter is devoted to this: Chapter 30: Term Projects. There are about 40 potential topics. For 20 of them, there exists a one or two-page detailed instructions (see a partial list below). Term projects are for group exercises with a maximum of 3 group members. In addition to submitting an Excel file and a Word document, students have to make a presentation in front of the whole class.

```
> .c30
function(i){
" i  Chapter 30: Term projects
   -  -----------------------------------
   1  Requirements for a term project
   2  Retirement calculator
   3  Which one is the best? CAPM, FF3, FFC4, or FF5
   4  Test of the January Effect using Excel
   5  Bankruptcy prediction by using Z-score
   6  Updating a monthly Excel data set and write an instruction
   7  Momentum trading strategy
   8  52-week high trading strategy replication
   9  Max trading strategy replication
  10  Spread estimation from daily price
  11  Event Study using Excel
  12  Monte Carlo Simulation to mimic a slot machine
  13  Monte Carlo Simulation to mimic Black Jack
  14  Benford Law and accounting fraud detection
  15  Readability of 10-K filings and firm's performance
 `16  Business cycle indicator
  17  illiquidity measure, Amihud (2002)
  18  Liquidity measure, Pastor and Stambough (2003)
  19  Spread estimation from TAQ (Trade and Quote) high-frequency data
  20  A reverse mortgage calculator
  21  KMV model and default probability
  22  Financial statement analysis
  23  Black-Litterman model
  24  Brandt, Santa-Clara and Valkanov model (2009)
  25  SEC filings
  26  Projects taken already

Example #1:>.c30      # see the above list
Example #2:>.c30(1)  # see the first explanation
```

Over 80 YouTube videos

For many finance and Excel topics, there exist wonderful YouTube videos. For certain students, they learn better by watching these types of videos rather than sitting in a classroom listening to dry lectures. For those students, they could watch various YouTube videos listed (see a list below):

```
> .youtube
function(i){
" i  youTube for finance
  -  -----------------------------------
  1  YouTube (3)   Time value of money
  2  YouTube (5)   Financial statement analysis
  3  YouTube (5)   CAPM (Capital Asset Pricing Model)
  4  YouTube (6)   Multi-factor models (FF4, FFC4, FF5)
  5  YouTube (5)   Portfolio analysis
  6  YouTube (4)   Call and put options
  7  YouTube (6)   various distributions, such as normal
  8  YouTube (7)   T-test,F-test, tests of equal mean and equal variance
  9  YouTube (10) Monte Carlo Simulation
 10  YouTube (6)   Credit analysis
 11  YouTube (8)   Excel basics
 12  YouTube (5)   Excel date,year(), month(), day()
 13  YouTube (6)   Simple Macro
 14  YouTube (7)   Simple VBA
 15  YouTube (7)   pivot Table
 16  YouTube (6)   vlookup, solver
 17  YouTube (6)   Conditional formatting
 18  YouTube (8)   Data input and output
 19  YouTube (8)   String manipulations
 20  YouTube (12) Data manipulations

 Example #1:> .yt    # get the above list
 Example #2:> .yt(1) # see the first explanation
```

Visual finance

Through various graphs, figures and images, students can understand finance theory better. For example, we could use sizes of $100 values today, in one year, or in 20 years to show the concept of the time value of money.

Many web sites plus 40 references

Students and instructors could find extra resources easily. With the help of R, we have included dozens of links for various topics and over 40 published papers.

Many utility functions

To help students learn and understand Excel and finance better, many utility functions are developed, such as .mimicExcel and .showFormula. To find all utility functions, just type .uu (see the image below):

```
*----------------------------------------*
* Utilities          -- short-cut --     *
*----------------------------------------*
* .inClassEx         # .ice              *
* .getData           # .gd       .gg     *
* .finCalculator     # .fincal           *
* .mimicExce         # .me       .mm     *
* .dataCases         # .dc       .dd     *
* .termProjects      # .tp       .tt     *
* .showFormula       # .sf       .ss     *
*----------------------------------------*
* .explainR          # .er       .ee     *
* .interactive       # .ia       .ii     *
* .usefulLinks       # .ul       .ll     *
* .references        #           .rr     *
* .youTube           # .yt       .yy     *
* .visualFinance     # .vf       .vv     *
* .funs              #           .ff     *
* .midTerm           # .md              *
* .finalExam         # .fe              *
*----------------------------------------*
* >.ice              # see a list of ice *
* >.uu               # back to utilites  *
* >.fm               # back to main menu *
*----------------------------------------*
```

