MA678 project

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Abstract

Multilevel models are a generalized form of traditional linear regression models and have the ability to directly model the time-series/cross-sectional nature of financial security returns. Baesd on the method that multilevel models generalize well-known asset pricing regression techniques like Fama-Macbeth and FamaFrench regressions, I fit the model to predict return of stock/

Introduction to WLTW

column names	explanation
Ticker symbol	WLTW
Securities	Willis Towers Watson
SEC filings	reprots
GICS Sector	Financials
GICS Sub Industry	Insurance Brokers
Address of Headquaters	London, United Kingdom
Date first added	2016/1/5
CIK	1140536

Data description

Datasets are from Kaggle, here is the link:https://www.kaggle.com/dgawlik/nyse (https://www.kaggle.com/dgawlik/nyse) Dataset consists of following files: 1)prices.csv: raw, as-is daily prices. Most of data spans from 2010 to the end 2016, for companies new on stock market date range is shorter. There have been approx. 140 stock splits in that time, this set doesn't account for that. 2)prices-split-adjusted.csv: same as prices, but there have been added adjustments for splits. 3)securities.csv: general description of each company with division on sectors 4)fundamentals.csv: metrics extracted from annual SEC 10K fillings (2012-2016), should be enough to derive most of popular fundamental indicators.

Symbol description

A ticker symbol or stock symbol is a unnique series of letters assigned to a security for trading purpose. Stock listed on the New York Stock Exchange can have four or fewer letters. Symbols are just a shorthand way of describing a company's stock.

	date <chr>	symbol <chr>	open <dbl>	close <dbl>	low <dbl>	high <dbl>	volume <dbl>
1	2016-01-05 00:00:00	WLTW	123.43	125.84	122.31	126.25	2163600
2	2016-01-06 00:00:00	WLTW	125.24	119.98	119.94	125.54	2386400

	date	symbol	open	close	low	high	volume
	<chr>	<chr>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>
3	2016-01-07 00:00:00	WLTW	116.38	114.95	114.93	119.74	2489500
4	2016-01-08 00:00:00	WLTW	115.48	116.62	113.50	117.44	2006300
5	2016-01-11 00:00:00	WLTW	117.01	114.97	114.09	117.33	1408600
6	2016-01-12 00:00:00	WLTW	115.51	115.55	114.50	116.06	1098000

6 rows

Visulization

The first plot shows the change Open Pice and Close Price during 2016, the second plot shows the difference between Low Price and High Price, the third plot showsthe volume of WLTW stock. According to the above plots, the trend of High Price is similar to the trend of moment price which is midway between High Price and Low Price. Based on the analysis and actual situation of the stock market, I use High Price to calculate Market Capitalization Weighted Index. (The explanation is in Appendix.)

Method: Multilevel Model

For simplicity, let us start with estimating an asset's CAPM β via linear regression. Exposure to the market factor, β, is measured as the slope of a regression with the security's return R_i as the explained variable and the return of the market-cap weighted index X_{mkt} as the explanatory variable. The α component, or the intercept of this regression, is meant to represent the return of a security in excess of what can be explained through exposure to the market. The model is given by

$$R_i = \alpha_i + \beta_i X_{mkt} + \epsilon_i$$

Each security i is given it's own β_i and α_i for securities $1, \dots, n$.

Multilevel models generalize these cases, and directly condition the slope and intercept on both global (pooled) information and group-level information. If information is strong enough for either approach, the model will converge to global or group-level models. We can think of these as a set of related models, where R_i is related not only to stock-specific information (β_i and α_i) but also to global parameters (β_0 and α_0). This model is given by

$$R_i = \alpha_0 + \alpha_i + \beta_0 X_{mkt} + \beta_i X_{mkt} + \epsilon_i + \epsilon_0$$

