Data Analytics in Business

Zhaohu (Jonathan) Fan

Information Technology Management

Scheller College of Business

Georgia Institute of Technology

September 26, 2024

Week 6: Upcoming deadlines and updates

- **Week 6 (Module 6)** is now available.
- **(Graded) Self-Assessment 5** has been released and is due by this Sunday, September 29, at 11:59 PM EST.
- **(Graded) Group Project Proposal** is due by next Sunday, October 6, at 11:59 PM EST
- **(Graded) Homework #2:** is now available and is due in three weeks, by Sunday, October 13, at 11:59 PM EST. This assignment includes:
  - **Homework #2, Part 1 (Theoretical): One attempt allowed.**
  - **Homework #2, Part 2 (Computation): One attempt allowed.**
  - You can work on both parts as much as you want within the due period, but remember to click "submit" only when you're completely ready.
- **Piazza Forum:** Always open for questions! It's the perfect place to interact with our teaching team and your classmates.

Vote for Your favorite TA of September

Scan me

- Or click on the link provided below.
  - Survey link

Main topics

- **Module 2: Finance & Investment (weeks 6-8)**
    - Week 6: Introduction, and Measuring Risk and Return

Introduction, and Measuring Risk and Return

Introduction: investing analytics

- Simple and compound returns(`Return.cumlative()` and `chart.CumReturns()`)
    - **Stock splits (e.g., 3 for 2)**
    - Dividends

Example I: stock split

We will calculate the new price per share after a stock split.

- **Scenario**: The original stock price is `$30.375` per share before the split. We have a **3 for 2** stock split.
- **The split ratio means that for every 2 shares owned before the split, the shareholder now owns 3 shares. To find the new price per share, we divide the old price by the split ratio of `1.5` (which is the equivalent of `3/2`).**

- **R code**

```r
# Step 1: Old price before the stock split
old_price <- 30.375
# Step 2: The split ratio is 3 for 2
split_ratio <- 1.5
# Step 3: Calculating the new price per share after the stock split
new_price <- old_price / split_ratio
```

- **Output**

```
 *new_price
20.25
```

Measuring risk

- **Measures of risk**
  - Standard deviation (SD): measures variation by looking at how far observations are from the mean
    - **a measure of total risk**
    - `table.Stats()`
  - Beta (β): a measure of a stock's sensitivity to overall market movements/measures sensitivity to market movements
    - e.g., **a risk free asset has a β=0 and the overall stock market has a β=1**.
  - R^2 : a measure of the percentage of the fund's performance that occurs as a result of the market
  - Compounded return
  - Drawdown: measures the peak to trough decline in your investment
    - cumulative loss since losses started
    - `chart.Drawdown()` and `table.Drawdowns()`
  - **Sharpe ratio** (e.g., Return–Risk free rate)/Standard Deviation of excess return)

Simple returns

- Calculating Simple Returns in R
    - This example demonstrates how to calculate the simple return of a stock, including dividends. The formula for the simple return is:
        - $\text{Simple Return} = \frac{\text{Closing Price}_{\text{end}} + \text{Dividend} - \text{Closing Price}_{\text{start}}}{\text{Closing Price}_{\text{start}}}$

Output

```
        Date Close Dividend SimpleReturn
1 2023-01-01   100        0           NA
2 2023-01-02   105        2         0.07
```

Calculating simple returns in R

R code

```r
# Example data
data <- data.frame(
  Date = as.Date(c('2023-01-01', '2023-01-02')),
  Close = c(100, 105),  # Adjusted closing prices
  Dividend = c(0, 2)    # Dividends paid out
)

# Calculating simple return
data$SimpleReturn <- with(data, (Close + Dividend) / lag(Close)-1)

# Viewing the results
print(data)
```

Output

```
##          Date Close Dividend SimpleReturn
## 1 2023-01-01   100        0           NA
## 2 2023-01-02   105        2         0.07
```

For more details, see the "Simple-Return.R" file, under 'Instructor's Session Files

Calculating simple returns in R (cont'd)

Note:

- The `shift()` function from the `data.table` package achieves the same result as the `dplyr` package's `lag()` function.
  - Please click on the link provided below.
  - `shift` function

Q&A

- **Q:** which stock is most/least risky based on standard deviation. For this purpose are we to consider the standard deviation of the "market" to be a stock?`

Q&A (cont'd)

- **Q:** which stock is most/least risky based on standard deviation. For this purpose are we to consider the standard deviation of the "market" to be a stock?`
    - **A:** In simple terms, no, we usually don't treat the market's standard deviation as a stock. The market is more like a backdrop to compare how risky each individual stock is. We look at the market to get a sense of the overall risk, but we don't call it a stock itself.