No focus on Excel Macro and VBA

For this book, we would not discuss Excel macros nor VBA for two reasons. First, we hope to make this book very useful for all readers including ones who have no prior knowledge about Excel. Second, even though Macro and VBA are quite useful, we argue that R and Python are way more powerful. With the same efforts, users would benefit more by leaning towards R or Python. With this in mind, students would spend one hour for Macro and one hour for VBA. For example, students learn how to copy-and-paste others' VBA (see a list below):

```
> .c28
function(i){
" i  Chapter 28: Simple VBAs        i  More ......
   -  ------------------------------  --  ----------------------
   1  Developer is not available      21  VBA 4 Black model (call on futures)
   2  Copy-and-paste others' VBA      22  VBA 4 converting 23.23
   3  correct file extension: *.xlsm  23  VBA 4 todayPrice()    ??
   4  VBA 4 doubling an input value   24  VBA 4 getting financial statements
   5  VBA 4 for mean                  25  VBA 4 Cholesky decomposition
   6  VBA 4 estimating the area       26  VBA 4 LPSD (Lower Partial Standard Deviation)
   7  VBA 4 showFormula() function    27  VBA 4 Sortinor ratio
   8  VBA 4 converting miles to km    28  VBA 4 financial statements (2)
   9  VBA 4 pvGrowingAnnuity          29  VBA 4 removeErr() funciton
  10  VBA 4 fvGrowingAnnuity          30  VBA 4 meanGivenProb
  11  VBA 4 geometric mean:geomeanYan 31  VBA 4 varGivenProb
  12  VBA 4 effective rate:EFFECTyan()32  VBA 4 finding duplicates
  13  VBA 4 NPV function: NPVyan()    33  VBA 4 finding duplicates (2)
  14  VBA 4 pvPerpetuity              34  VBA 4 noRepeats
  15  VBA 4 varCovariance matrix      35  VBA 4 durationYan
  16  VBA 4 correlation matrix        36  VBA 4 modifed duration
  17  VBA 4 PV(growing perpetuity)    37  VBA 4 bond convexity
  18  VBA 4 Black-Scholes call option 38  VBA 4 bond price
  19  VBA 4 Black-Scholes put  option 39  VBA 4 second highest value
  20  Links                          40  VBA 4 freqGivenNumber

  Example #1:>.c28     # find out the above list
  Example #2:>.c28(1)  # see the first explanation
```

Interactive mode

When students are actively engaged, they tend to learn better. For this reason, the interactive mode is designed. For example, it is a difficult task to convert an effective rate to another one or estimate APR (Annual Percentage Rate) with certain compounding frequencies a given APR. With interactive mode, students could enter their own interest rates with their corresponding frequencies and choose their designed interest rates for output.

First and last weeks

When taking "Financial Modeling using Excel" with this book, the structures of all lectures are quite similar (see the first week's menu below):

```
*-------------------------------------------------------------*
* Financial Modeling with Excel  2018 yany@canisius.edu  *
*-------------------------------------------------------------*
*  1: R installation/Excel basics  * 16: R basics         *
*-------------------------------------------------------------*
* >.c1        # go to chapter 1 (a dot in front c1)        *
* >.c16       # go to chapter 16                           *
* >.fm        # back to the main menu                      *
*-------------------------------------------------------------*
```

