Chapter 2: Exploratory Data Analysis in Python

Date	Open	High	Low	Close	Adj Close	Volume
2015-05-15	18251.970703	18272.720703	18215.070313	18272.560547	18272.560547	108220000
...	...	...	...	...	...	...
2020-05-14	23049.060547	23630.859375	22789.619141	23625.339844	23625.339844	472700000

1211 rows × 6 columns

Date	Open	High	Low	Close	Adj Close	Volume
2015-05-15	2122.070068	2123.889893	2116.810059	2122.72998	2122.72998	3092080000
...	...	...	...	...	...	...
2020-05-14	2794.540039	2852.800049	2766.639893	2852.50000	2852.50000	5641920000

1209 rows × 6 columns

Date	Open	High	Low	Close	Adj Close	Volume
2015-05-15	12.46	13.090000	12.350000	12.380000	12.380000	0
...	...	...	...	...	...	...
2020-05-14	35.16	39.279999	32.330002	32.610001	32.610001	0

1206 rows × 6 columns

Date	Open_A	High_A	Low_A	Close_A	Adj Close_A	Volume_A	Open_B
2015-05-15	18251.970703	18272.720703	18215.070313	18272.560547	18272.560547	108220000.0	2122.070068
...	...	...	...	...	...	...	...
2020-05-14	23049.060547	23630.859375	22789.619141	23625.339844	23625.339844	472700000.0	2794.540039

1259 rows × 18 columns

Date	Open_A	High_A	Low_A	Close_A	Adj Close_A	Volume_A	Open_B
2015-05-15	18251.970703	18272.720703	18215.070313	18272.560547	18272.560547	108220000.0	2122.070068
...	...	...	...	...	...	...	...
2020-05-14	23049.060547	23630.859375	22789.619141	23625.339844	23625.339844	472700000.0	2794.540039

1111 rows × 18 columns

Date	Open_A	High_A	Low_A	Close_A	Adj Close_A	Volume_A	Open_B
2015-05-18	18267.250000	18325.539063	18244.259766	18298.880859	18298.880859	79080000.0	2121.300049
...	...	...	...	...	...	...	...
2020-05-01	24120.779297	24120.779297	23645.300781	23723.689453	23723.689453	418160000.0	NaN

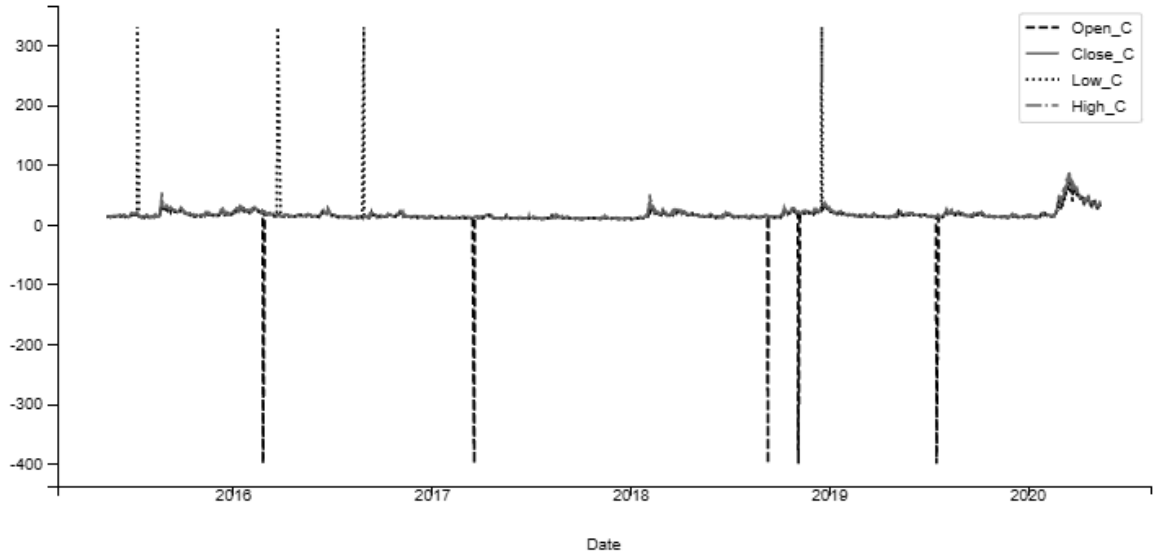
165 rows × 18 columns

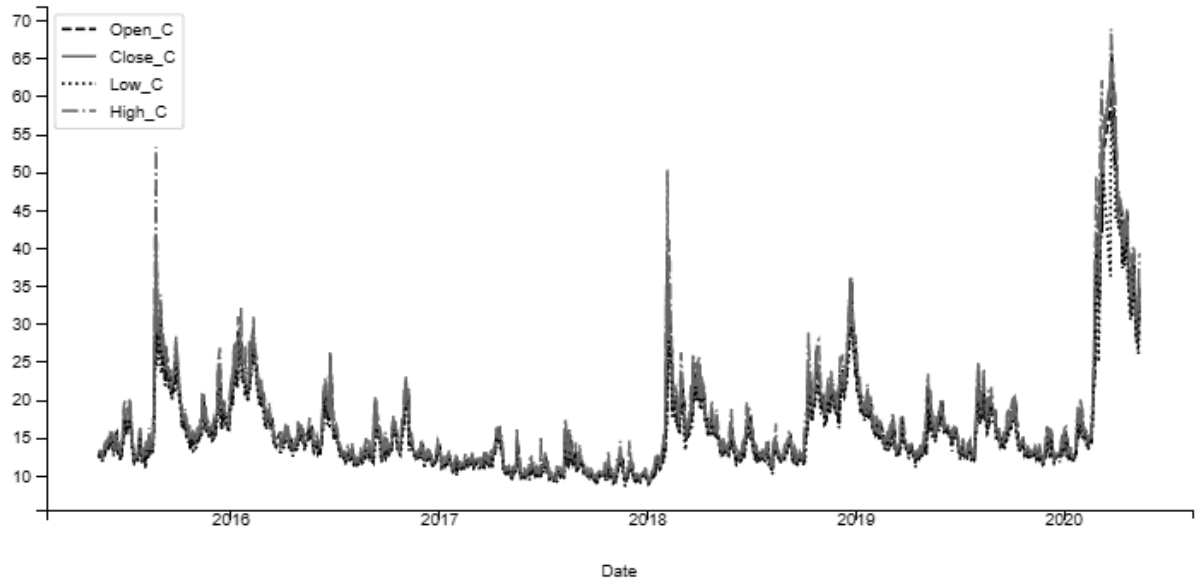
	Open_A	High_A	Low_A	Close_A	Adj Close_A	Volume_A	Open_B
count	1111.000000	1111.000000	1111.000000	1111.000000	1111.000000	1.111000e+03	1111.000000
mean	22291.125036	22402.395046	22168.922744	22292.881128	22292.531416	2.614436e+08	2517.857235
std	3771.056417	3784.558787	3755.740756	3769.395516	3767.906829	1.537677e+08	374.081451
min	15676.259766	15897.820313	15370.330078	15660.179688	15660.179688	4.589000e+07	1833.400024
25%	18232.280274	18285.384766	18156.614258	18230.160156	18227.615235	1.233350e+08	2144.320069
50%	22762.029297	22872.890625	22634.449219	22773.669922	22773.669922	2.631800e+08	2521.199951
75%	25516.320312	25659.810547	25382.705078	25518.895508	25518.895508	3.328450e+08	2815.010010
max	29440.470703	29568.570313	29406.750000	29551.419922	29551.419922	2.190810e+09	3380.449951

Date	Open_A	High_A	Low_A	Close_A	Adj Close_A	Open_B
2015-05-15	18251.970703	18272.720703	18215.070313	18272.560547	18272.560547	2122.070068
...	...	...	...	...	...	...
2020-05-14	23049.060547	23630.859375	22789.619141	23625.339844	23625.339844	2794.540039

1111 rows × 15 columns


Open_A
Close_A
Low_A
High_A
30,000
28,000
26,000
24,000
22,000
20,000
18,000
16,000
2016
2017
2018
2019
2020
Date


Open_C
Close_C
Low_C
High_C
300
200
100
0
-100
-200
-300
-400
2016
2017
2018
2019
2020
Date

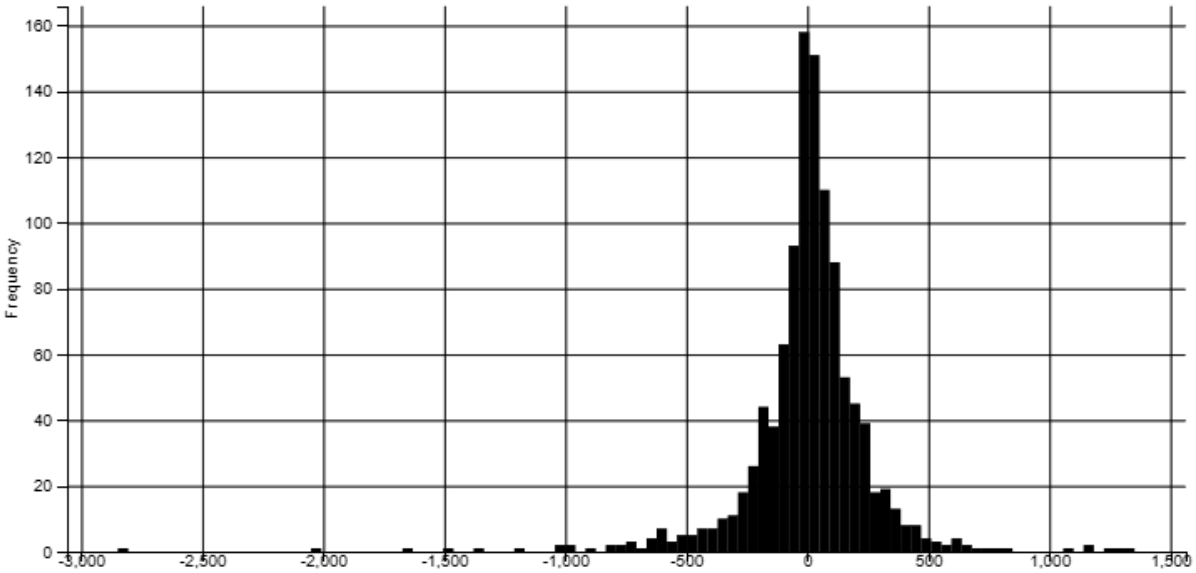

Open_C
Close_C
Low_C
High_C
70
65
60
55
50
45
40
35
30
25
20
15
10
2016
2017
2018
2019
2020
Date

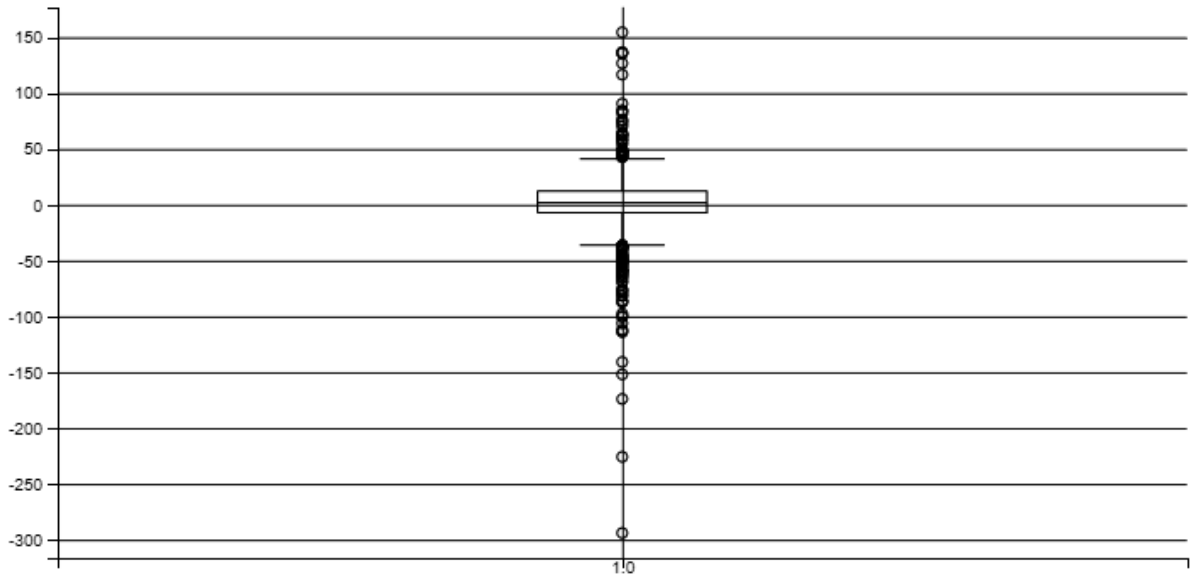
	Open_C	Close_C	Low_C	High_C
count	1095.000000	1095.000000	1095.000000	1095.000000
mean	16.147571	16.072648	15.223635	17.214539
std	6.764147	6.773569	5.995822	7.588690
min	9.010000	9.140000	8.560000	9.310000
25%	12.420000	12.285000	11.865000	12.890000
50%	14.160000	14.060000	13.440000	14.940000
75%	17.625000	17.500000	16.550000	18.929999
max	65.669998	63.950001	58.029999	68.860001

