project_8 report

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1 Empirical Method in Financial Econometrics: Project 8

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1.2 Exercise 1

1.2.1 A

[86]:
```
prices = [142.19,142.27,142.29,142.62,142.70,142.64,142.61,142.62,142.63,142.
↪67,142.62,142.50,142.45,142.57,142.54,142.32,142.17,142.03,141.85,141.30,141.
↪36,141.01,140.78,140.96,141.16,141.38]
```

[87]:
```
len_prices = len(prices)
```

[88]:
```
print(len_prices)
```

```
26
```

[89]:
```
freq_prices = (5*78/len_prices)
```

[90]:
```
print(freq_prices)
```

```
15.0
```

The sampling frequency of the prices above is every 15-minutes 1 observation.

1.2.2 B

[200]:
```
import math
log_returns = []
for i in range(1,len(prices)):
    log_returns.append(math.log(prices[i]) - math.log(prices[i-1]))
```

1.2.3 C

[92]:
```
import statistics as stat
average_return = stat.mean(log_returns)
print(average_return)
```

```
-0.00022851562661898583
```

[93]:
```
standard_deviation = stat.stdev(log_returns)
print(standard_deviation)
```

```
0.0013378543298329293
```

The average return is about -0.0002285; and the standard deviation of the returns is 0.0013379.

1.2.4 D

[94]:
```
def realized_variance(log_returns):
    rv = 0
    for r in log_returns:
        rv += r**2
    return rv
```

[95]:
```
RV = realized_variance(log_returns)
annulized_RV = 100*math.sqrt(252*RV)
print(RV)
print(annulized_RV)
```

```
4.426198577869189e-05
10.561259591653997
```

The annulized value is 10.56125959%.

1.2.5 E

[96]:
```
print(0.1 + 0.2 == 0.3)
```

```
False
```

[97]:
```
print(sum([0.1,0.2]) == 0.3)
```

```
False
```

[98]:
```
print(0.1 + 0.2)
```

```
0.30000000000000004
```

[99]:
```
print(sum([0.1,0.2]))
```

```
0.30000000000000004
```

Because as we can see, the original equations are wrong, like 0.1+0.2 is not exactly equal to 3. This situation can be find in other programming tools like C, C++, Java and so on The reason is that binary can't accurately describe decimal fractions, so there is an error in the operation of float. I think this issue could not affect the computation of the realized variance, because the space for float is enough.

1.2.6 F

sum function: Return the sum of a 'start' value (default: 0) plus an iterable of numbers. When the iterable is empty, return the start value. This function is intended specifically for use with numeric values and may reject non-numeric types.

fsum function: Return an accurate floating point sum of values in the iterable seq. Assumes IEEE-754 floating point arithmetic.

[100]:
```
r = []
for i in range(0,len(log_returns)):
    r.append(log_returns[i]**2)
    RV = math.fsum(r)
annulized_RV = 100*math.sqrt(252*RV)
print(annulized_RV)
```

```
10.561259591653997
```

Compared to the two results, I think they are same.

1.2.7 G

[101]:
```
b = []
for i in range(1,len(log_returns)):
    b.append(abs(log_returns[i])*abs(log_returns[i-1]))
    BV = math.fsum(b) * math.pi/2
annulized_BV = 100*math.sqrt(252*BV)
print(annulized_BV)
```

```
9.997816709510156
```

The annulized value is 9.9978167%.

1.3 Excercise 2 - DIS

1.3.1 A

[167]:
```
import os
os.getcwd()
os.chdir("/Users/zhouxijie/python/project_8/data/")
```

[168]:
```
import csv
with open("DIS.csv","r") as  data:
    content = data.read()
```

[169]:
```
data_lines = content.split("\n")
```

[170]:
```
dates, times, prices = [], [], []
for line in data_lines:
    if line:
```

```
        date, time, price = line.split(',')
        dates.append(int(date))
        times.append(int(time))
        prices.append(float(price))
```

1.3.2 B

[171]:
```
N = dates.count(dates[0])
T = len(dates)//dates.count(dates[0])
print(N)
print(T)
```

```
78
2769
```

There are 78 observations available each day and 2769 days available in the sample.

