the time-varing process of

beta coefficient

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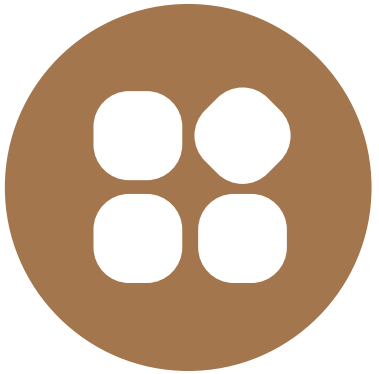
CAPM model



03

Program with python

Part 1

Background

Beta Coefficient

A **MEASURE** of systematic risk of a portfolio in comparison to the market

BETA is used in the capital asset pricing model (CAPM)

It **INDICATES** whether the investment is more or less volatile than the market

CAPM model calculates the expected return of an asset based on β and expected market returns

Beta measures...

the risk of an investment that cannot be reduced by diversification.
the amount of risk the investment adds to an already-diversified portfolio.

Beta does not measures...

the risk of an investment held on a stand-alone basis

The value of Beta

The market portfolio(市场组合) of all investable assets has a β of exactly 1

$\beta > 1$

more volatile than the market

the asset tends to move up and down with the market.

(e.g. a stock in a big technology company)

$0 < \beta < 1$

less volatile than the market

price movements are not highly correlated with the market

(e.g. a treasury bill, gold)

The value of Beta

The market portfolio(市场组合) of all investable assets has a β of exactly 1

$\beta < 0$

investments go down when the market goes up (e.g. some derivatives(衍生品) like put options can have large negative betas.)

$\beta = 0$

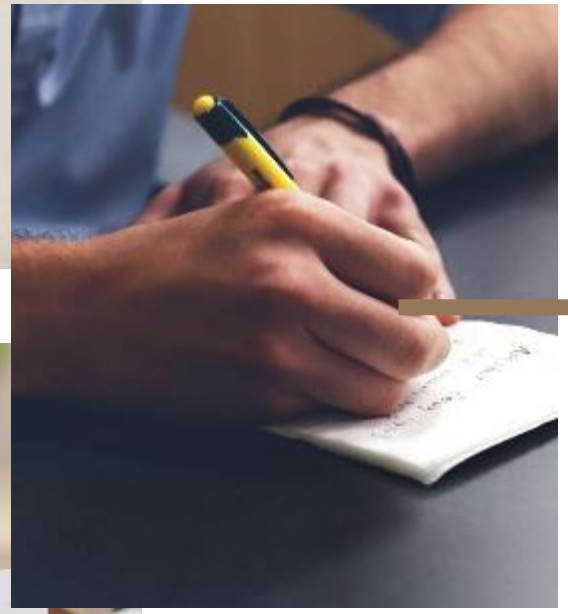
uncorrelated to the market (e.g. Fixed-yield asset)

Summary Sheet

Value of Beta	Interpretation	Example
$\beta < 0$	Asset movement is in the opposite direction of the benchmark	An inverse exchange-traded fund or a short position
$\beta = 0$	Asset movement is uncorrelated to the benchmark	Fixed-yield asset, whose growth is unrelated to the movement of the stock market
$0 < \beta < 1$	Asset moves in the same direction, but in a lesser amount than the benchmark	Stable, "staple" stock such as a company that makes soap. Moves in the same direction as the market at large, but less susceptible to day-to-day fluctuation.
$\beta = 1$	Asset moves in the same direction and in the same amount as the benchmark	A representative stock, or a stock that is a strong contributor to the index itself.
$\beta > 1$	Asset moves in the same direction, but in a greater amount than the benchmark	Stocks which are very strongly influenced by day-to-day market news, or by the general health of the economy.