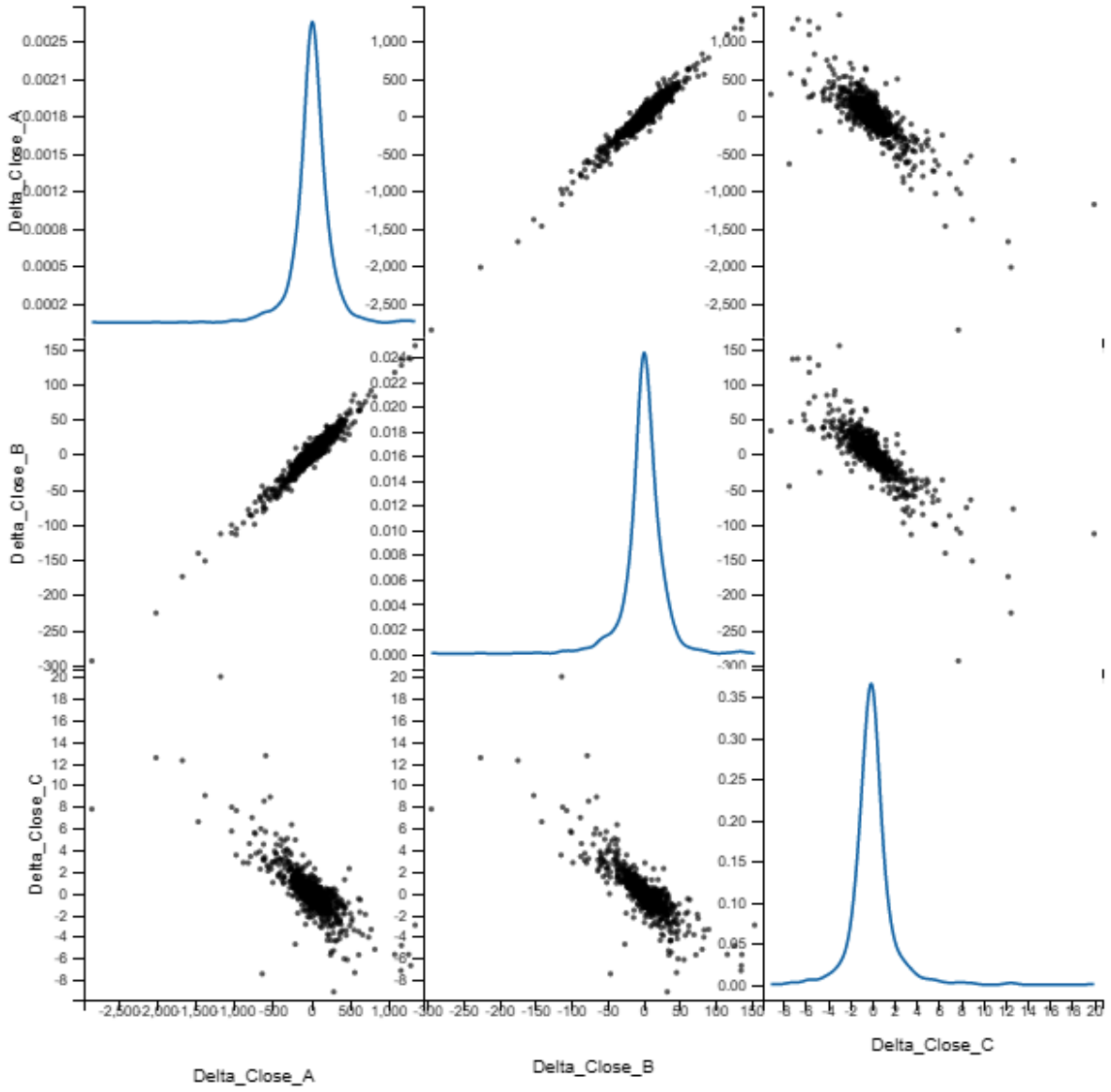
Date	Delta_Close_A	Delta_Close_B	Delta_Close_C
2015-05-15	26.320312	6.469971	0.350000
2015-05-18	13.509766	-1.369873	0.120000
...	...	...	...
2020-05-13	377.369141	32.500000	-2.669998
2020-05-14	0.000000	0.000000	0.000000

1095 rows × 3 columns

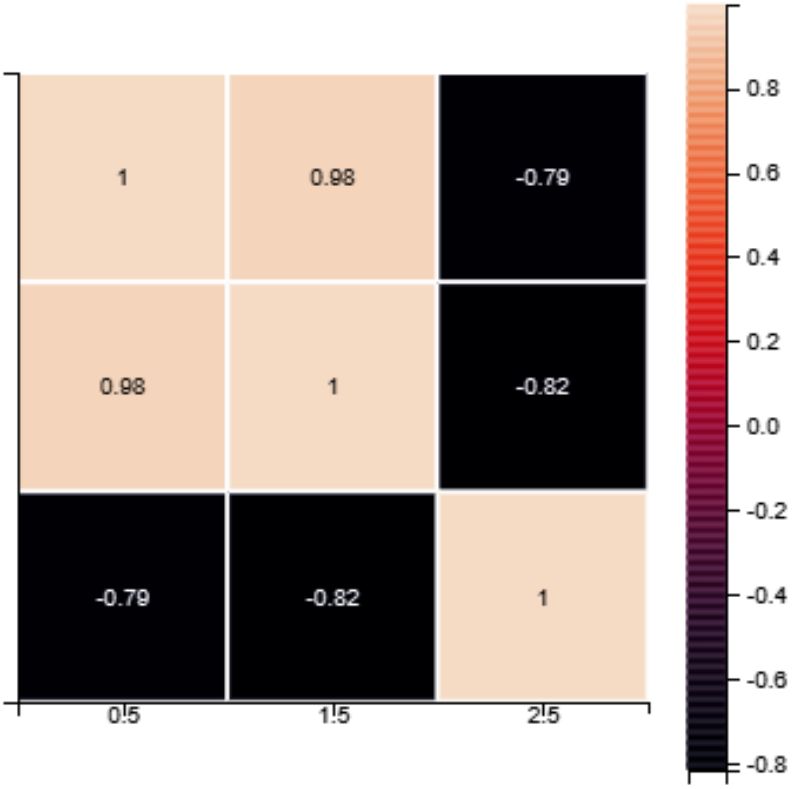
	Delta_Close_A	Delta_Close_B	Delta_Close_C
count	1095.000000	1095.000000	1095.000000
mean	4.888383	0.666457	0.018475
std	268.137091	29.218995	1.938761
min	-2848.310547	-294.049805	-9.120001
25%	-70.894532	-7.140076	-0.760000
50%	15.539063	1.770020	-0.080000
75%	113.290039	12.255005	0.540001
max	1351.619141	154.510009	20.010001


Frequency
160
140
120
100
80
60
40
20
0
-3,000
-2,500
-2,000
-1,500
-1,000
-500
0
500
1,000
1,500

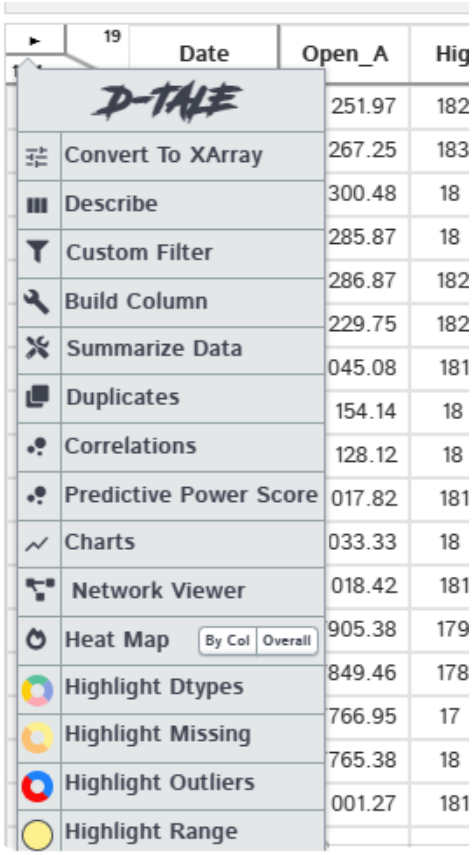

150
100
50
0
-50
-100
-150
-200
-250
-300
1.0



	Delta_Close_A	Delta_Close_B	Delta_Close_C
Delta_Close_A	1.000000	0.976104	-0.785566
Delta_Close_B	0.976104	1.000000	-0.817788
Delta_Close_C	-0.785566	-0.817788	1.000000



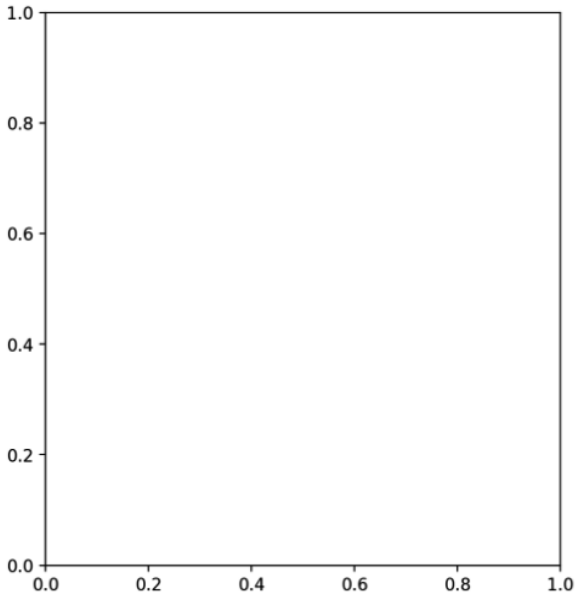
► 19 / 1111	Date	Open_A	High_A	Low_A	Close_A	Adj Close_A	Volume_A	Open_B
0	2015-05-15	18251.97	18272.72	18215.07	18272.56	18272.56	108220000.00	2122.07
1	2015-05-18	18267.25	18325.54	18244.26	18298.88	18298.88	79080000.00	2121.30
2	2015-05-19	18300.48	18351.36	18261.35	18312.39	18312.39	87200000.00	2129.45
3	2015-05-21	18285.87	18314.89	18249.90	18285.74	18285.74	84270000.00	2125.55
4	2015-05-22	18286.87	18286.87	18217.14	18232.02	18232.02	78890000.00	2130.36
5	2015-05-26	18229.75	18229.75	17990.02	18041.54	18041.54	109440000.00	2125.34
6	2015-05-27	18045.08	18190.35	18045.08	18162.99	18162.99	96400000.00	2105.13
7	2015-05-28	18154.14	18154.14	18066.40	18126.12	18126.12	67510000.00	2122.27
8	2015-05-29	18128.12	18128.12	17967.74	18010.68	18010.68	139810000.00	2120.66
9	2015-06-01	18017.82	18105.83	17982.06	18040.37	18040.37	85640000.00	2108.64
10	2015-06-02	18033.33	18091.87	17925.33	18011.94	18011.94	77550000.00	2110.41
11	2015-06-03	18018.42	18168.09	18010.42	18076.27	18076.27	73120000.00	2110.64
12	2015-06-05	17905.38	17940.78	17822.90	17849.46	17849.46	89140000.00	2095.09
13	2015-06-08	17849.46	17852.35	17760.61	17766.55	17766.55	86300000.00	nan
14	2015-06-09	17766.95	17817.83	17714.97	17764.04	17764.04	90550000.00	2079.07
15	2015-06-10	17765.38	18045.14	17765.38	18000.40	18000.40	96980000.00	2081.12
16	2015-06-11	18001.27	18109.77	18001.27	18039.37	18039.37	89490000.00	2106.24