The no pooling models are given by

$$R_i = \alpha_i + \beta_{i,1} X_{mkt} + \epsilon_i$$

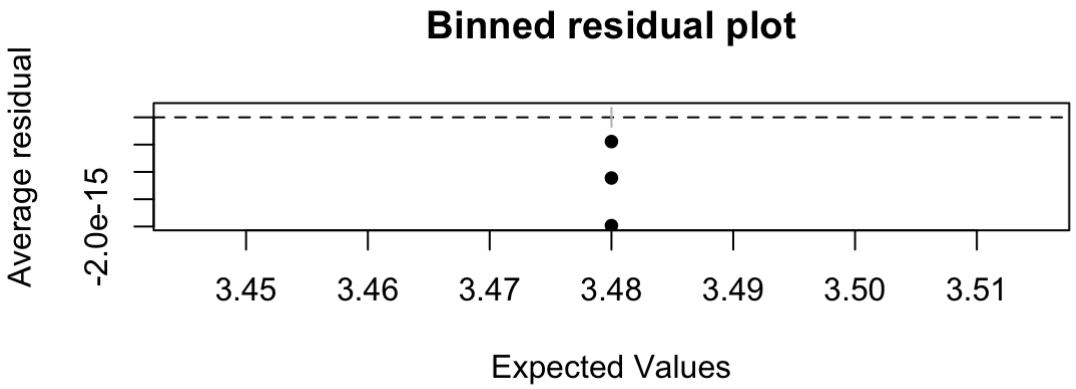
	outstanding	mkt.cap	CWI.composite	mkt-cap weighted
1	216360000	27315450000	39597.1	0.0007565925
2	238640000	29958865839	39597.1	0.0007528146
3	248950000	29809272502	39597.1	0.0005950433
4	200630000	23561987601	39597.1	0.0004173817
5	140860000	16527104082	39597.1	0.0003218263

The above table shows part of the data. Outstanding represents the number of stocks that is outstanding in market, mkt.cap represents market capitalization, CWI composite is total capitalization, and mkt-cap weighted represents market capitalization weighted index.

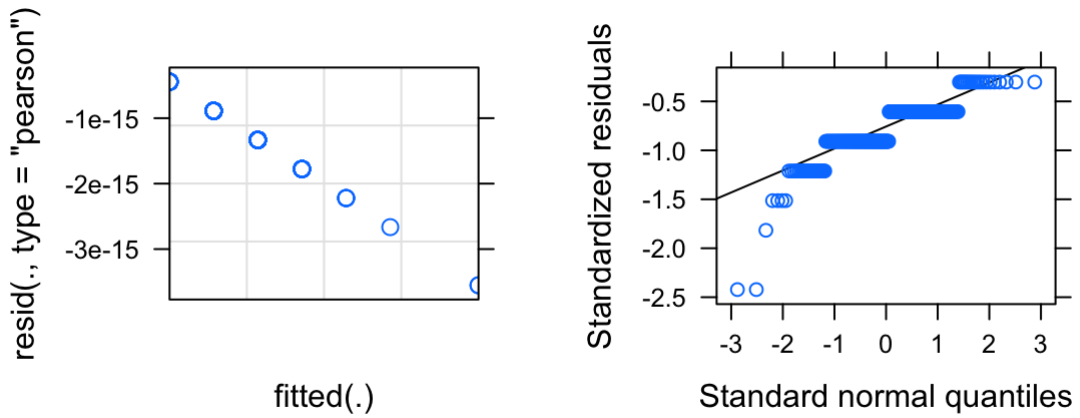
fitting model

	Estimate	Std. Error	t value
(Intercept)	3.480e+00	2.599e-16	1.339e+16
mkt cap weighted index	5.502e-12	9.235e-13	5.957e+00

Result:Model validation



Residual plot and Q-Q plot.



Residual plot and Q-Q plot.

According to the residual plots, the model needs a lot of improvement. According to the qq plot, many dots are not one the line, the nnormality is not good.

Discussion

As the stock market is complex and volatile, we should consider more influencing factors.

Reference

https://corporatefinanceinstitute.com/resources/knowledge/trading-investing/capitalization-weighted-index/ (https://corporatefinanceinstitute.com/resources/knowledge/trading-investing/capitalization-weighted-index/)

https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3411358 (https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3411358)

https://www.slickcharts.com/sp500 (https://www.slickcharts.com/sp500)

Appendix

The market-cap weighted index X_{mkt} (CWI) is a type of stock market index in which each component of the index is weighted relative to its total market capitalization.

$$Market\ Capitalization = StockPrice \times No.\ of\ Shares\ Outstanding$$

The total market capitalization of the index is the sum of the market capitalization of all the components. Therefore, the market capitalization of the CWI composite is:

$$CWI\ Compostie = Market\ Capitalization_1 + Market\ Capitalization_2 + \cdots + Market\ Capitalization_n$$

The weight og each index component is determined using the formula below:

$$Weight_i = \frac{Market\ Capitalization_i}{CWI\ Composite} \times 100\%$$