And below is the last week's menu:

```
*-------------------------------------------------------------*
* Financial Modeling with Excel     2018  yany@canisius.edu  *
*-------------------------------------------------------------*
*   .c1 R installation/Excel basics  .c16 R basics           *
*   .c2 Time value of money          .c17 Excel basics (II)  *
*   .c3 Financial statement analysis .c18 Data sources       *
*   .c4 Risk vs. return              .c19 Utility functions  *
*   .c5 T-test, F-test               .c20 Issues with Excel  *
*   .c6 Bond and stock evaluation    .c21 vlookup, solver    *
*   .c7 CAPM                         .c22 Data input         *
*   .c8 FF3, FFC4, FF5, etc.         .c23 Data manipulation  *
*   .c9 Various distributions        .c24 Data output        *
* .c10 Black-Scholes option model    .c25 Simple graph       *
* .c11 Monte Carlo Simulation        .c26 Excel matrix       *
* .c12 VaR (Value at Risk)           .c27 Simple Macros      *
*                                    .c28 Simple VBAs        *
*                                    .c30 Term projects      *
*-------------------------------------------------------------*
* >.c27           # go to chapter 27                         *
* >.uu            # go to utilities                         *
* >.fm            # back to the main menu                    *
*-------------------------------------------------------------*
```

Easy to modify and extend

Since all programs are prewritten and publicly available, the instructor would not spend extra time if he/she wants adopt the same teaching methodology. In other words, the instructors do not need to spend time on those programs. On the other hand, an instructor could easily modify those files since they are all written in a text format.

Instructors' tool box

For this course, we supply several tools for a potential instructor, such as .schedule() and .weekly() functions. For example, today is September 7. When launching R, the following schedule would pop up.

```
              Date                              Tasks
1 09/08(Friday)      Senate meeting SH1013 2:00pm-4:00pm
2 09/07(Thursday) FIN414  and FIN455
```

It tells us that we have to teach FIN414 and FIN455 today and tomorrow we would have a senator meeting starting from 2:00pm to 4:00pm. The input file has a very simple structure with a text format (see the first several lines below). Another beauty of such an input file is that we could use it next year with minor modification.
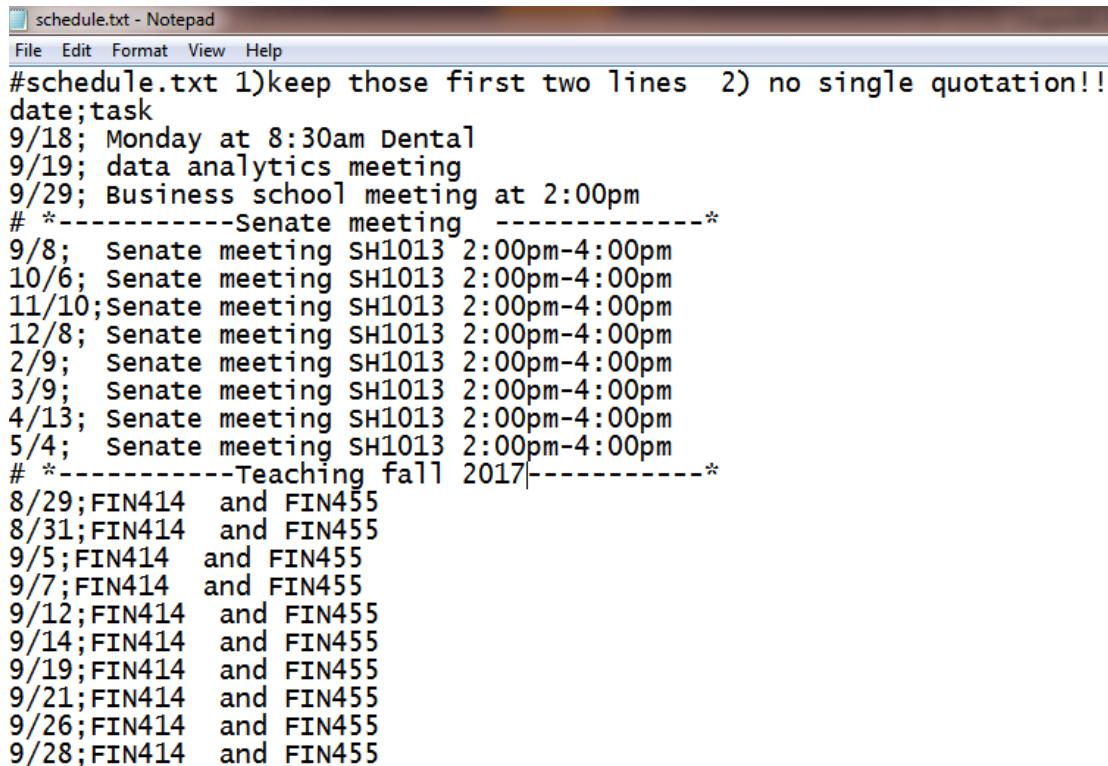
```
schedule.txt - Notepad
File  Edit  Format  View  Help
#schedule.txt 1)keep those first two lines  2) no single quotation!!
date;task
9/18; Monday at 8:30am Dental
9/19; data analytics meeting
9/29; Business school meeting at 2:00pm
# *-----------Senate meeting  ------------*
9/8;   Senate meeting SH1013 2:00pm-4:00pm
10/6; Senate meeting SH1013 2:00pm-4:00pm
11/10;Senate meeting SH1013 2:00pm-4:00pm
12/8; Senate meeting SH1013 2:00pm-4:00pm
2/9;   Senate meeting SH1013 2:00pm-4:00pm
3/9;   Senate meeting SH1013 2:00pm-4:00pm
4/13; Senate meeting SH1013 2:00pm-4:00pm
5/4;   Senate meeting SH1013 2:00pm-4:00pm
# *-----------Teaching fall 2017-----------*
8/29;FIN414  and FIN455
8/31;FIN414  and FIN455
9/5;FIN414  and FIN455
9/7;FIN414  and FIN455
9/12;FIN414  and FIN455
9/14;FIN414  and FIN455
9/19;FIN414  and FIN455
9/21;FIN414  and FIN455
9/26;FIN414  and FIN455
9/28;FIN414  and FIN455
```