Part 2

CAPM model



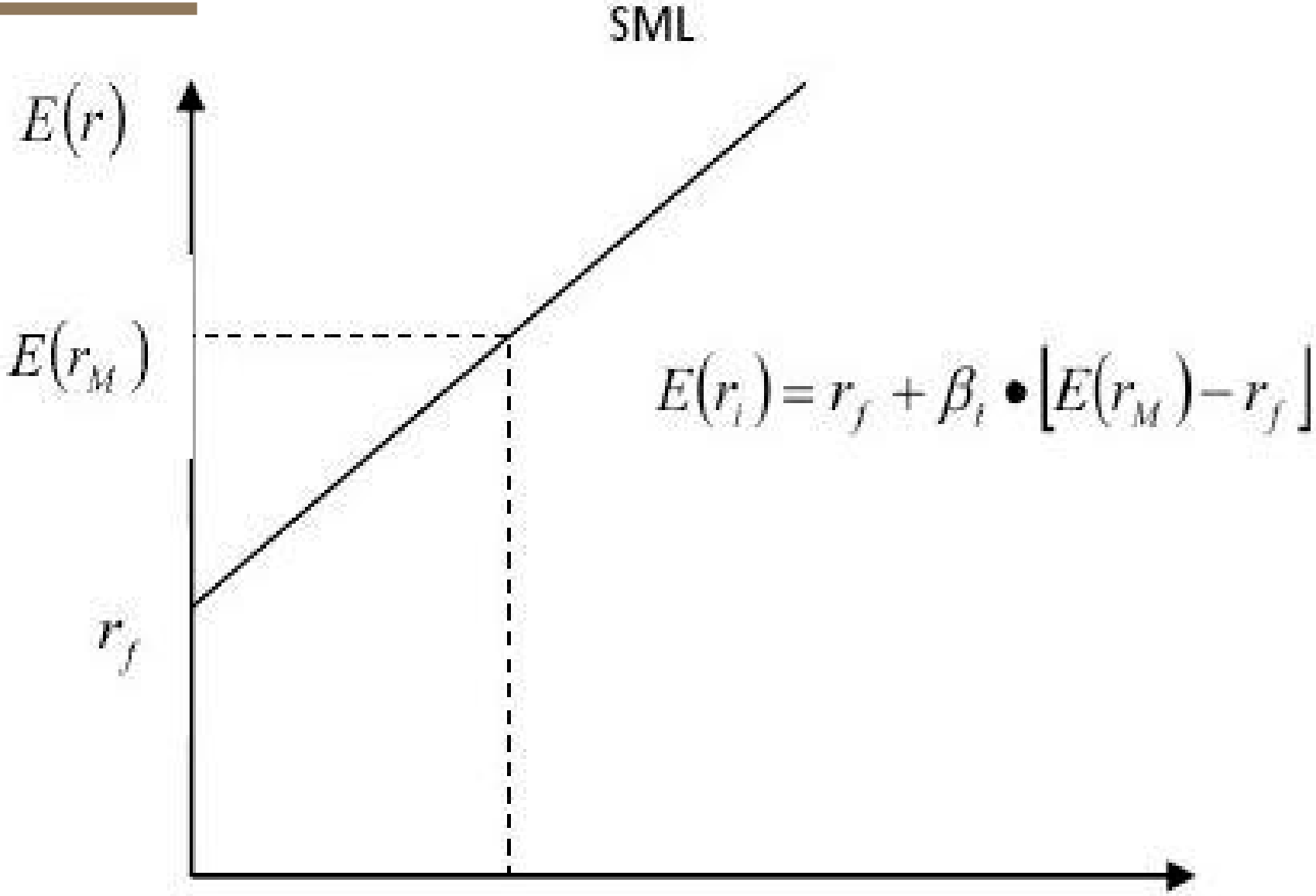
What is CAPM?

A model used to determine a theoretically appropriate required rate of return of an asset, to make decisions about adding assets to a well-diversified portfolio.

SML(security market line)

Enables us to calculate the reward-to-risk ratio（风险比率） for any security in relation to that of the overall market.

Securities Market Line



How to calculate?

Select the closing price index of the first 10 shares of A-shares as the sample to investigate a certain security and use CSI 300 to represent the sets of securities.

CSI 300

a capitalization-weighted stock market index designed to replicate the performance of 300 stocks traded in the Shanghai and Shenzhen stock exchanges.

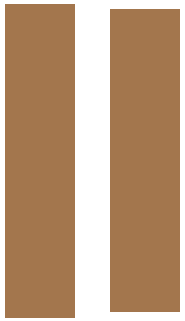
It has been calculated since April 8, 2005. Its value is normalized relative to a base of 1000 on December 31, 2004.