1.3.3 C

[172]:
```
new_list = [prices[i:i+N] for i in range(0, len(prices), N)]
```

1.3.4 D

[173]:
```
log_prices = [math.log(price) for price in prices]
log_list = [log_prices[i:i+N] for i in range(0, len(log_prices), N)]
log_returns = []
for i in range(len(log_list)):
    log_returns.append([log_list[i][j+1] - log_list[i][j] for j in␣
 ↪range(len(log_list[0])-1)])
```

1.3.5 E

[199]:
```
RV_new = [realized_variance(rlist) for rlist in log_returns]
```

1.3.6 F

[175]:
```
average_rv = stat.mean(RV_new)
annulized_av_rv = 100*math.sqrt(252*average_rv)
print(annulized_av_rv)
```

```
21.778821985923436
```

[176]:
```
median_rv = stat.median(RV_new)
annulized_md_rv = 100*math.sqrt(252*median_rv)
print(annulized_md_rv)
```

```
15.019035530425818
```

The average of the realized variance is 21.78%; the median of the realized variance is 15.02%.

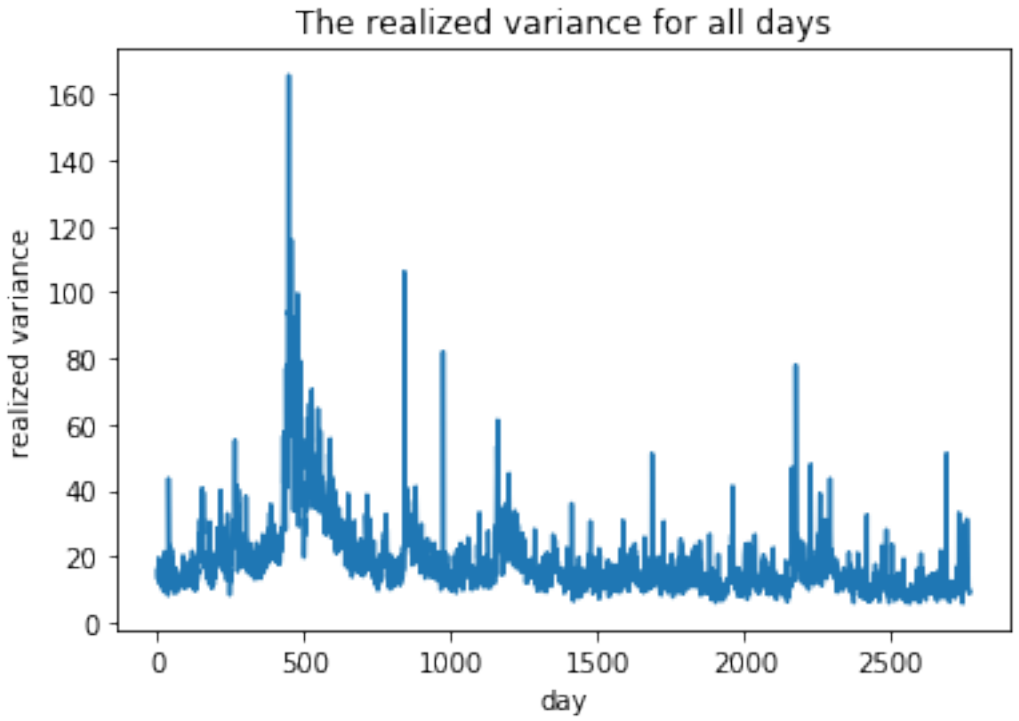
1.4 Exercise 3 - DIS

1.4.1 A

[177]:
```
import matplotlib.pyplot as plt
```

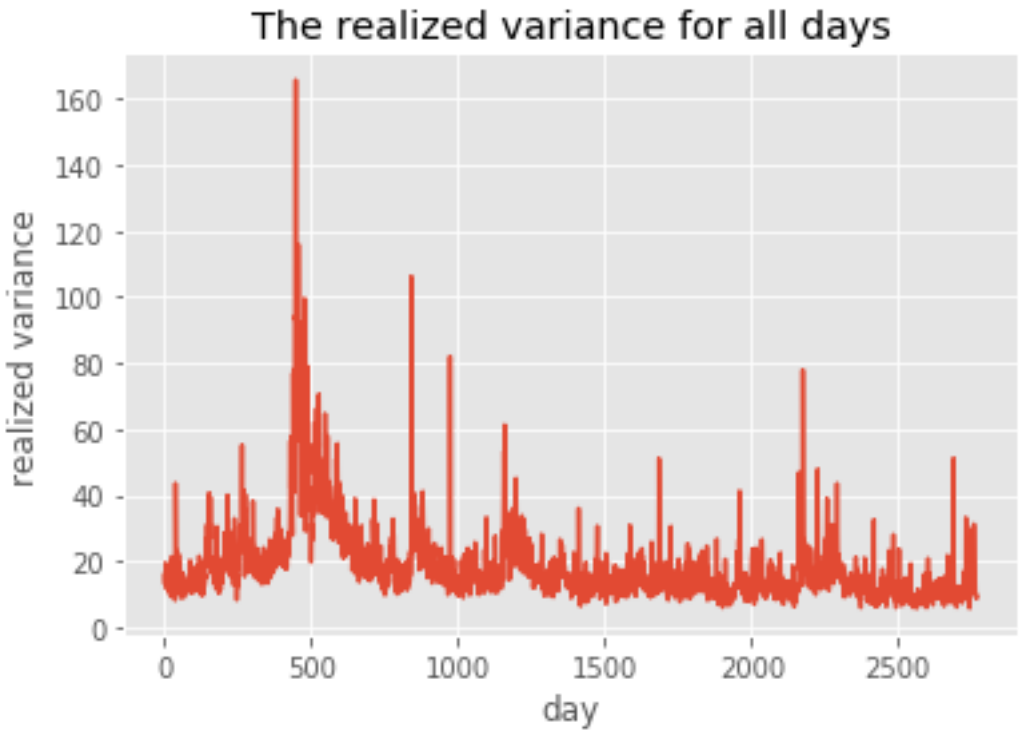
[178]:
```
plt.plot([math.sqrt(rv*252)*100 for rv in RV_new])
plt.xlabel('day')
plt.ylabel('realized variance')
plt.title('The realized variance for all days')
```

[178]:
```
Text(0.5, 1.0, 'The realized variance for all days')
```



1.4.2 B

[179]:
```
with plt.style.context("ggplot"):
    plt.plot([math.sqrt(rv*252)*100 for rv in RV_new])
    plt.xlabel('day')
    plt.ylabel('realized variance')
    plt.title('The realized variance for all days')
```



1.4.3 C

[180]:
```
from datetime import datetime
print(datetime(2017, 11, 20))
print(datetime.strptime('20171120 0927', '%Y%m%d %H%M'))
```

```
2017-11-20 00:00:00
2017-11-20 09:27:00
```

When using the method strptime, the format for %H is from 01 to 12, so we need to type '09' other than '9' for python to recognize this format. %Y means year, %m means month, %d means day, %M means minute.

1.4.4 D

[181]:
```
zipped = list(zip(dates, times))
dt = []
for time in zipped:
    if time[1]//1000 < 1:
        dt.append([str(time[0]) + " " + '0' + str(time[1])])
    else:
        dt.append([str(time[0]) + ' ' + str(time[1])])
print(dt[0])
```

```
['20070103 0935']
```

