October 14, 2019

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In [1]: import numpy as np
        import pandas as pd
        import random as random
        import matplotlib.pyplot as plt
        import scipy.stats as ss
        from datetime import datetime
        import wrds
        random.seed(420)

In [2]: #mdp:
        #goqhuB-1hafqe-dojvix
        db = wrds.Connection(wrds_username = 'antb95')

Enter your WRDS username [bedanian]:antb95
Enter your password:ůůůůůůůů
WRDS recommends setting up a .pgpass file.
You can find more info here:
https://www.postgresql.org/docs/9.5/static/libpq-pgpass.html.
Loading library list...
Done


In [3]: msft = db.raw_sql("select prc, date from crsp.dsf where permco in (8048.0) and date >=
        intc = db.raw_sql("select prc, date from crsp.dsf where permco in (2367.0) and date >=
        yhoo = db.raw_sql("select prc, date from crsp.dsf where permco in (14521.0) and date >=

In [4]: msft['date'] = pd.to_datetime(msft['date'], format='%Y-%m-%d')
        intc['date'] = pd.to_datetime(intc['date'], format='%Y-%m-%d')
        yhoo['date'] = pd.to_datetime(yhoo['date'], format='%Y-%m-%d')

In [5]: msft_r = np.log(msft['prc']) - np.log(msft['prc'].shift(1))
        intc_r = np.log(intc['prc']) - np.log(intc['prc'].shift(1))
        yhoo_r = np.log(yhoo['prc']) - np.log(yhoo['prc'].shift(1))

In [6]: df_stock = pd.DataFrame()
        df_stock['date'] = msft['date']
        df_stock['msft'] = msft['prc']
        df_stock['intc'] = intc['prc']
        df_stock['yhoo'] = yhoo['prc']
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In [7]: df_return = pd.DataFrame()
        df_return['date'] = pd.to_datetime(msft['date'], format='%Y-%m-%d').copy()
        df_return['msft'] = msft_r
        df_return['intc'] = intc_r
        df_return['yhoo'] = yhoo_r
        df_return.dropna(inplace = True)

In [8]: cov_matrix = df_return.set_index('date').rolling(502).cov().dropna()
        mean = df_return.set_index('date').rolling(502).mean().dropna()

In [9]: #msft
        m = (intc[intc['date'] == '2013-03-11']['prc'].values[0]*100)/msft[msft['date'] == '20
        #yahoo
        n = (intc[intc['date'] == '2013-03-11']['prc'].values[0]*100)/yhoo[yhoo['date'] == '20
        #lambda
        lbda = np.array([m,100,n])

In [10]: M = 100000
         VAR_95 = []
         VAR_99 = []
         date = cov_matrix.index.get_level_values('date').drop_duplicates().values
         for i in date :
             temp_cov = cov_matrix.loc[i,:].values
             temp_mean = mean.loc[i,:].values
             rd_vec = np.random.multivariate_normal(temp_mean,temp_cov,M)
             #mean var method
             L = rd_vec * lbda * df_stock[df_stock['date'] == i][['msft','intc','yhoo']].values
             L = -1*np.sum(L, axis = 1)
             VAR_95 += [np.mean(L)+np.std(L)*ss.norm.ppf(0.95)]
             VAR_99 += [np.mean(L)+np.std(L)*ss.norm.ppf(0.99)]

In [11]: LOSS = []
         for i in date:
             temp = (np.exp(df_return[df_return['date'] == i][['msft','intc','yhoo']].values)-1
             temp = -1*np.sum(temp, axis = 1)
             LOSS += [temp]

In [30]: up_95 = [0]*len(LOSS)
         up_99 = [0]*len(LOSS)
         val_95 = []
         val_99 = []
         for k in range(0,len(LOSS)):
             if LOSS[k] > VAR_95[k]:
                 up_95[k] = 1
                 val_95 += [[date[k],VAR_95[k]]]
             if LOSS[k] > VAR_99[k]:
                 up_99[k] = 1
                 val_99 += [[date[k],VAR_99[k]]]
         print('Number of days where the loss is above 95% of the Var :',np.sum(up_95))
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        print('Number of days where the loss is above 99% of the Var :',np.sum(up_99))