Sub-Indicies

CSI 300 Energy Index
CSI 300 Materials Index
CSI 300 Industrials Index
CSI 300 Consumer Discretionary Index
CSI 300 Consumer Staples Index
CSI 300 Health Care Index
CSI 300 Financial Index
CSI 300 Information Technology Index
CSI 300 Telecommunications Index
CSI 300 Utilities Index

Part 3

Programming



Preparation

import packages for the following calculation and graphing

```
# insert statistics from csv file
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt

# for the following calculation
import math
```

Read data loacally

parse_dates=[0]
将第一列数据解析成时间格式

index_col=0
将第一列数据指定为索引

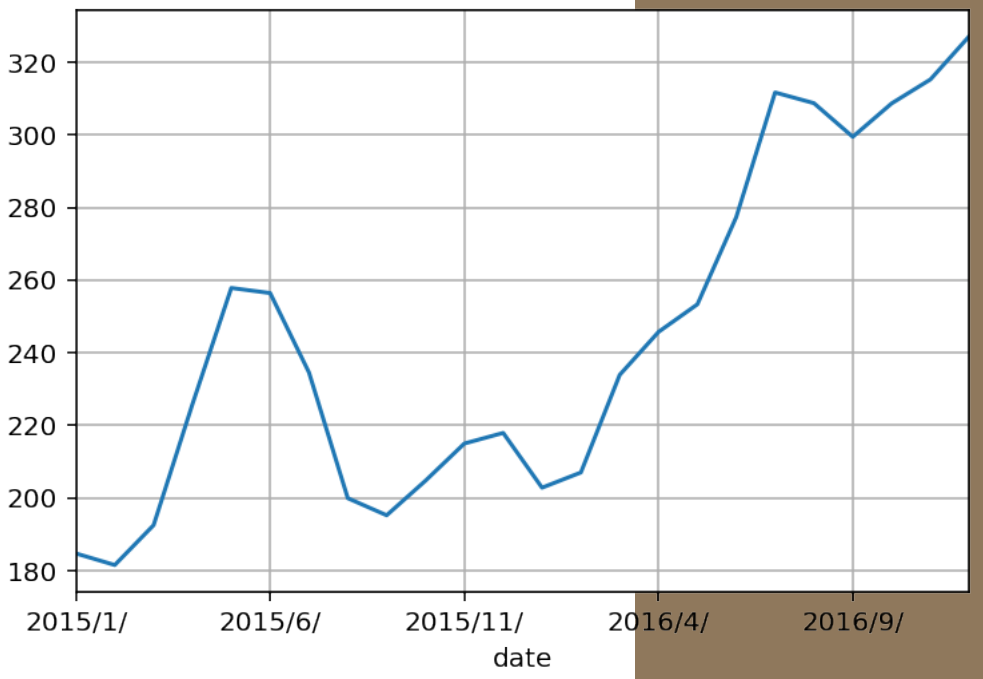
```
stock = pd.read_csv
('/Users/Administrator/Desktop/code/600519.csv',parse_dates=[0], index_col=0)
```

The fluctuation of the stock prices

We choose “Kweichow Moutai Company” as an example.

Firstly, the python program reads data of time and closing prices of the stock using [pandas]. Then, we graph a line chart whose X axis is time and Y axis is the closing prices of the stock we choose using [matplotlib].

```
stock[' close '].plot(grid=True)
```



Caculating the expected rate of return

```
close_price = stock['close']
```

Firstly, we define a new column for the closing price of stock.