For our teaching practices, we have a short check-list before each lecture. This short list could include several items, such as attendance list, which chapter or contents to be covered, which data cases to be distributed, which in-class exercise and the like. For this purpose, we have designed a function called .weekly(), see one example below. The output is for the first week of Financial Modeling using Excel.

```
> .weekly(2)
cat(.weekly2)
///////////////////////////////////
  1) Attendance list
  2) =PV(
  3) =FV(
  4) =Nper(
  5) =rate(

Second day
-----------------------
   1) Attendance list
   2) NPV rule
   3) a true NPV function
   4) effective rate conversion
   5) data case #1

///////////////////////////////////
```

In this case, we have two classes for each week. Another beauty is that we could modify this text file quite easily when we have something left over for the next class.

What this book covers

Chapter 1, R installation and Excel Basics, explains how to install R software and teaches many basic Excel concepts such as Excel being a two dimensional spreadsheet and relative and absolute addresses.

Chapter 2, Time value of Money, reviews basic concepts of finance: time value of money, various formulae to estimate present and future values.

Chapter 3, Financial Statement Analysis, first discusses the design of the balance-sheet, income statement and cash flow statement, then several important ratios such as the current ratio, debt equity ratio and DuPont identity.

Chapter 4, Risk vs. Return, introduces various definitions of return, such as total return, dividend yield, capital gain yield, time-weighted return vs. dollar weighted returns, various definitions of risk (such as variance, standard deviations, LPSD (lower Partial Standard Deviation)) and trade-offs between benefit (returns) and cost (risk): Sharpe ratio, Treynor ratio, Sortino ration and a utility function.

Chapter 5, Interest rate and bond/stock evaluation, starts with a discussion of various definitions of rates, APR (annual percentage rate), EAR (Effective Annual Rate), how to convert one effective rate to another one, and how to evaluate bond and stock.

Chapter 6, T-test, F-test and normality test, discusses various import tests for learning finance and conducting empirical research: T-test, F-test, χ^2 test and normality tests.