Open for discussion

What is the topic for next week?

Factor investing

Factor investing

Prior academic research has uncovered a number of fundamental factors that drive stock returns: `Click on the link: Description of Fama/French Factors`

- **Size (SMB)**
  - A positive coefficient on SMB indicates that the fund is tilted toward small cap stocks.
- **Market Value (HML)**
  - A positive coefficient on HML indicates that the fund is titled toward value stocks.
- **Momentum (MOM)**
  - A positive coefficient on MOM indicates that the fund is tilted toward high momentum stocks.
- **Risk (BAB)**
  - A positive coefficient on BAB indicates that the fund is titled toward safe stocks.
- **Quality (QMJ)**
  - A positive coefficient on QMJ indicates that the fund is titled toward profitable stocks.

Run factor regressions in R

We typically estimate factor models using linear regression:

- **The dependent variable** r^{fund}- r^{f} is typically the **fund's excess return above the risk free rate**.
- **The factors are typically the independent variables**.
  - Market Beta r^{m} - r^{f}, Size (SMB), Market Value (HML), Quality (QMJ)...
- The constant term (intercept) captures alpha: the measure of skill for the fund manager
  - **A positive (negative) alpha** and significant coefficient indicate the fund manager is **outperforming (underperforming)** the regression- based benchmark

R code

```
factor1 ← lm(Contra.rf~Mkt_rf, data=data)
factor3 ← lm(Contra.rf ~ Mkt_rf+SMB+HML, data = data)
factor4 ← lm(Contra.rf ~ Mkt_rf+SMB+HML+Mom, data=data)
factor6 ← lm(Contra.rf~Mkt_rf+SMB+HML+Mom+BAB+QMJ, data=data)
```

	Dependent variable:			
	Contra.rf			
	(1)	(2)	(3)	(4)
Mkt_rf	0.901***	0.885***	0.913***	0.914***
	(0.019)	(0.020)	(0.019)	(0.022)
SMB		0.048*	0.042	0.038
		(0.029)	(0.027)	(0.030)
HML		-0.048	0.004	-0.070**
		(0.030)	(0.029)	(0.032)
Mom			0.132***	0.096***
			(0.018)	(0.019)
BAB				0.150***
				(0.025)
QMJ				-0.011
				(0.045)
Constant	0.002***	0.002***	0.001	0.0004
	(0.001)	(0.001)	(0.001)	(0.001)
Observations	462	462	462	462
R^2	0.833	0.835	0.852	0.863
Adjusted R^2	0.832	0.834	0.851	0.861
Residual Std. Error	0.018 (df = 460)	0.018 (df = 458)	0.017 (df = 457)	0.016 (df = 455)
F Statistic	2,288.618*** (df = 1; 460)	773.335*** (df = 3; 458)	658.014*** (df = 4; 457)	478.797*** (df = 6; 455)
Note:				*p<0.1; **p<0.05; ***p<0.01

Note: The numbers in parentheses represent standard errors.

	Dependent variable:			
	Contra.rf			
	(1)	(2)	(3)	(4)
Mkt_rf	0.901***	0.885***	0.913***	0.914***
	(0.019)	(0.020)	(0.019)	(0.022)
SMB		0.048*	0.042	0.038
		(0.029)	(0.027)	(0.030)
HML		-0.048	0.004	-0.070**
		(0.030)	(0.029)	(0.032)
Mom			0.132***	0.096***
			(0.018)	(0.019)
BAB				0.150***
				(0.025)
QMJ				-0.011
				(0.045)
Constant	0.002***	0.002***	0.001	0.0004
	(0.001)	(0.001)	(0.001)	(0.001)
Observations	462	462	462	462
R^2	0.833	0.835	0.852	0.863
Adjusted R^2	0.832	0.834	0.851	0.861
Residual Std. Error	0.018 (df = 460)	0.018 (df = 458)	0.017 (df = 457)	0.016 (df = 455)
F Statistic	2,288.618*** (df = 1; 460)	773.335*** (df = 3; 458)	658.014*** (df = 4; 457)	478.797*** (df = 6; 455)

Note: *p<0.1; **p<0.05; ***p<0.01

- Model 4 (six-factors model):Four coefficients are significant.
  - `Mkt_rf` : The fund has a market beta of 0.914.
  - `HML` : The fund is tilted away from value stocks.
  - `MOM` : The fund is tilted toward high momentum stocks.
  - `BAB` : The fund is tilted toward safe stocks (those with low beta).