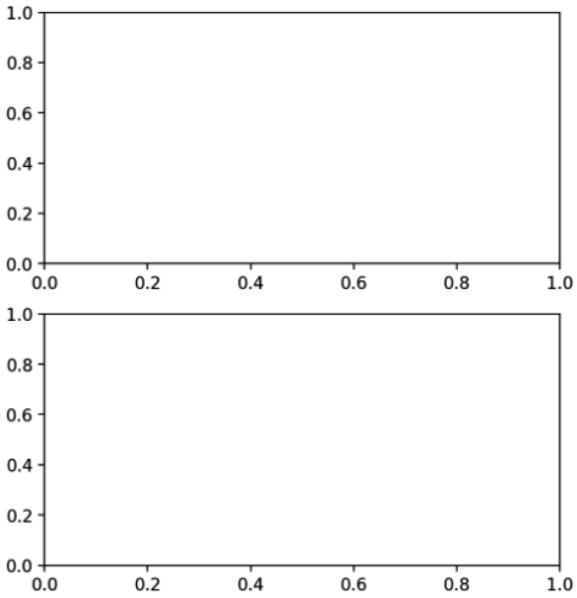


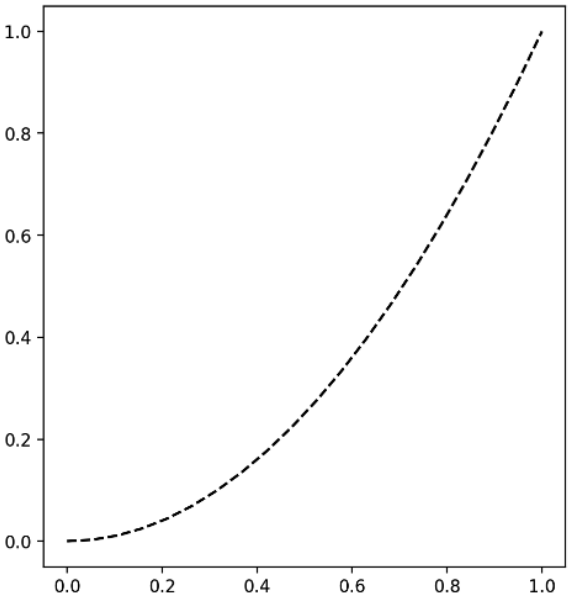

```
import dtale
dtale.show(valid_close_df, ignore_duplicate=True)
```

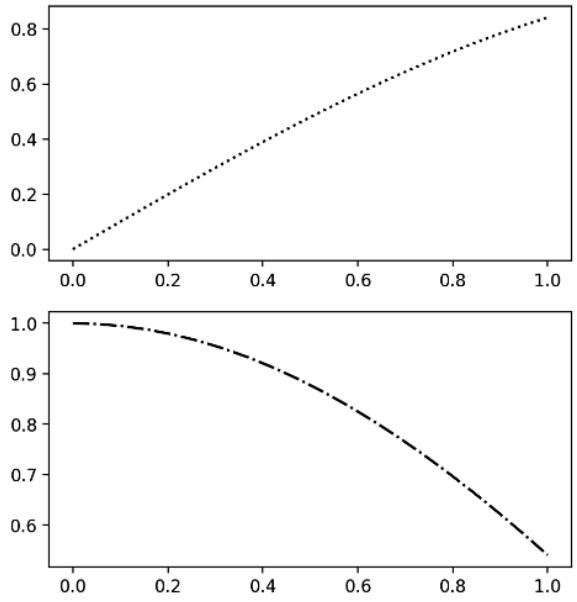
1111	19 Date	Open_A	High_A	Low_A	Close_A	Adj
0	2015-05-15				272.56	
1	2015-05-18				298.88	
2	2015-05-19				312.39	
3	2015-05-21				285.74	
4	2015-05-22				232.02	
5	2015-05-26				041.54	
6	2015-05-27				162.99	
7	2015-05-28				126.12	
8	2015-05-29				010.68	
9	2015-06-01				040.37	
10	2015-06-02				011.94	
11	2015-06-03				076.27	
12	2015-06-05				849.46	
13	2015-06-08				766.55	
14	2015-06-09				764.04	
15	2015-06-10				000.40	
16	2015-06-11				039.37	

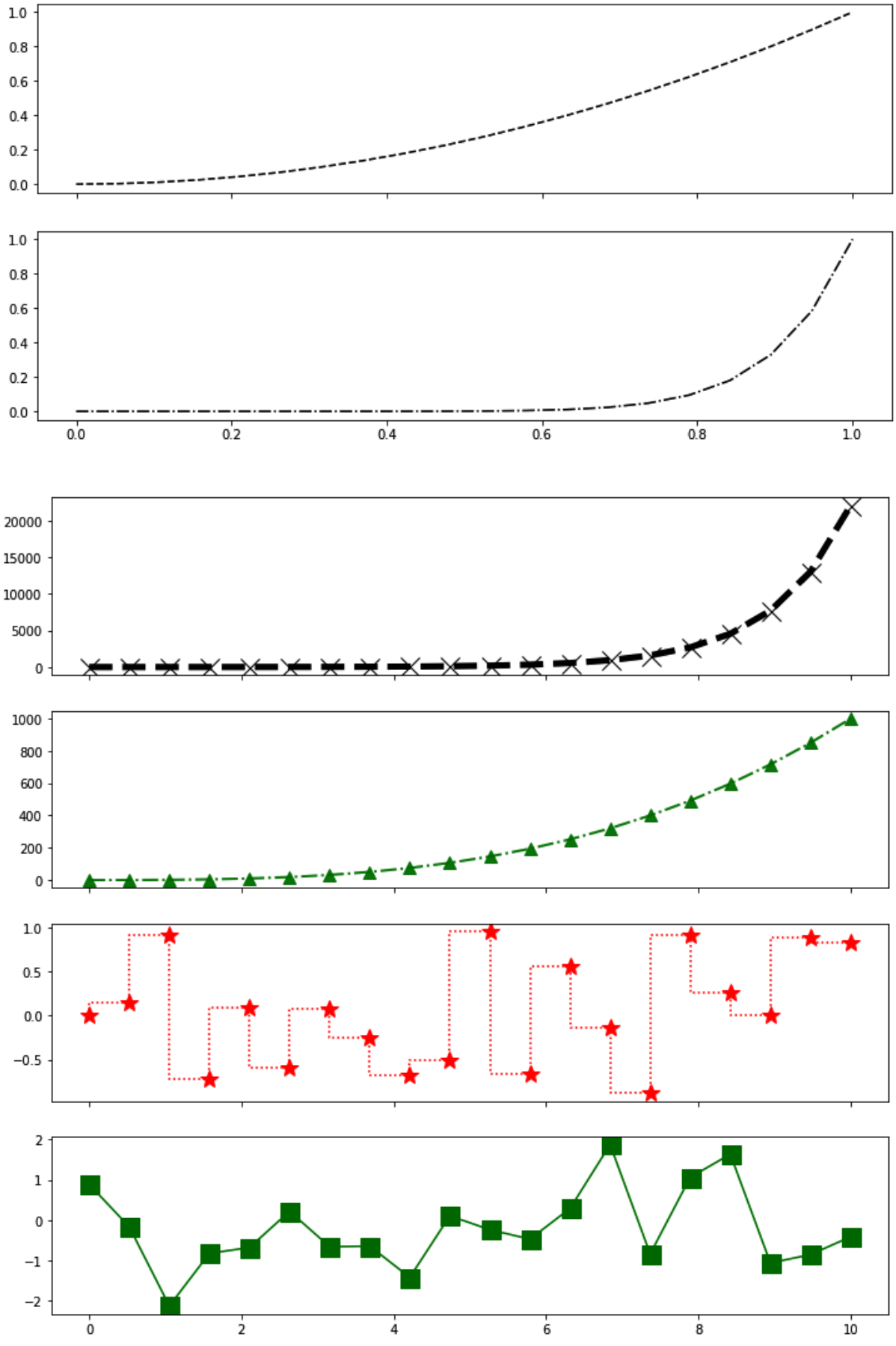
Chapter 5: Data Visualization Using Matplotlib