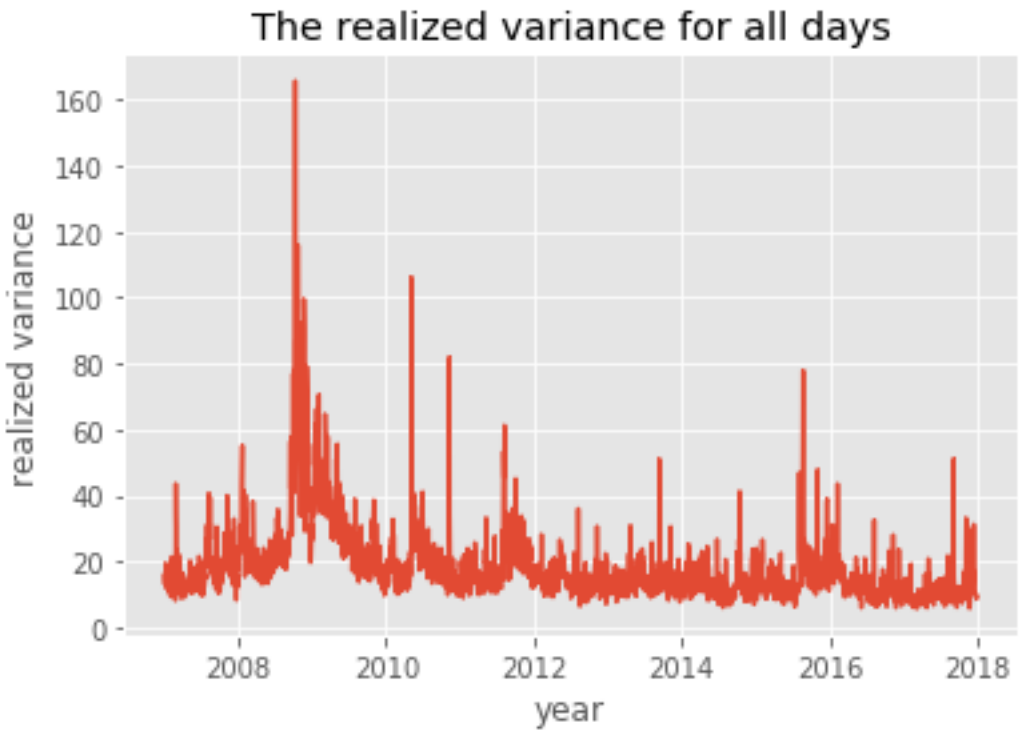
1.4.5 E

[182]:
```
format_dt = [datetime.strptime(str(dt[0]), '%Y%m%d %H%M') for dt in dt]
```

[183]:
```
dts = []
for t in range(0,len(dt)):
    subdt = []
    for i in range(0,len(dt[t])):
        time = datetime.strptime(dt[t][i],'%Y%m%d %H%M')
        subdt.append(time)
    dts.append(subdt)
```

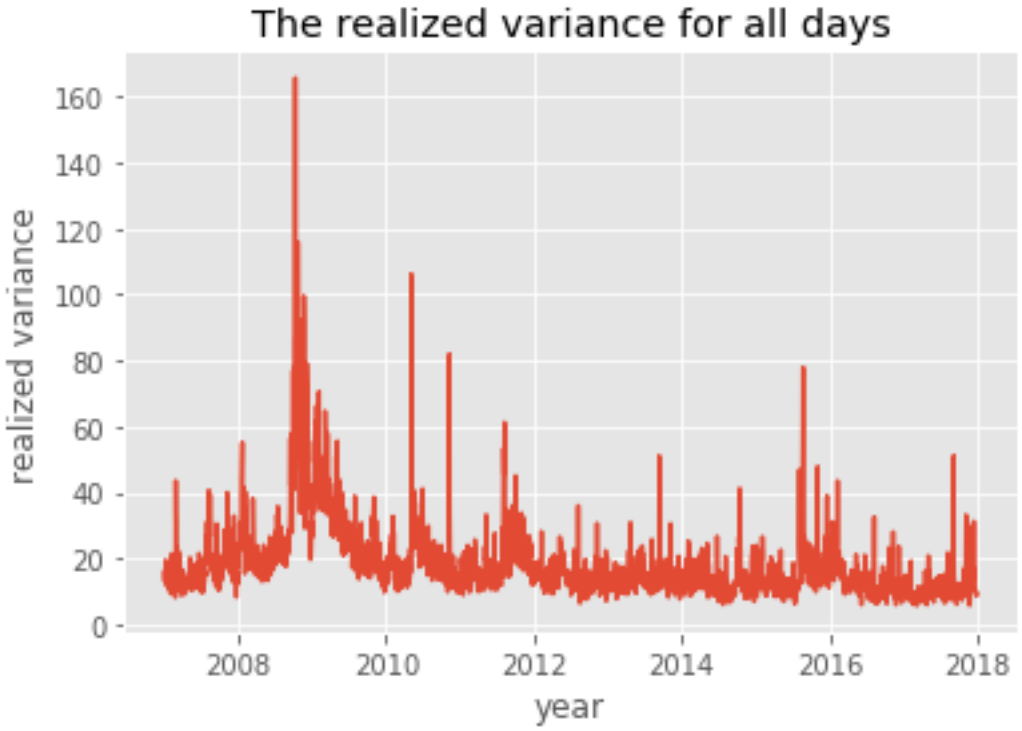
1.4.6 F

[184]:
```
with plt.style.context("ggplot"):
    dtx = [datetime.strptime(str(dates[i]), '%Y%m%d') for i in range(0,␣
 ↪len(dates), N)]
    plt.plot(dtx, [math.sqrt(rv*252)*100 for rv in RV_new])
    plt.xlabel('year')
    plt.ylabel('realized variance')
    plt.title('The realized variance for all days')
```