Chapter 7, CAPM, reviews the CAPM (Capital Asset Pricing Model), the simplest one-factor linear model to estimate the cost of equity.

Chapter 8, Fama-French 3 factor model and other multi-factor models extends CAPM, discussed in the previous chapter, to various multi-factor models such as FF3, FFC4 and FF5.

Chapter 9, Various distributions, discusses uniform distribution, normal distribution and their related Excel functions.

Chapter 10, Black-Scholes-Merton option model, discusses the concepts of options in detail: call, put and the famous Black-Scholes-Merton call and put models. In addition, various trading strategies involving options are explained in detail.

Chapter 11, Monte Carlo Simulation, offers a short introduction to MCS, and explains how to generate various types of random numbers (such as from an evenly distribution and a normal distribution), and how to simulate stock prices and returns.

Chapter 12, VaR (Value at Risk), explains another important risk measure: VaR and procedures on how to estimate VaR for individual stocks and portfolios.

Chapter 13, Liquidity measure and high-frequency data, first explains why liquidity measure is important, then introduces several measures such as Illiquidity measure, Amihud (2002), Pastor and Stambough (2003) liquidity measure. In addition, students use free high-frequency data to measure spread and relative spread to verify different liquidity measures generated by low-frequency data such as daily or monthly data.

Chapter 14, Portfolio Theory, discusses many aspects related to portfolio analysis such as definitions of covariance, correlation, and how to estimate the variance covariance matrix.

Chapter 15, Credit Risk Modeling, explains the spread, the relationship between yield spread and credit rating, Z-score and credit spread migration matrix.

Chapter 16, R basics, is an optional chapter, which means that readers who are afraid of programming could safely skip this chapter. In this 8-page long short chapter, we discuss how to download R software, launch/quit R and about 2 dozen basic concepts, such as whether R is case sensitive, and how to assign a value to a new variable.

Chapter 17, Excel Basics (II), offers more basic Excel concepts in addition to those introduced in Chapter 1: R installation and Excel Basics.

Chapter 18, Data Sources, lists all public data courses used in this book for Economics, Finance and Accounting. To get the major menu, we simply type `.getdata`.

Chapter 19, Utility Functions, lists the so-called utility functions for learning Excel, such as `.getdata` (get all types of public data), `.mimicExcel`, `.fincal` (a free financial calculator), `.midTerm`, `.finalExam`, `.dataCases` and `.termProjects`.

Chapter 20, Issues with Excel, explains several issues with Excel such as the Excel sign convention, how to treat blanks and inconsistencies for several Excel functions. One example of such an inconsistency is that `stdev()` is for sample, while `covar()` is for population.

Chapter 21, Vlookup and solver, explains two extremely useful Excel functions called `vlookup()` and solver procedure.

Chapter 22, Data Input, offers detailed explanations for various input methods: csv (comma separated value), text file and from web links.

Chapter 23, Data Manipulation, shows many ways to manipulate input data such as converting daily returns into weekly, monthly or annual ones, how to construct a good date variable and how to merge stock data with index data by date,

Chapter 24, Data Output, shows several output formats (e.g., csv format, text format) to save our data.

Chapter 25, Simple graphs, offers a short introduction, and explains how generate an x-y graph, bar, and chart as well as add titles and legends.

Chapter 26, Excel Matrix Manipulation, explains concepts of rows, columns, matrices and how to use Excel function such as `mmult()` and `transpose()` to manipulate them.

Chapter 27, Simple Macros, focuses on how to record a simple macro and how to copy-and-paste others' macros.

Chapter 28, Simple VBAs, similar to the previous chapter, focuses on how to copy-and-paste other's VBAs. In total, around 2 dozen VBAs are available for students to practice on.

Chapter 29, Pivot table, explains how to use the Pivot Table to solve various problems. One example is how to convert daily returns into weekly, 10-day, monthly or annual ones.

Chapter 30, Term Projects, offers a list of 40 potential topics for a term paper. For many of them, there exists a one or 2-page detailed description on how to download and process data.

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