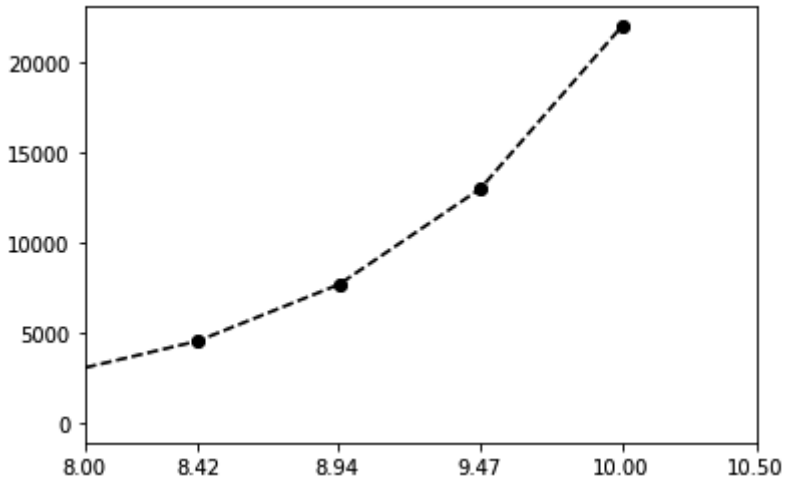


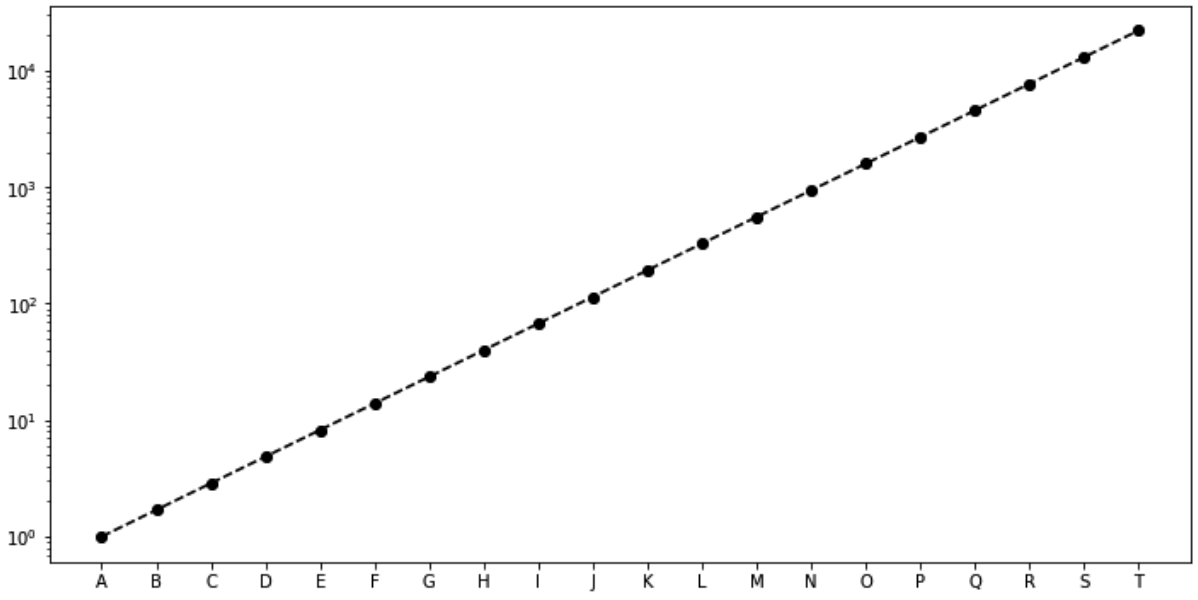


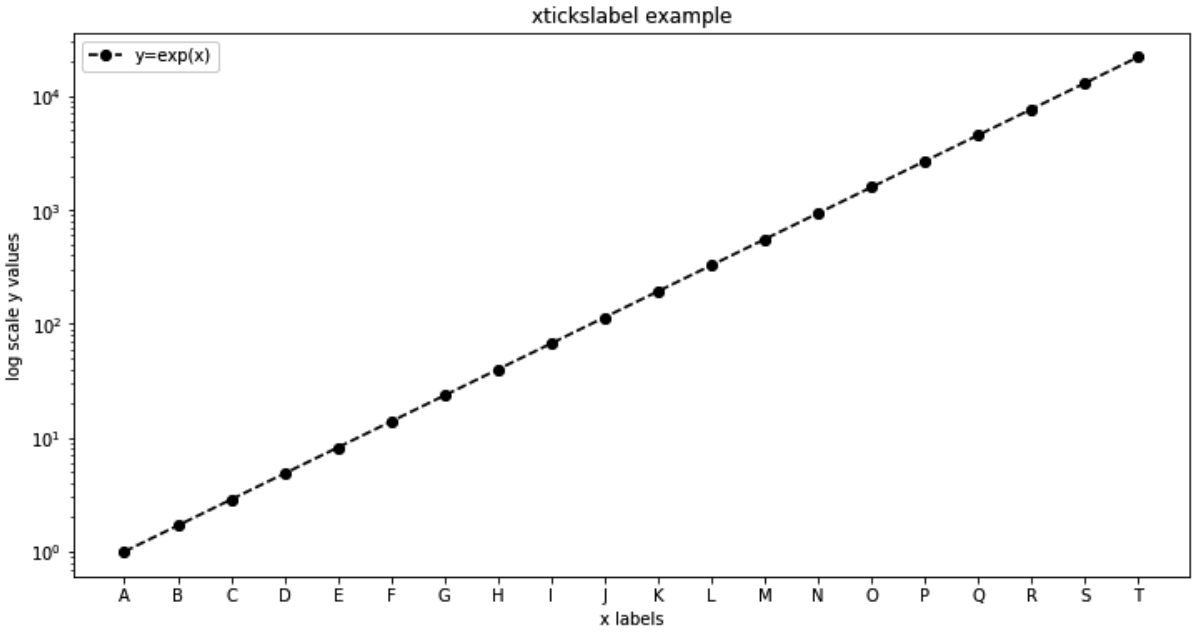


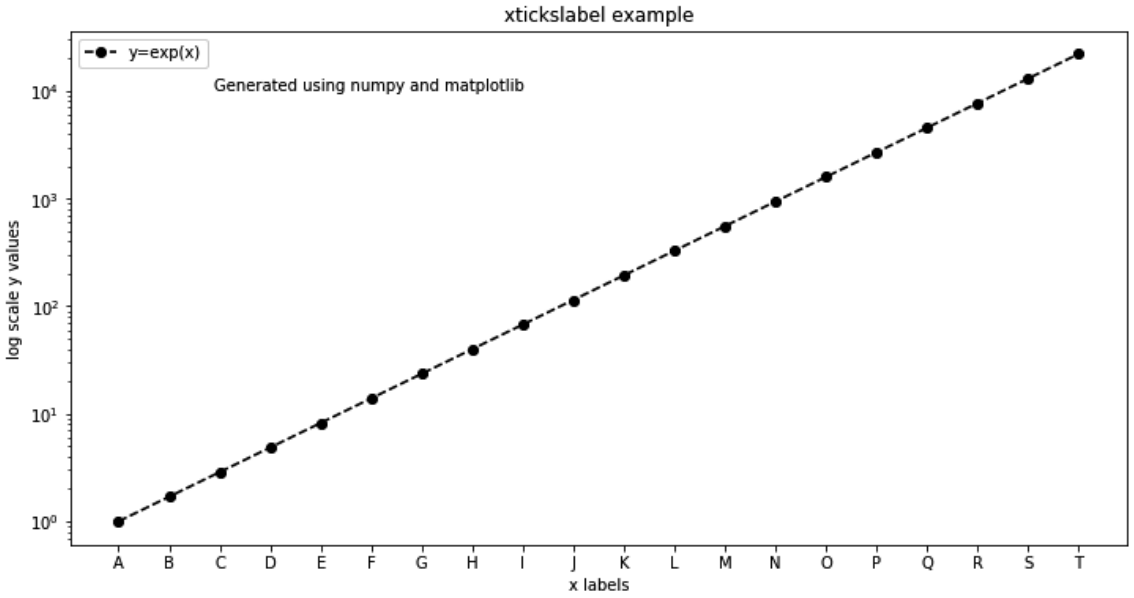


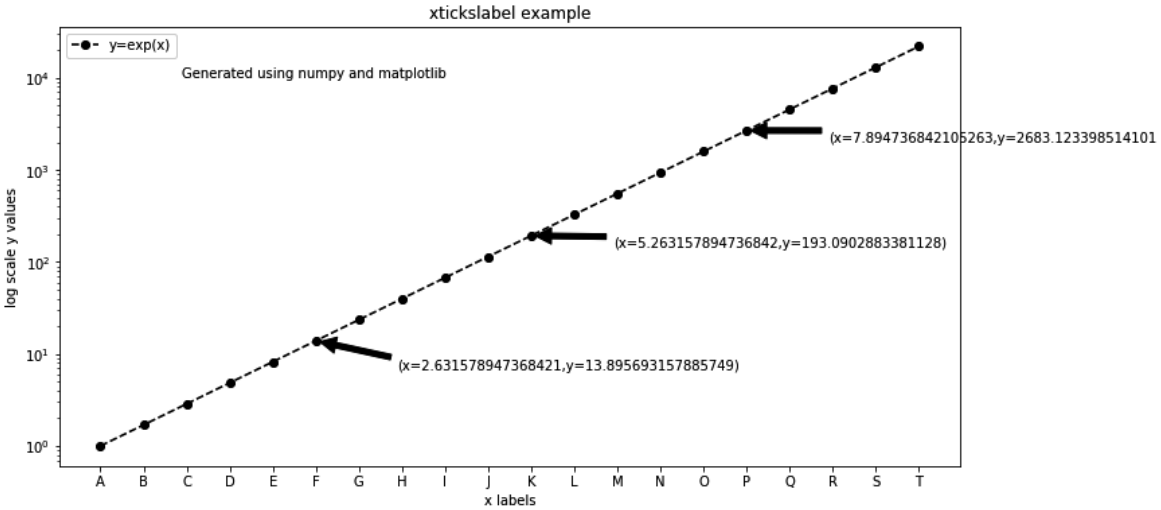

1.0
0.8
0.6
0.4
0.2
0.0
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
20000
15000
10000
5000
0
1000
800
600
400
200
0
1.0
0.5
0.0
−0.5
2
1
0
−1
−2
0
2
4
6
8
10

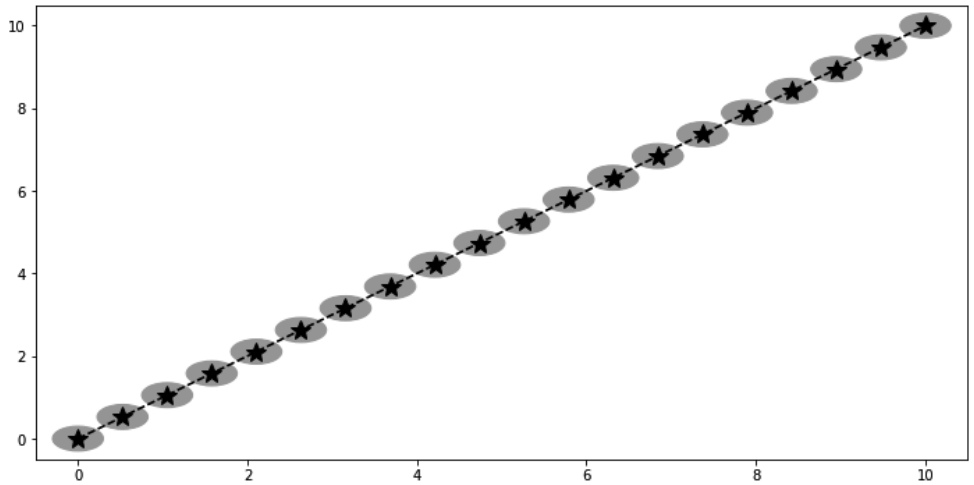

20000
15000
10000
5000
0
8.00
8.42
8.94
9.47
10.00
10.50

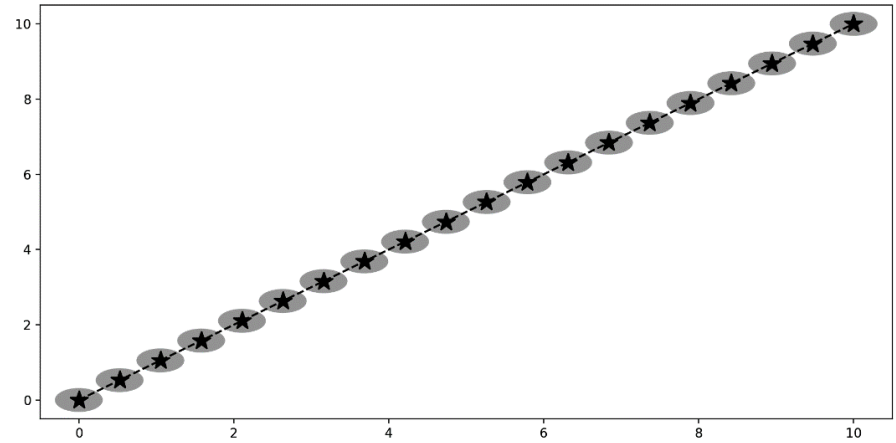

10^4
10^3
10^2
10^1
10^0
A B C D E F G H I J K L M N O P Q R S T

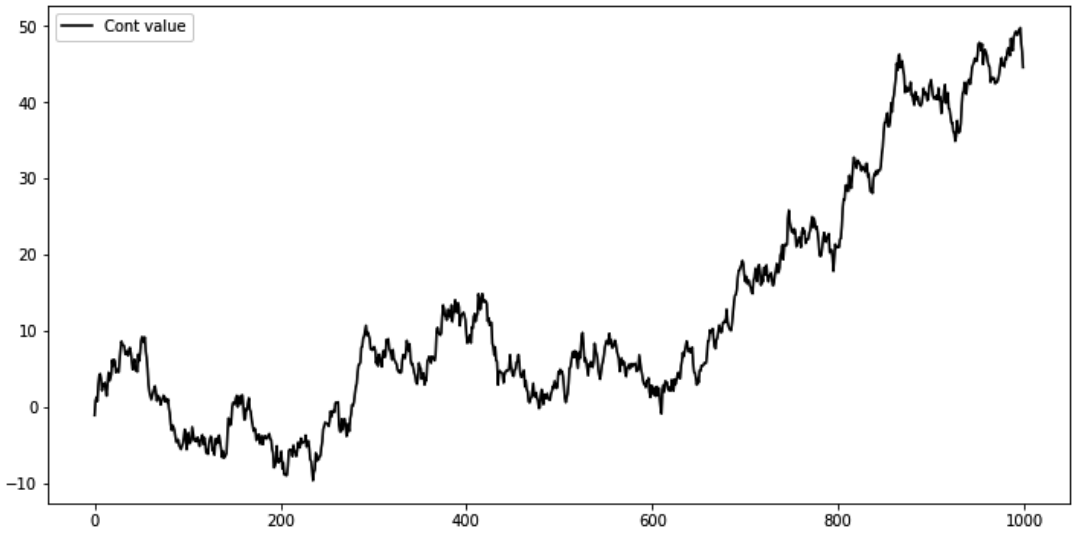

xtickslabel example
y=exp(x)
log scale y values
10^4
10^3
10^2
10^1
10^0
A B C D E F G H I J K L M N O P Q R S T
x labels

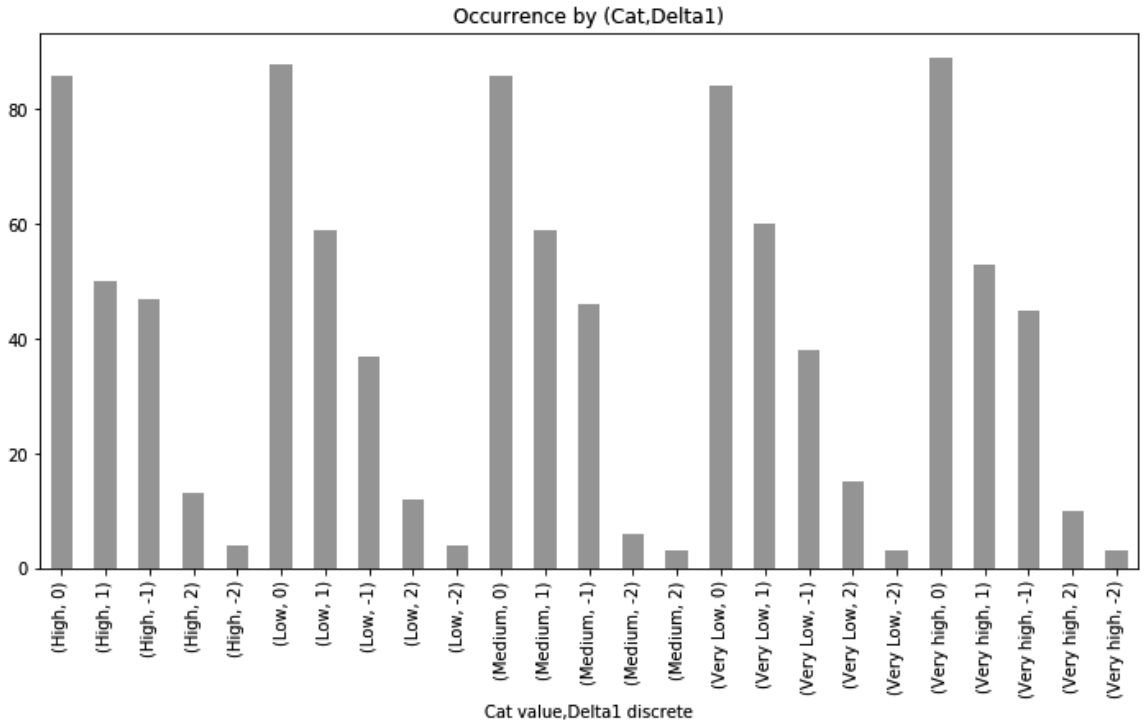

xtickslabel example
y=exp(x)
Generated using numpy and matplotlib
log scale y values
x labels
A B C D E F G H I J K L M N O P Q R S T