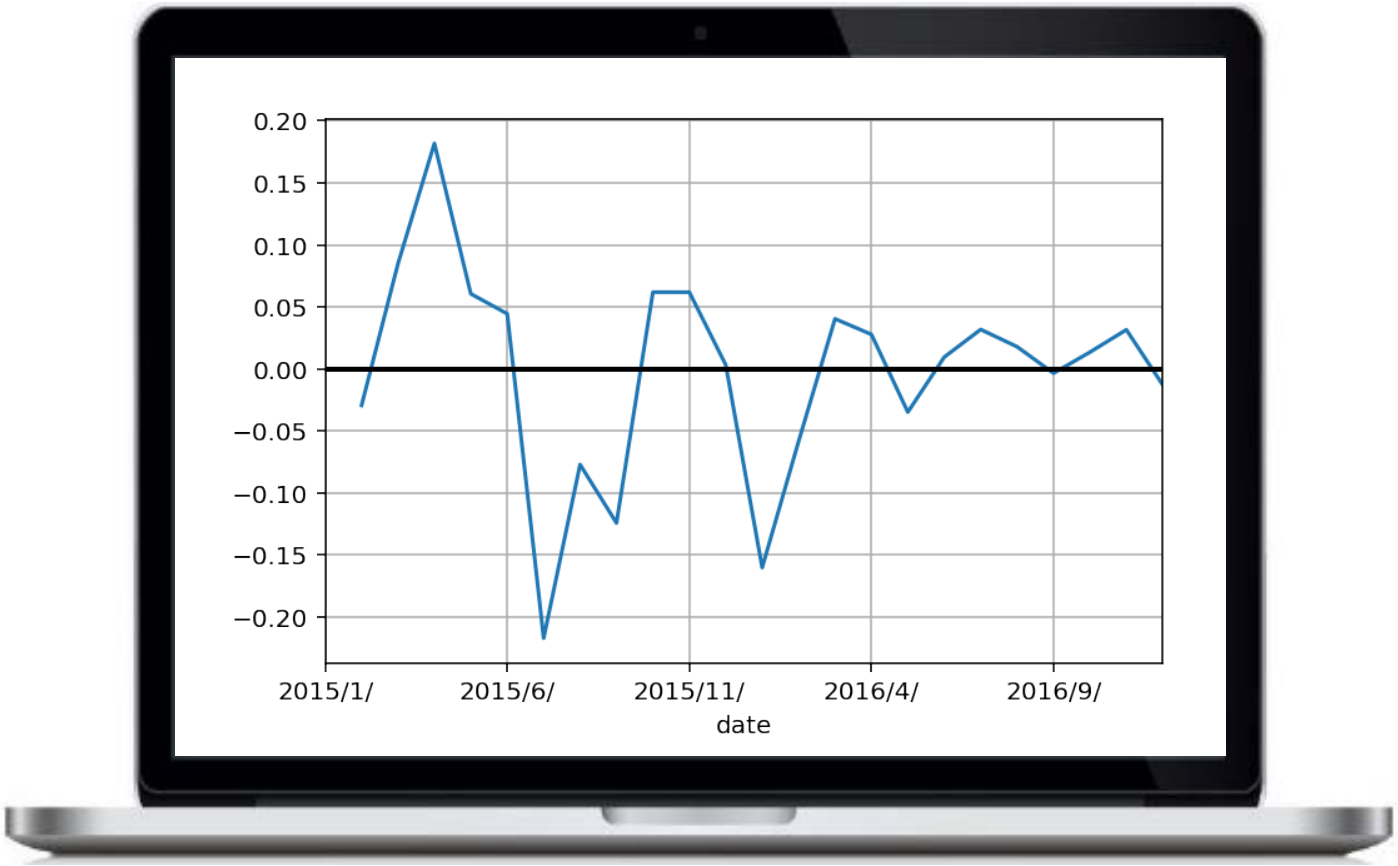
```
stock["expected"] =
np.log(close_price) -
np.log(close_price.shift(1))
```

Secondly, we use the formula:

$$R_k = In(P_t) - In(P_{t-1})$$

R_k means the expected rate of return, P_t means the closing price of time t, P_{t-1} means the closing price of time t-1

```
stock["expected"].plot(grid=True).axhline(
y=0, color='black', lw=2)
```