1.4.7 G

[185]:
```
with plt.style.context("ggplot"):
    dtx = [datetime.strptime(str(dates[i]), '%Y%m%d') for i in range(0,␣
 ↪len(dates), N)]
    plt.plot(dtx, [math.sqrt(rv*252)*100 for rv in RV_new])
    plt.xlabel('year')
    plt.ylabel('realized variance')
    plt.title('The realized variance for all days')
```



1.5 Excercise 2 - PG

1.5.1 A

[186]:
```
import os
os.getcwd()
os.chdir("/Users/zhouxijie/python/project_8/data/")
import csv
with open("PG.csv","r") as  data:
    content = data.read()
data_lines = content.split("\n")
dates, times, prices = [], [], []
for line in data_lines:
    if line:
```

```
        date, time, price = line.split(',')
        dates.append(int(date))
        times.append(int(time))
        prices.append(float(price))
```

1.5.2 B

[187]:
```
N = dates.count(dates[0])
T = len(dates)//dates.count(dates[0])
print(N)
print(T)
```

```
78
2769
```

There are 78 observations available each day and 2769 days available in the sample.

1.5.3 C

[188]:
```
new_list = [prices[i:i+N] for i in range(0, len(prices), N)]
```

1.5.4 D

[189]:
```
log_prices = [math.log(price) for price in prices]
log_list = [log_prices[i:i+N] for i in range(0, len(log_prices), N)]
log_returns = []
for i in range(len(log_list)):
    log_returns.append([log_list[i][j+1] - log_list[i][j] for j in␣
 ↪range(len(log_list[0])-1)])
```

1.5.5 E

[190]:
```
RV_new = [realized_variance(rlist) for rlist in log_returns]
```

1.5.6 F

[191]:
```
average_rv = stat.mean(RV_new)
annulized_av_rv = 100*math.sqrt(252*average_rv)
print(annulized_av_rv)
median_rv = stat.median(RV_new)
annulized_md_rv = 100*math.sqrt(252*median_rv)
print(annulized_md_rv)
```

```
15.624203800306113
11.364598799912011
```

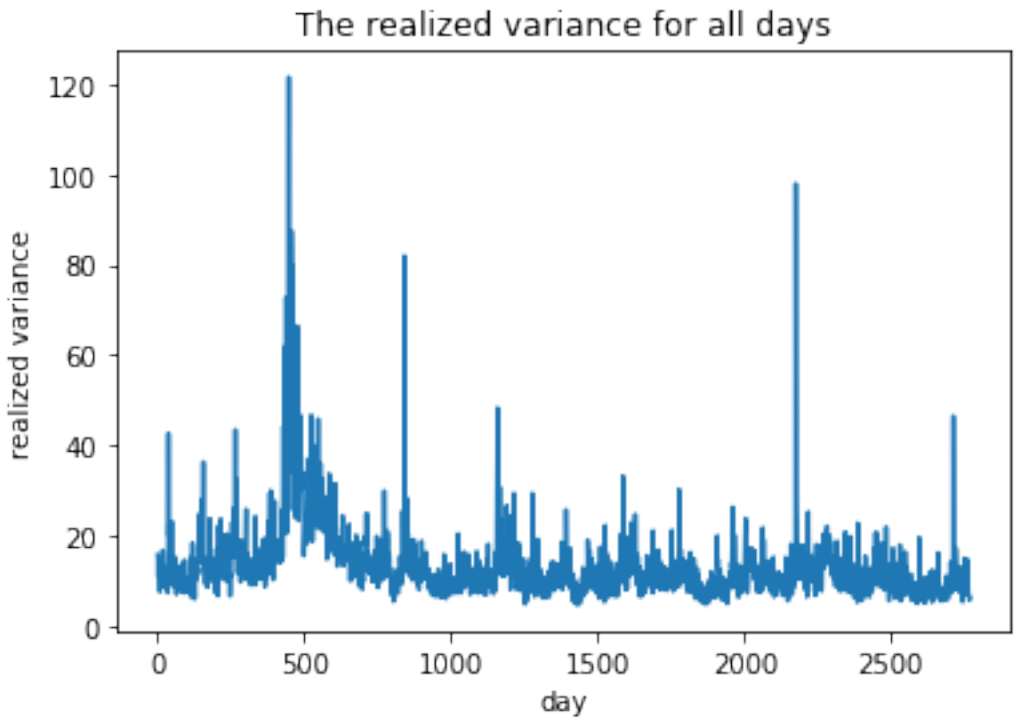
The average of the realized variance is 15.62%; the median of the realized variance is 11.36%.