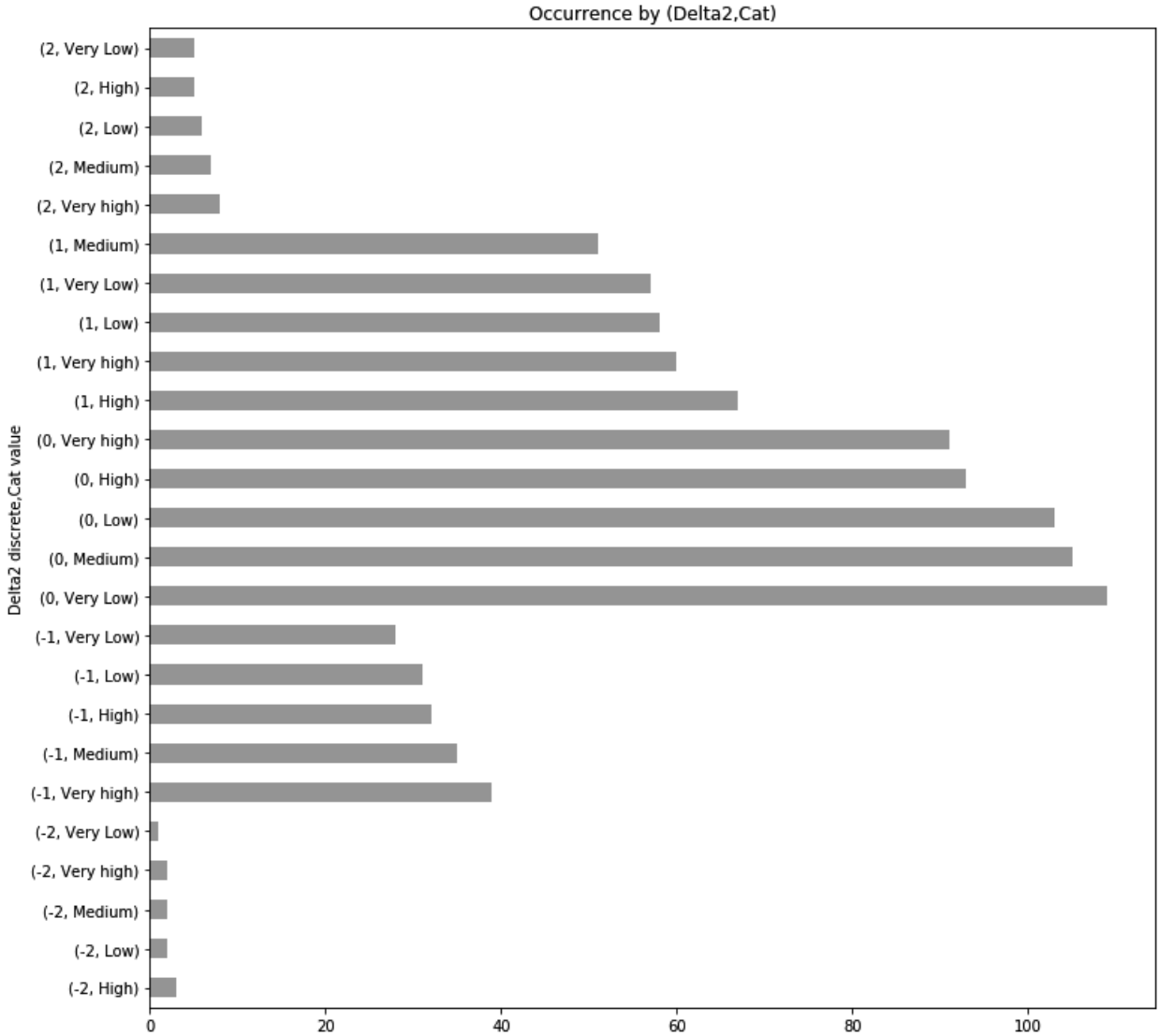

xtickslabel example
y=exp(x)
Generated using numpy and matplotlib
(x=7.894736842105263,y=2683.123398514101
(x=5.263157894736842,y=193.0902883381128)
(x=2.631578947368421,y=13.895693157885749)
log scale y values
x labels
A B C D E F G H I J K L M N O P Q R S T