        val_99 = np.array(val_99)
        val_95 = np.array(val_95)
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Number of days where the loss is above 95% of the Var : 49
Number of days where the loss is above 99% of the Var : 17
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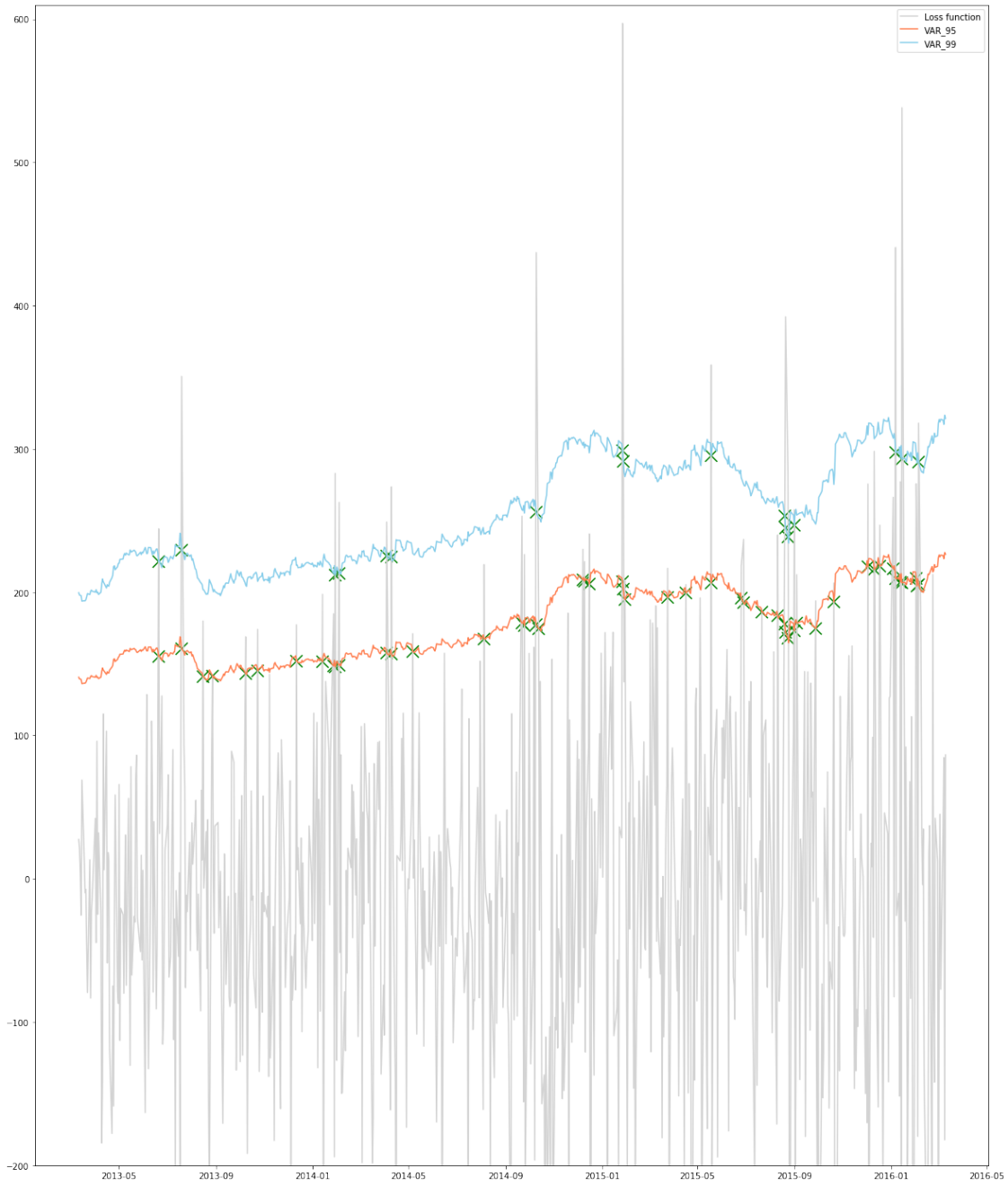
In [13]: plt.figure(1, figsize = (20, 25))
         s = [200]*len(val_95)
         plt.scatter(val_95[:,0],val_95[:,1],color = 'g',marker = 'x', s=s)
         plt.scatter(val_99[:,0],val_99[:,1],color = 'g',marker = 'x', s=s)
         plt.plot(date,LOSS,color = 'lightgrey',label = 'Loss function')
         plt.plot(date,VAR_95,color = 'coral',label = 'VAR_95')
         plt.plot(date,VAR_99,color = 'skyblue',label = 'VAR_99')
         plt.ylim((-200, 610))
         plt.legend()
         plt.savefig('/Users/bedanian/Desktop/QRM/QRM/TD 3/Q1.png')
```

```
/Users/bedanian/anaconda3/lib/python3.7/site-packages/pandas/plotting/_converter.py:129: Future

To register the converters:
        >>> from pandas.plotting import register_matplotlib_converters
        >>> register_matplotlib_converters()
  warnings.warn(msg, FutureWarning)
```




```
In [29]: res_99 = 1 - ss.binom.cdf(np.sum(up_99) - 1, len(date), 0.01)
         res_95 = 1 - ss.binom.cdf(np.sum(up_95) - 1, len(date), 0.05)
         print('The probability of 17 or more breaches in the course of 3 years is ','{0:.5f}'
         print('The probability of 49 or more breaches in the course of 3 years is ','{0:.5f}'

The probability of 17 or more breaches in the course of 3 years is  0.00203
The probability of 49 or more breaches in the course of 3 years is  0.04189
```