1.6 Exercise 3 - PG

1.6.1 A

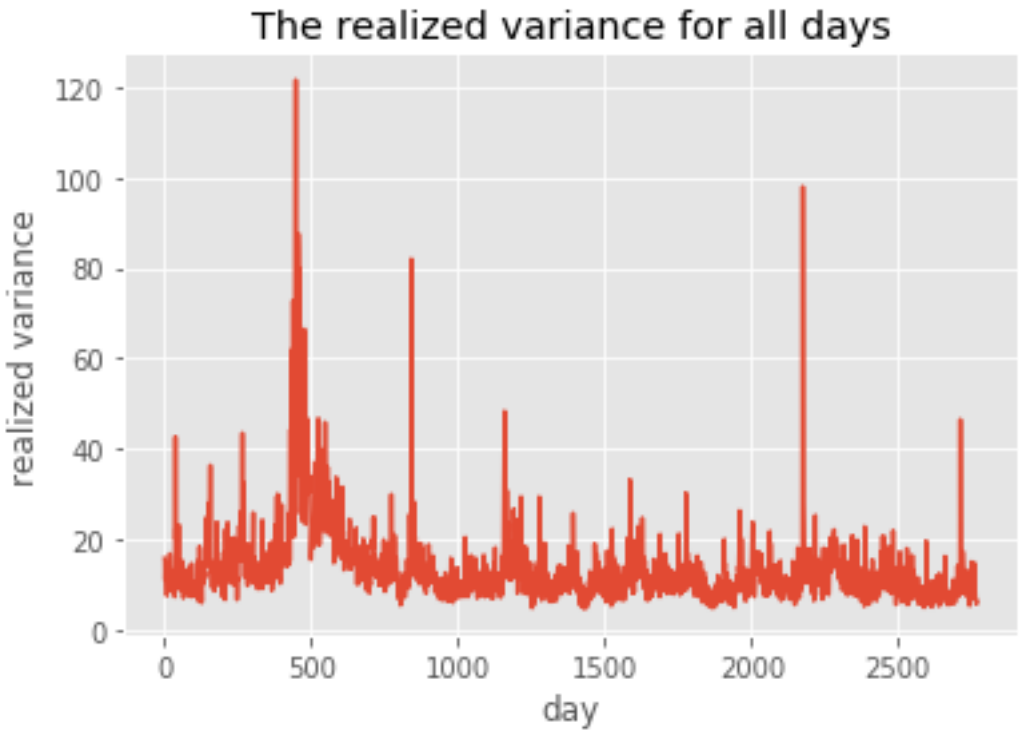
[192]:
```
import matplotlib.pyplot as plt
plt.plot([math.sqrt(rv*252)*100 for rv in RV_new])
plt.xlabel('day')
plt.ylabel('realized variance')
plt.title('The realized variance for all days')
```

[192]:
```
Text(0.5, 1.0, 'The realized variance for all days')
```



1.6.2 B

[193]:
```
with plt.style.context("ggplot"):
    plt.plot([math.sqrt(rv*252)*100 for rv in RV_new])
    plt.xlabel('day')
    plt.ylabel('realized variance')
    plt.title('The realized variance for all days')
```



1.6.3 C

[194]:
```
from datetime import datetime
print(datetime(2017, 11, 20))
print(datetime.strptime('20171120 0927', '%Y%m%d %H%M'))
```

```
2017-11-20 00:00:00
2017-11-20 09:27:00
```

When using the method strptime, the format for %H is from 01 to 12, so we need to type '09' other than '9' for python to recognize this format. %Y means year, %m means month, %d means day, %M means minute.