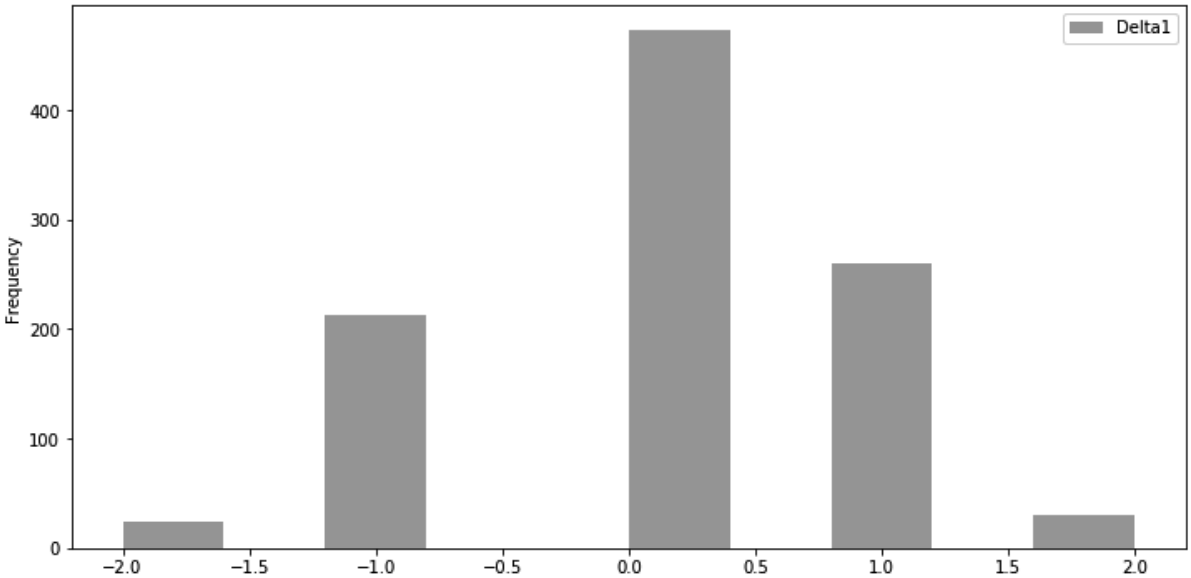


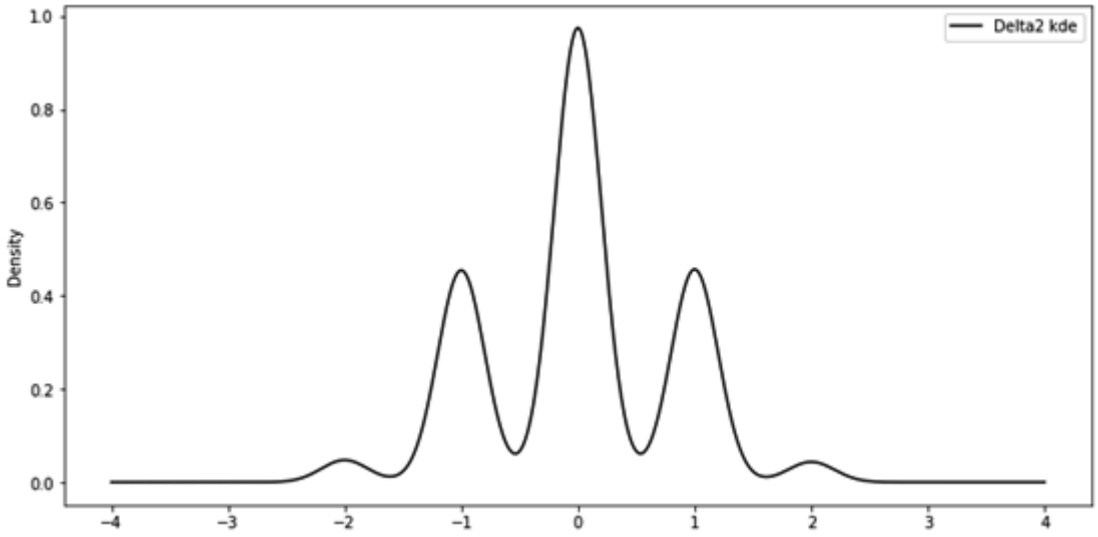

0
2
4
6
8
10

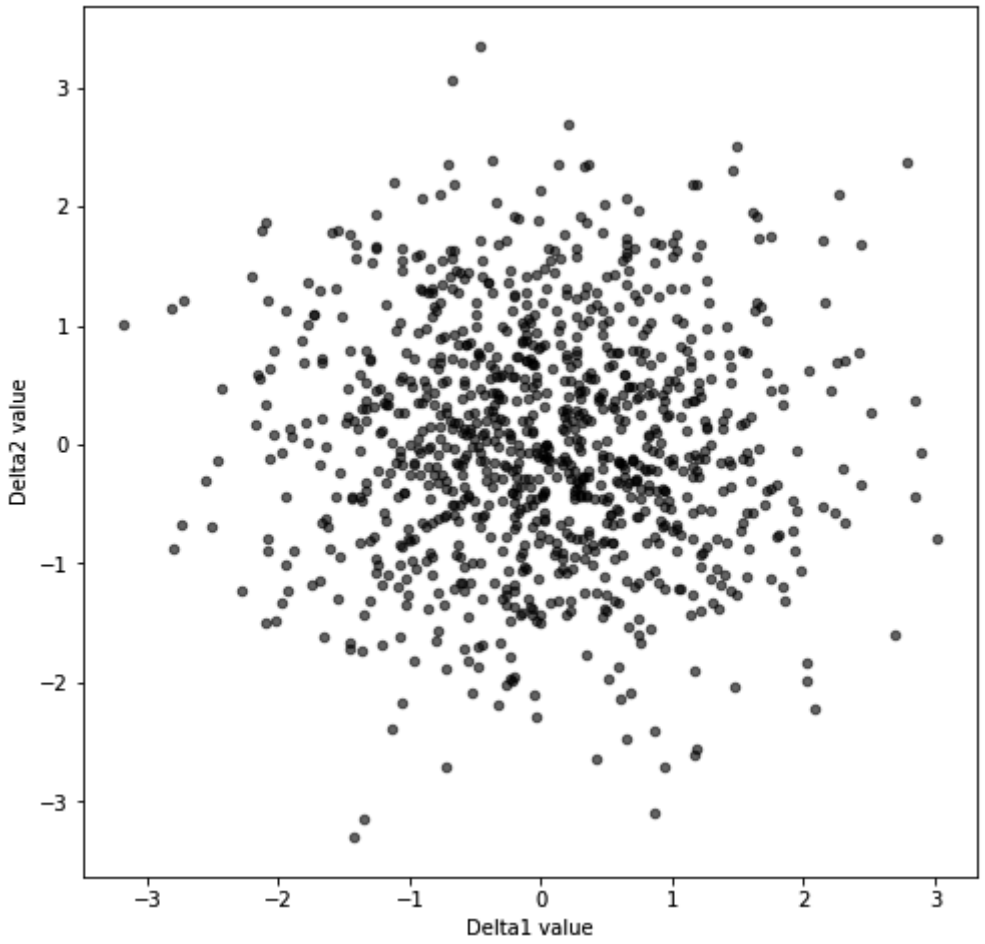

Cont value
50
40
30
20
10
0
−10
0
200
400
600
800
1000

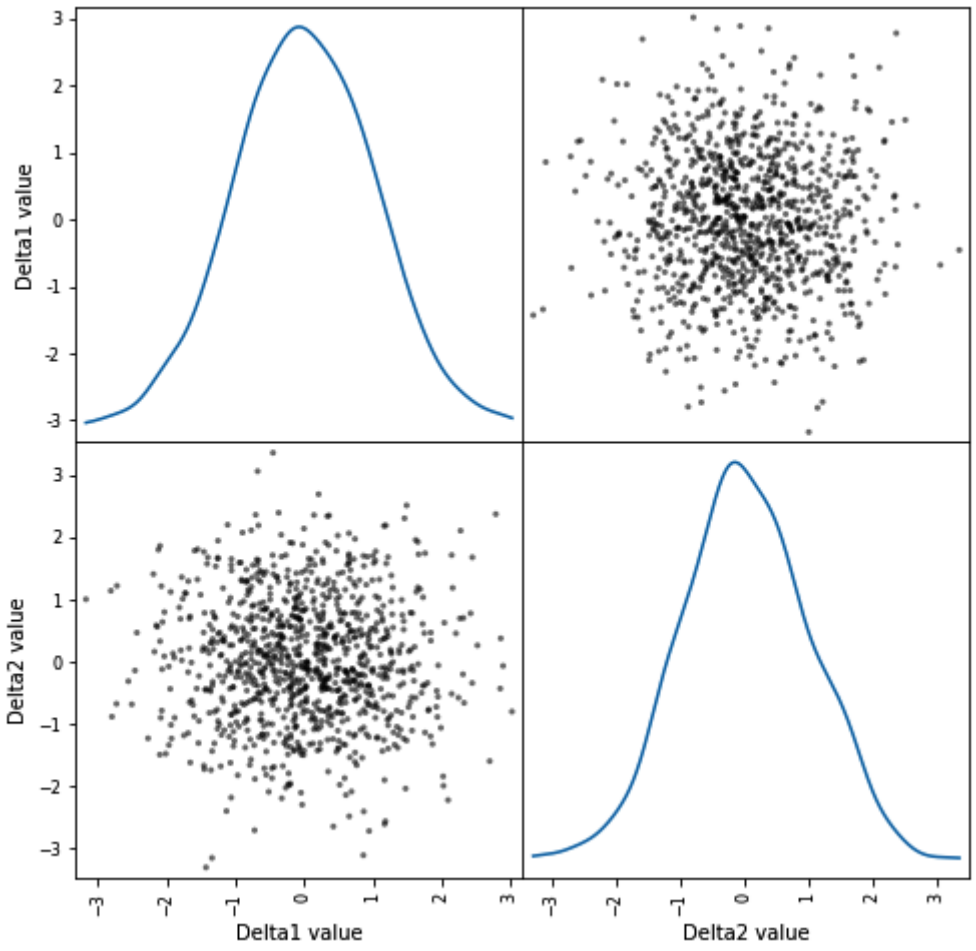

Occurrence by (Cat,Delta1)
80
60
40
20
0
(High, 0)
(High, 1)
(High, -1)
(High, 2)
(High, -2)
(Low, 0)
(Low, 1)
(Low, -1)
(Low, 2)
(Low, -2)
(Medium, 0)
(Medium, 1)
(Medium, -1)
(Medium, -2)
(Medium, 2)
(Very Low, 0)
(Very Low, 1)
(Very Low, -1)
(Very Low, 2)
(Very Low, -2)
(Very high, 0)
(Very high, 1)
(Very high, -1)
(Very high, 2)
(Very high, -2)
Cat value,Delta1 discrete

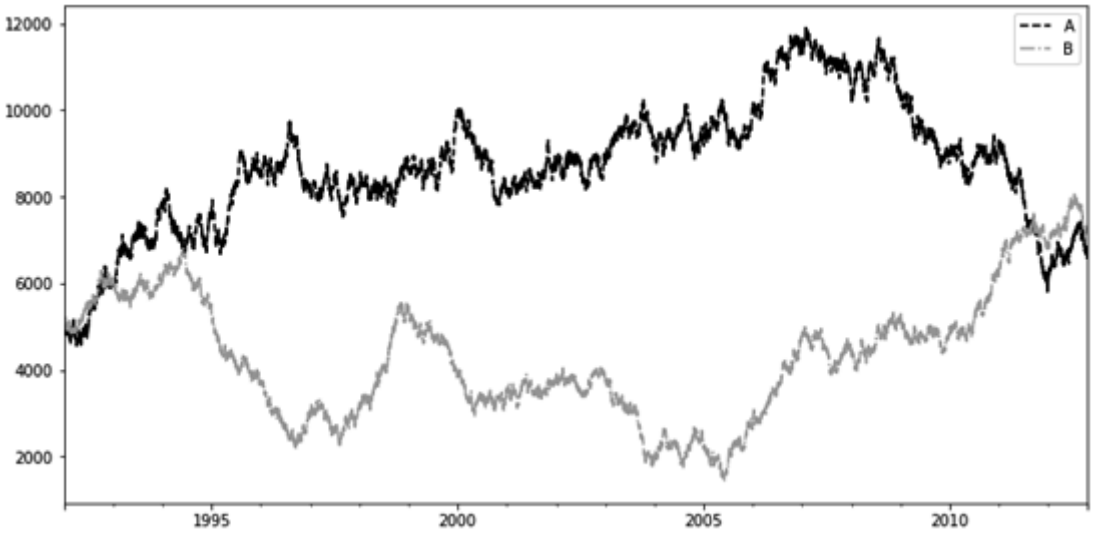

Occurrence by (Delta2,Cat)
Delta2 discrete,Cat value
(2, Very Low)
(2, High)
(2, Low)
(2, Medium)
(2, Very high)
(1, Medium)
(1, Very Low)
(1, Low)
(1, Very high)
(1, High)
(0, Very high)
(0, High)
(0, Low)
(0, Medium)
(0, Very Low)
(-1, Very Low)
(-1, Low)
(-1, High)
(-1, Medium)
(-1, Very high)
(-2, Very Low)
(-2, Very high)
(-2, Medium)
(-2, Low)
(-2, High)
0
20
40
60
80
100