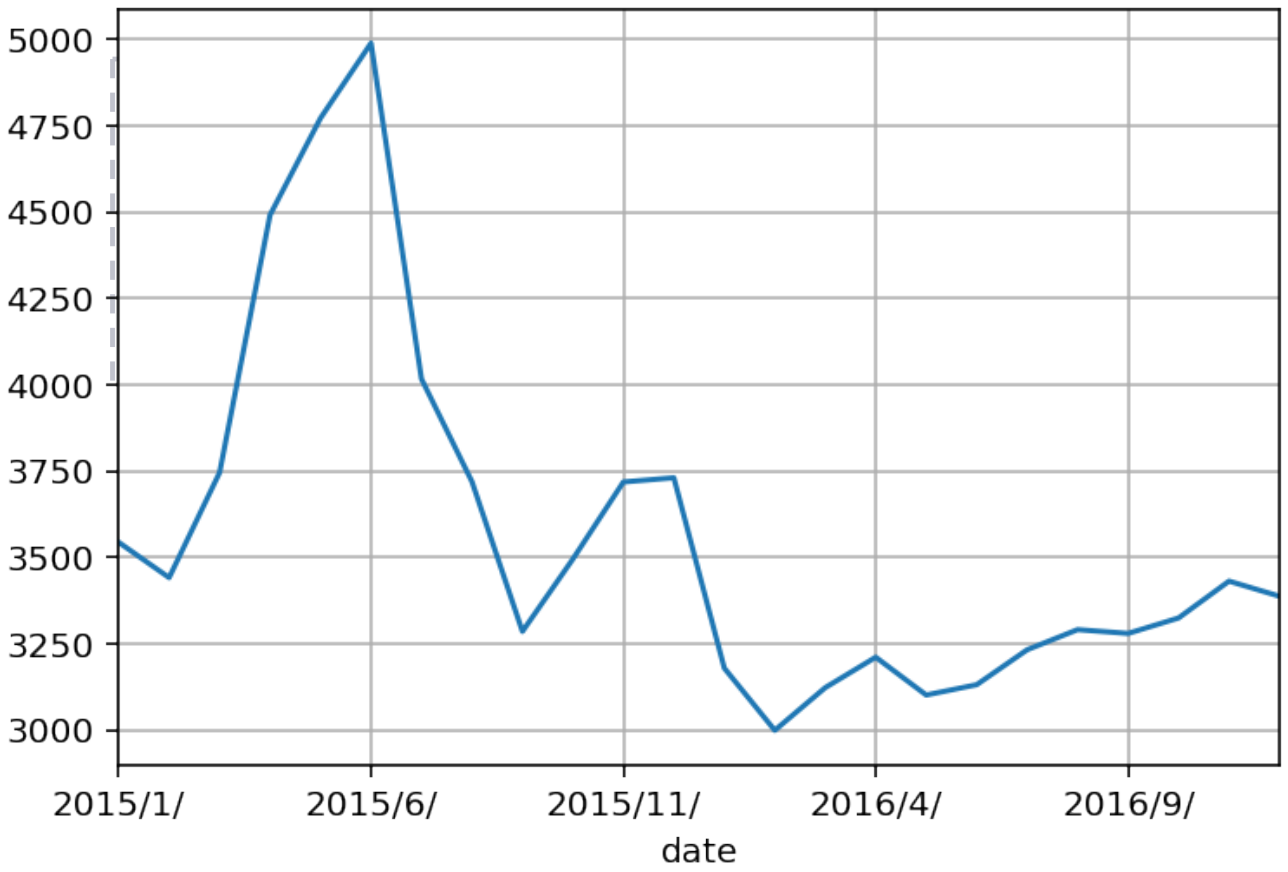
Graphing the line chart

We graph a line chart whose X axis is time and Y axis is the expected rate of return rk using [matplotlib].

The fluctuation of the price of market portfolio

The code is similar to that of the stock price

In our project, the data we used as closing prices of stock is CSI300 index, which reflects the overall trend of the stock market in Shanghai and Shenzhen.