1.6.4 D

[195]:
```
zipped = list(zip(dates, times))
dt = []
for time in zipped:
    if time[1]//1000 < 1:
        dt.append([str(time[0]) + " " + '0' + str(time[1])])
    else:
        dt.append([str(time[0]) + ' ' + str(time[1])])
print(dt[0])
```

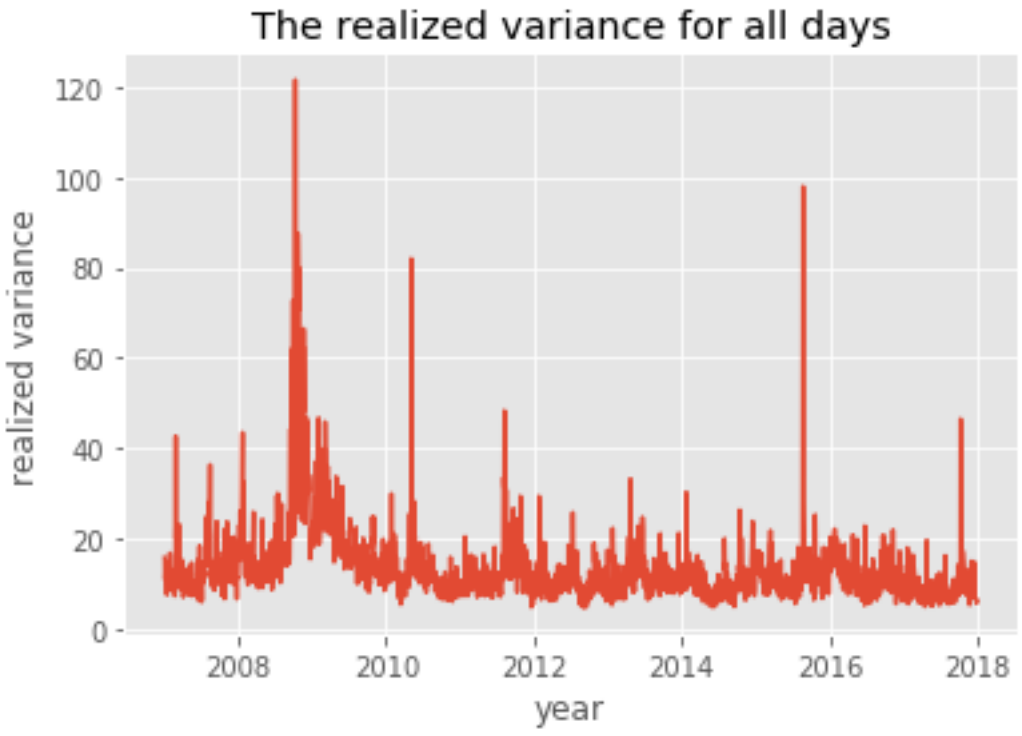
```
['20070103 0935']
```

1.6.5 E

[196]:
```
format_dt = [datetime.strptime(str(dt[0]), '%Y%m%d %H%M') for dt in dt]
dts = []
for t in range(0,len(dt)):
    subdt = []
    for i in range(0,len(dt[t])):
        time = datetime.strptime(dt[t][i],'%Y%m%d %H%M')
        subdt.append(time)
    dts.append(subdt)
```

1.6.6 F

[197]:
```
with plt.style.context("ggplot"):
    dtx = [datetime.strptime(str(dates[i]), '%Y%m%d') for i in range(0,␣
 ↪len(dates), N)]
    plt.plot(dtx, [math.sqrt(rv*252)*100 for rv in RV_new])
    plt.xlabel('year')
    plt.ylabel('realized variance')
    plt.title('The realized variance for all days')
```



1.6.7 G

[198]:
```
with plt.style.context("ggplot"):
    dtx = [datetime.strptime(str(dates[i]), '%Y%m%d') for i in range(0,␣
↪len(dates), N)]
    plt.plot(dtx, [math.sqrt(rv*252)*100 for rv in RV_new])
    plt.xlabel('year')
    plt.ylabel('realized variance')
    plt.title('The realized variance for all days')
```