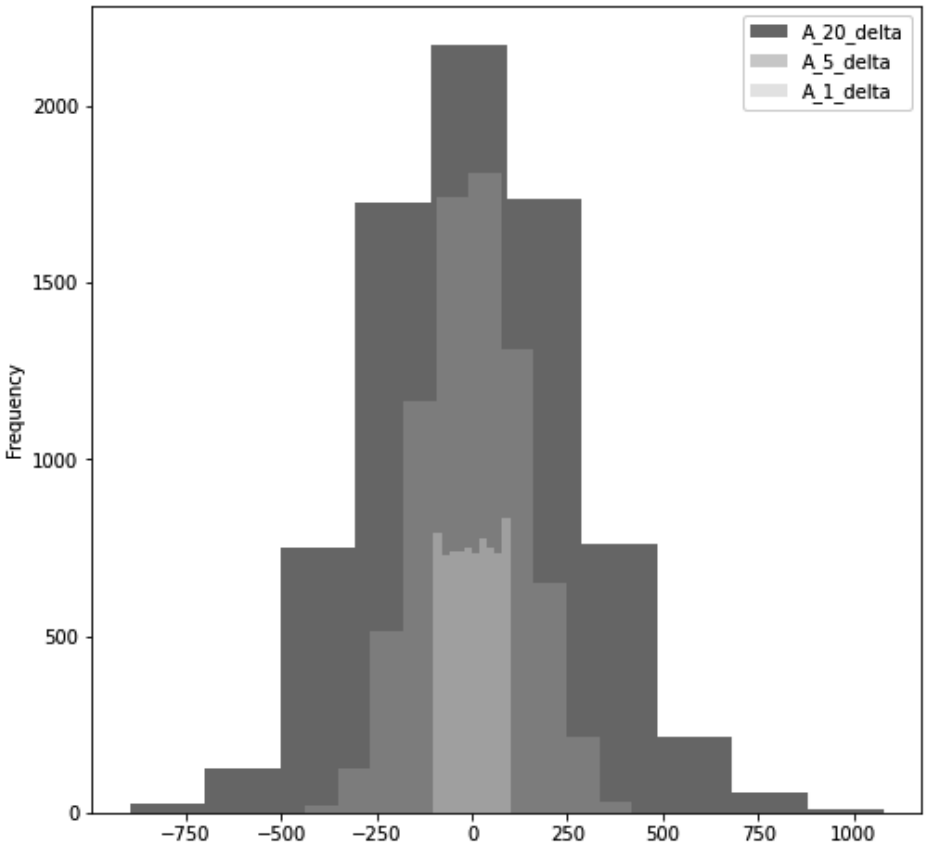

Delta1
Frequency
0
100
200
300
400
−2.0
−1.5
−1.0
−0.5
0.0
0.5
1.0
1.5
2.0

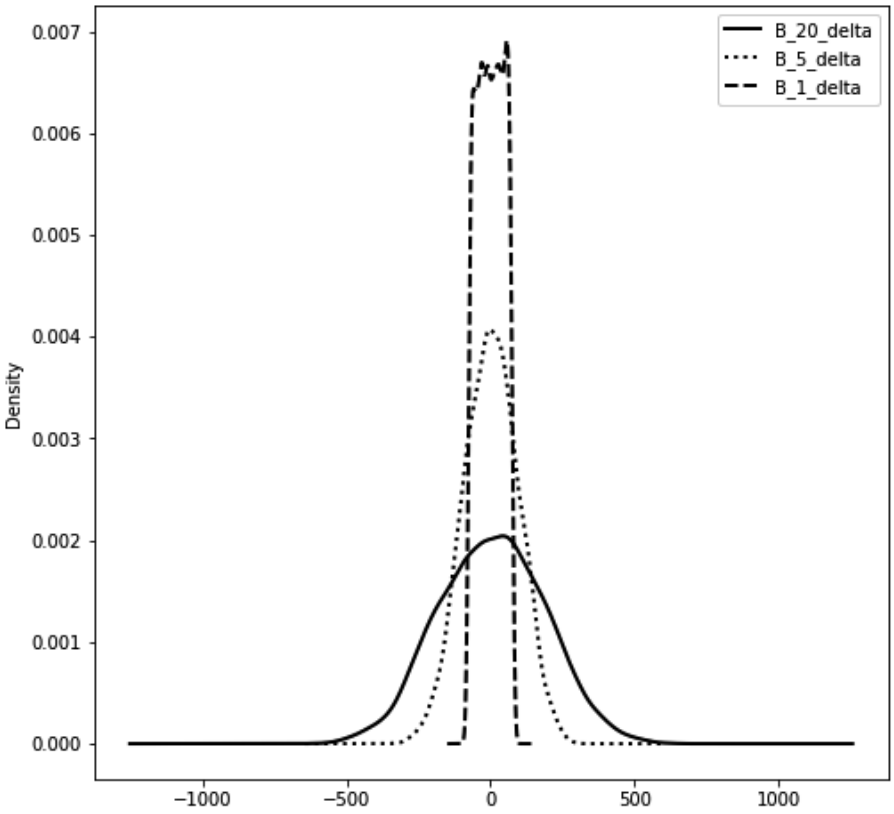

Delta2 kde
Density
1.0
0.8
0.6
0.4
0.2
0.0
−4
−3
−2
−1
0
1
2
3
4

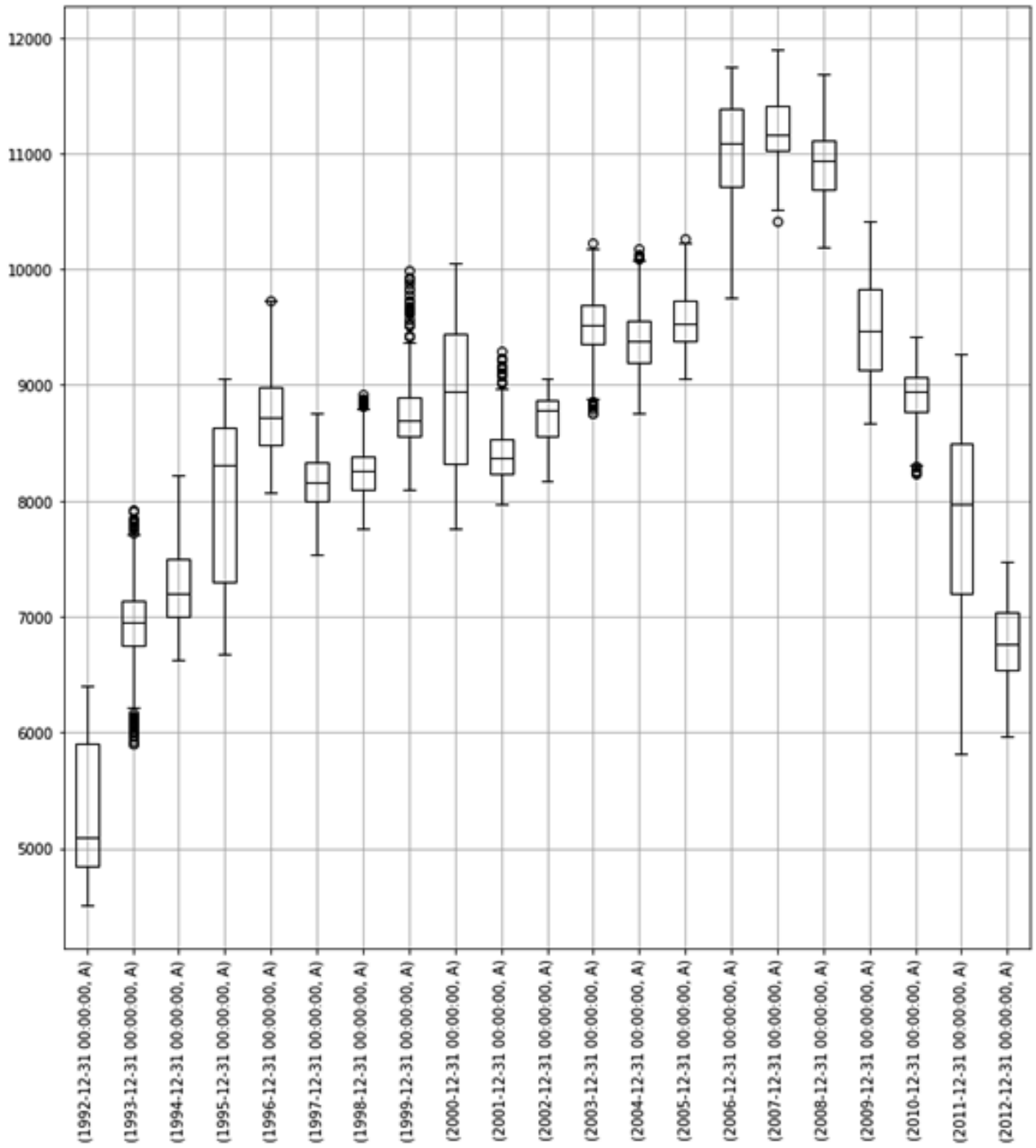

Delta2 value
Delta1 value
3
2
1
0
−1
−2
−3
−3
−2
−1
0
1
2
3

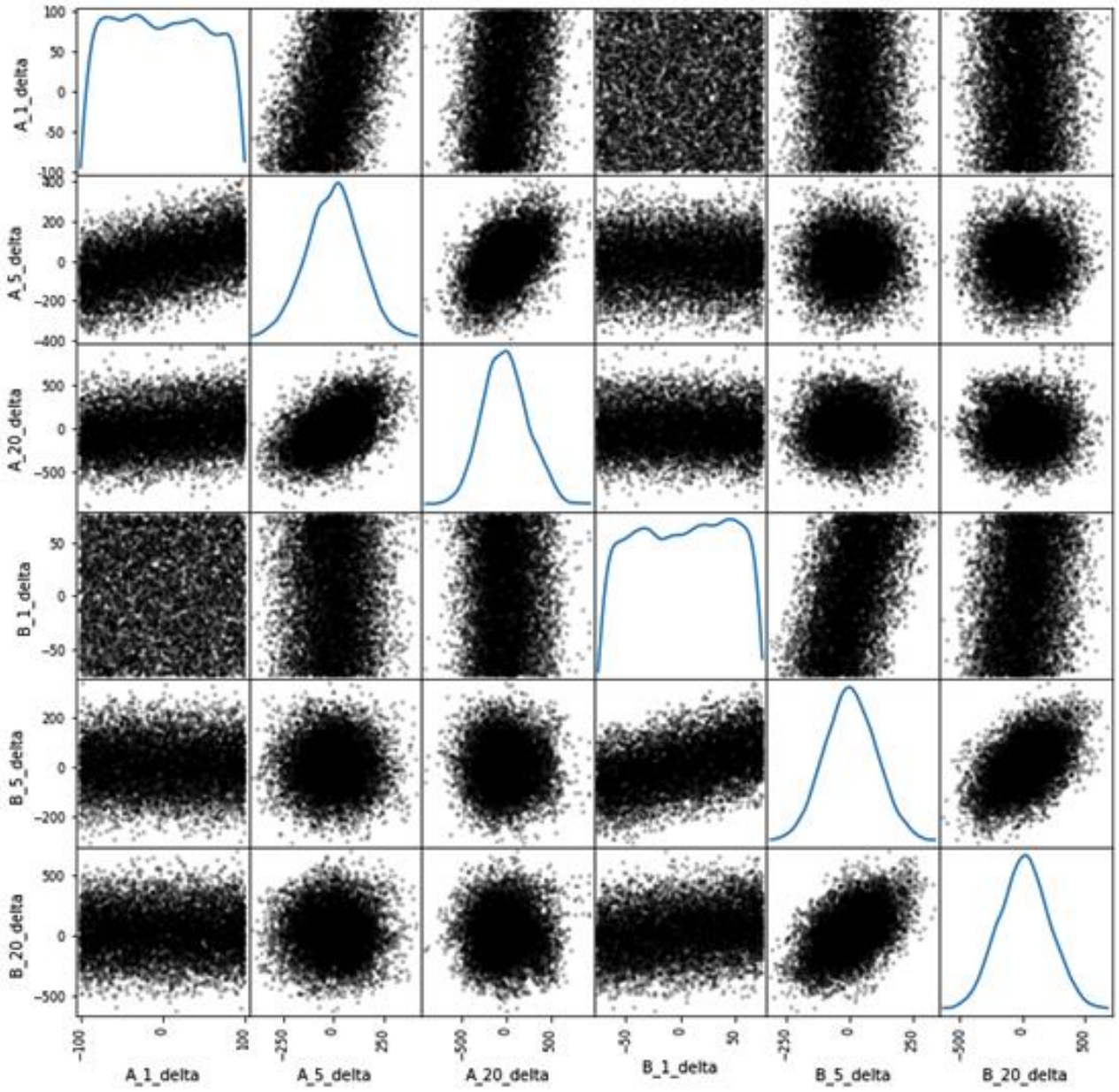

Delta1 value
Delta2 value
Delta1 value
Delta2 value

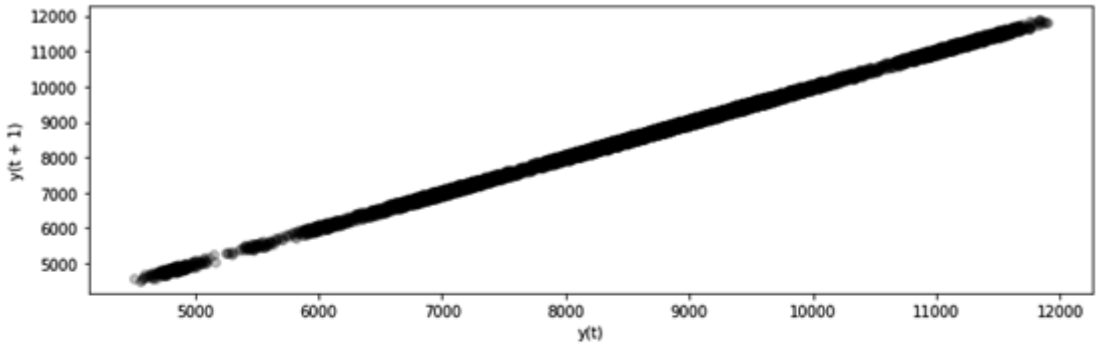

A
B
12000
10000
8000
6000
4000
2000
1995
2000
2005
2010

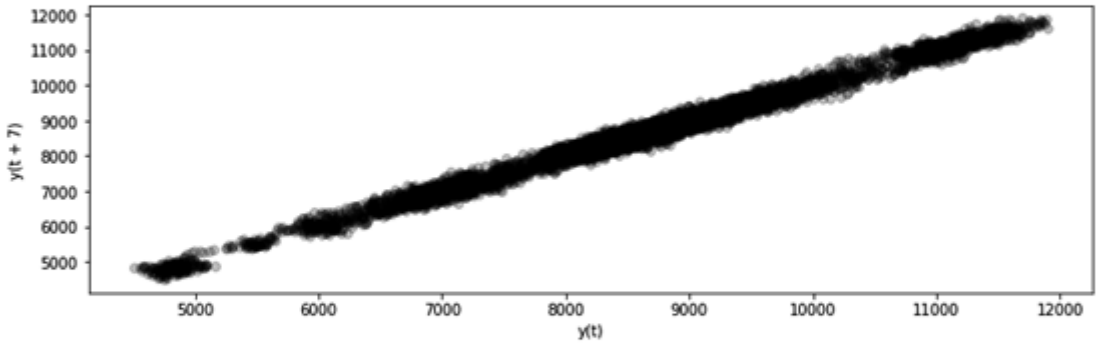

A_20_delta
A_5_delta
A_1_delta
Frequency
2000
1500
1000
500
0
−750
−500
−250
0
250
500
750
1000

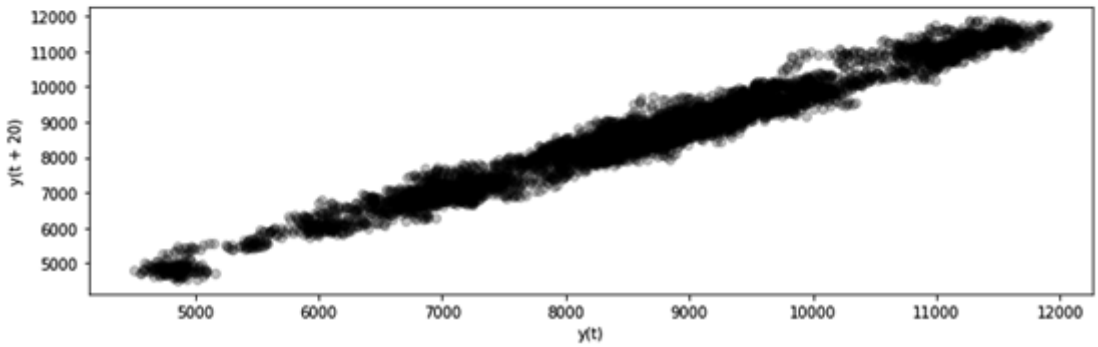

B_20_delta
B_5_delta
B_1_delta
Density
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0.000
−1000
−500
0
500
1000

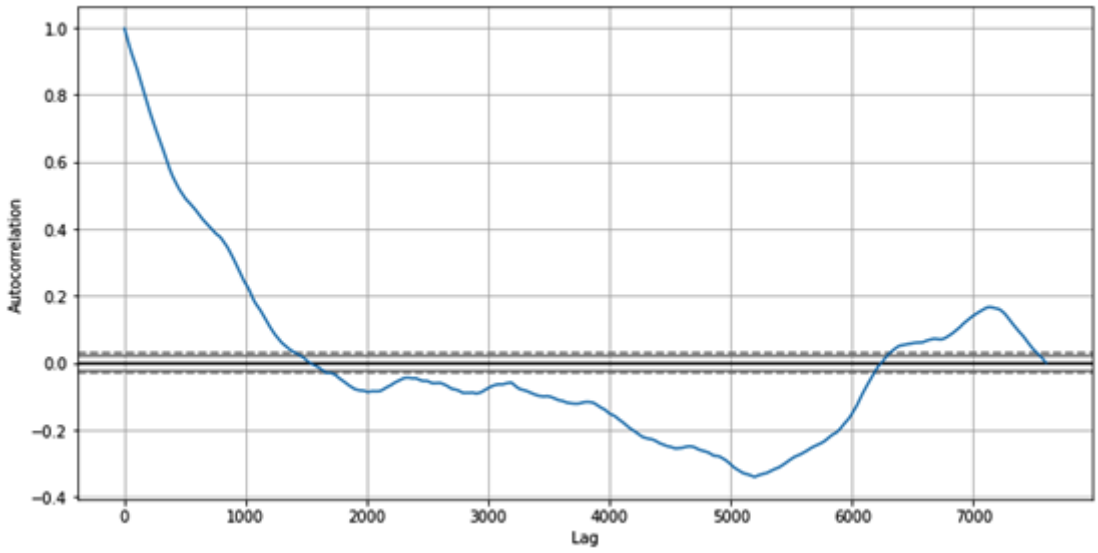

12000
11000
10000
9000
8000
7000
6000
5000
(1992-12-31 00:00:00, A)
(1993-12-31 00:00:00, A)
(1994-12-31 00:00:00, A)
(1995-12-31 00:00:00, A)
(1996-12-31 00:00:00, A)
(1997-12-31 00:00:00, A)
(1998-12-31 00:00:00, A)
(1999-12-31 00:00:00, A)
(2000-12-31 00:00:00, A)
(2001-12-31 00:00:00, A)
(2002-12-31 00:00:00, A)
(2003-12-31 00:00:00, A)
(2004-12-31 00:00:00, A)
(2005-12-31 00:00:00, A)
(2006-12-31 00:00:00, A)
(2007-12-31 00:00:00, A)
(2008-12-31 00:00:00, A)
(2009-12-31 00:00:00, A)
(2010-12-31 00:00:00, A)
(2011-12-31 00:00:00, A)
(2012-12-31 00:00:00, A)