Calculate the market rate of return

The code is similar to that of the stock price

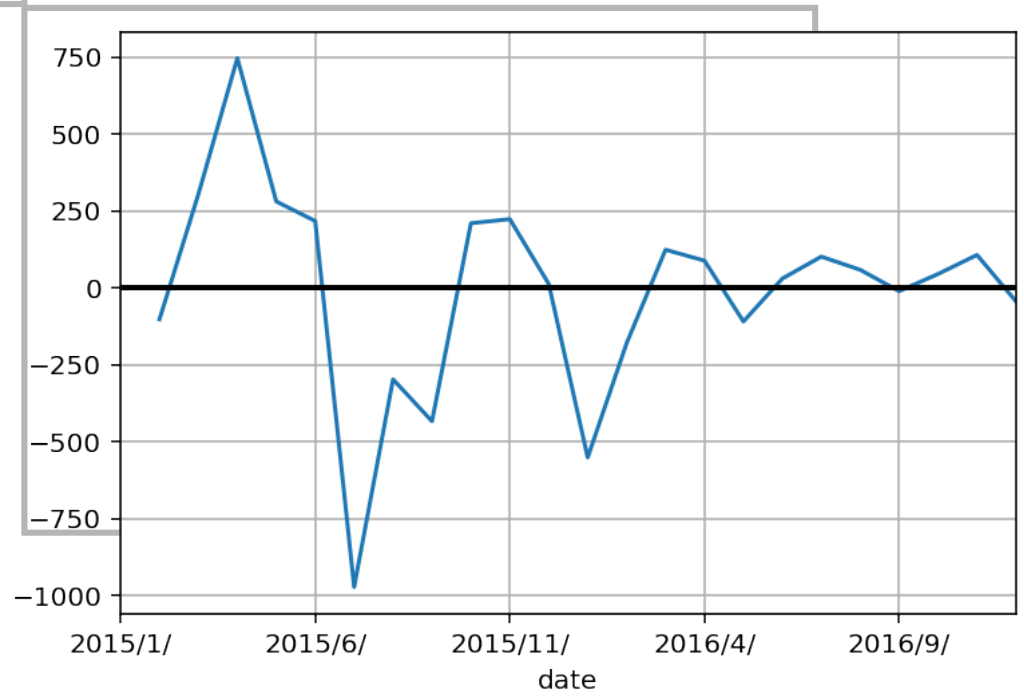
```
close_price_market = market['close']

market["expected"] =
close_price_market -
close_price_market.shift(1)
```

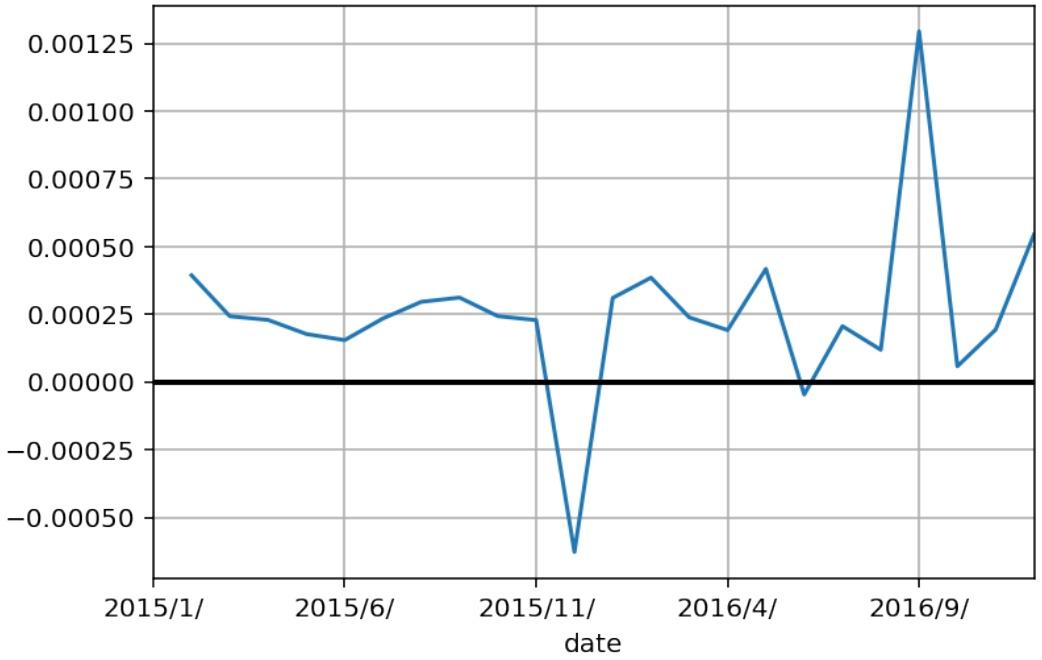
we use theformula:

$$R_m = P_t / P_{t-1} - 1$$

R_m means the market rate of return, P_t means the closing price of time t, P_{t-1} means the closing price of time t-1.



Calculating the value of Beta Coefficient




```
def beta(rk,rm):
    return (rk - 0.011)/(rm - 0.011)
```

```
market['beta']=
beta(stock["expected"],market['expected'])
```

```
market['beta'].plot(grid=True).axhline(y=0,
color='black', lw=2)
```


THANK YOU FOR WATCHING