A_1_delta
A_5_delta
A_20_delta
B_1_delta
B_5_delta
B_20_delta

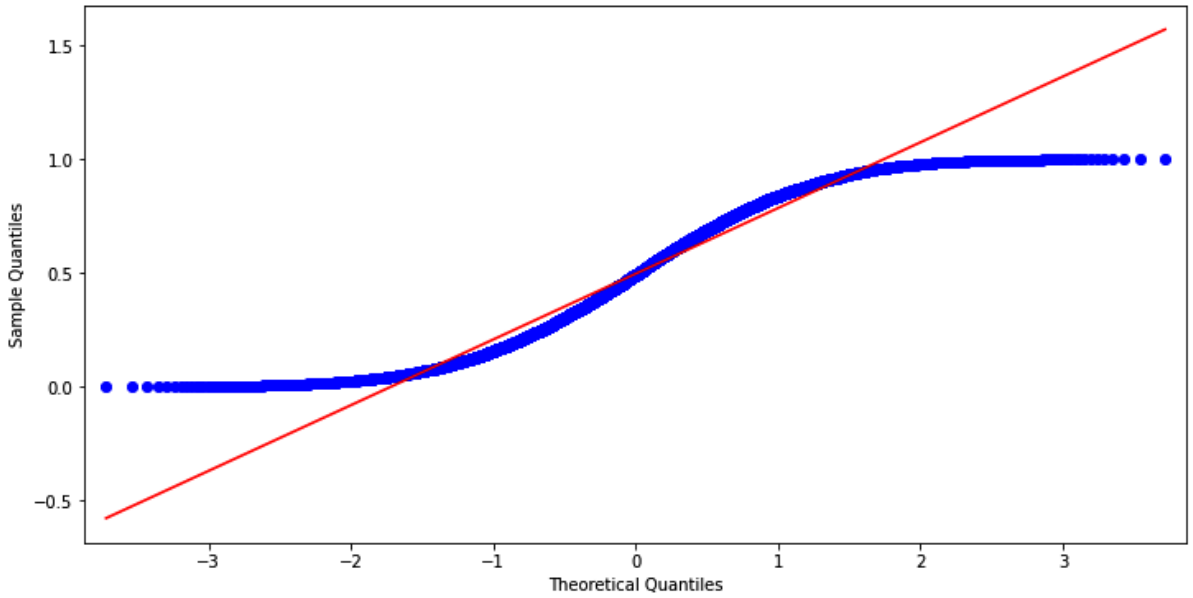

y(t + 1)
y(t)

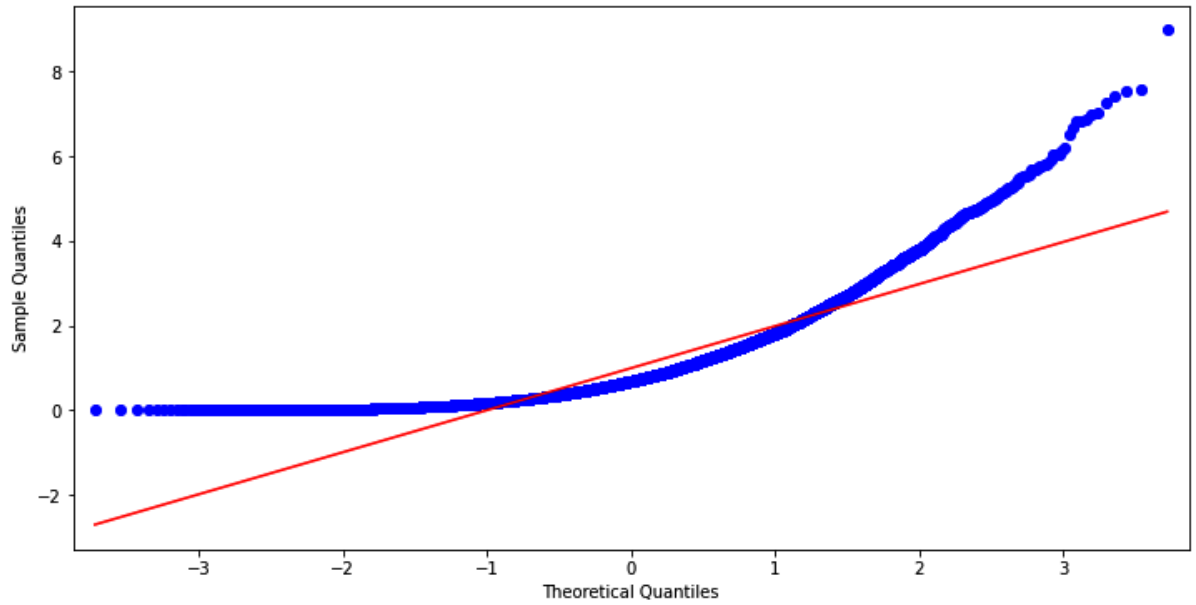

y(t + 7)
y(t)

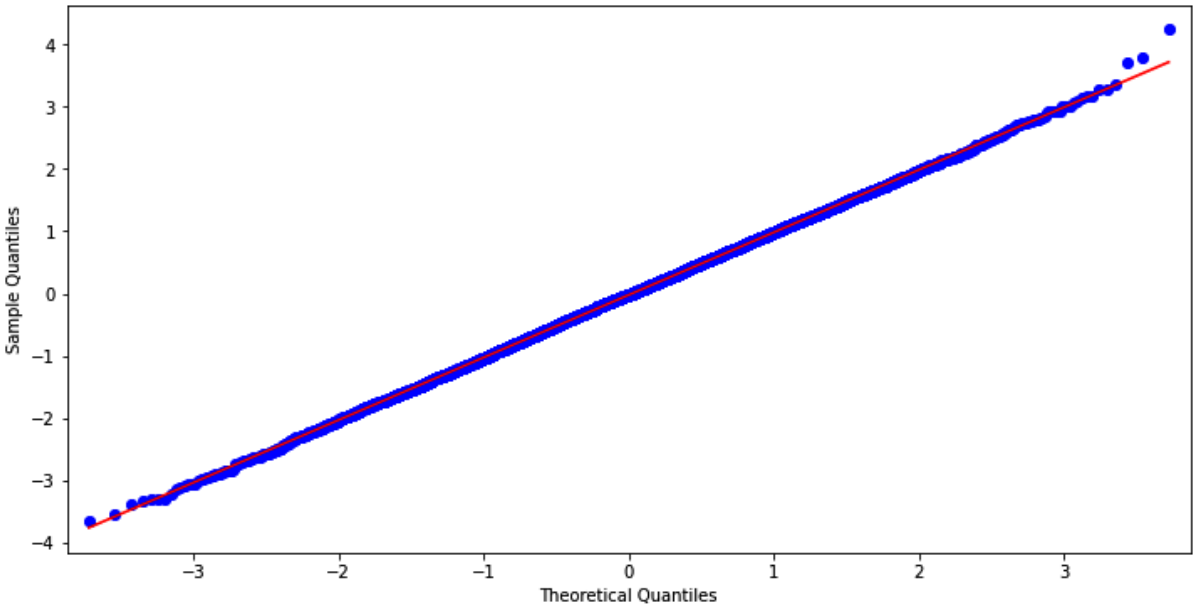

y(t + 20)
y(t)

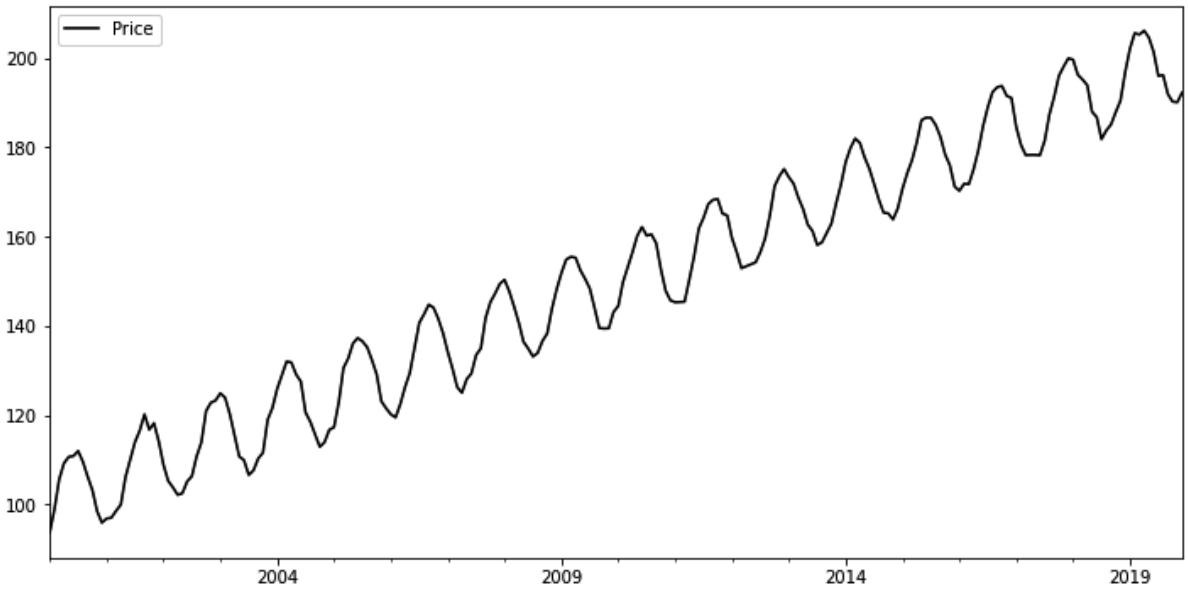

Autocorrelation
Lag

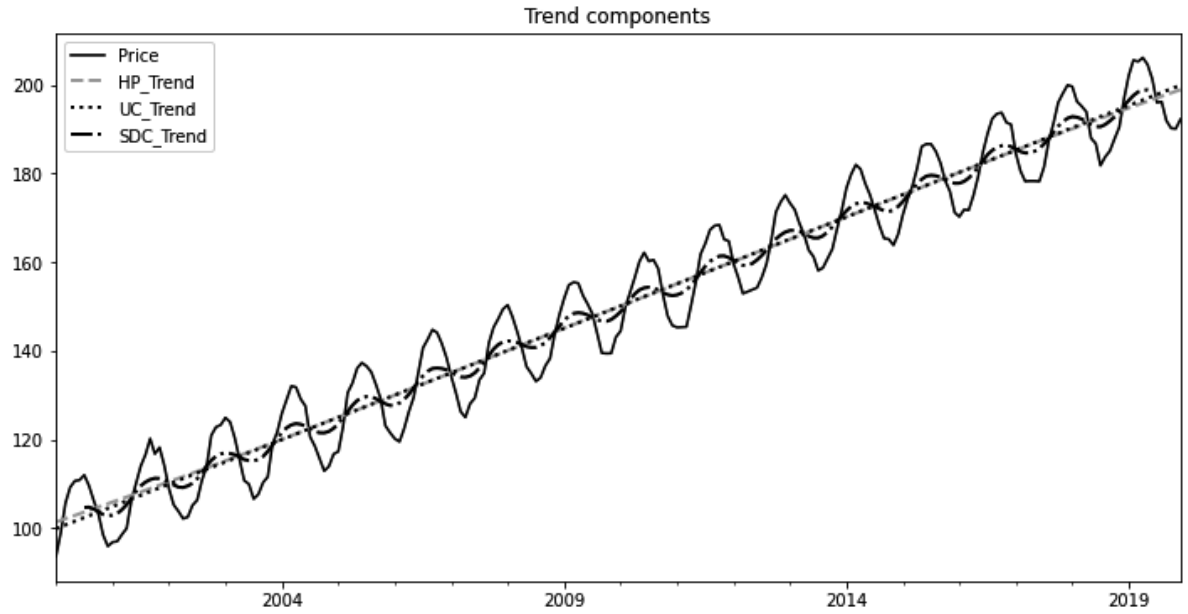
Chapter 6: Statistical Estimation, Inference, and Prediction

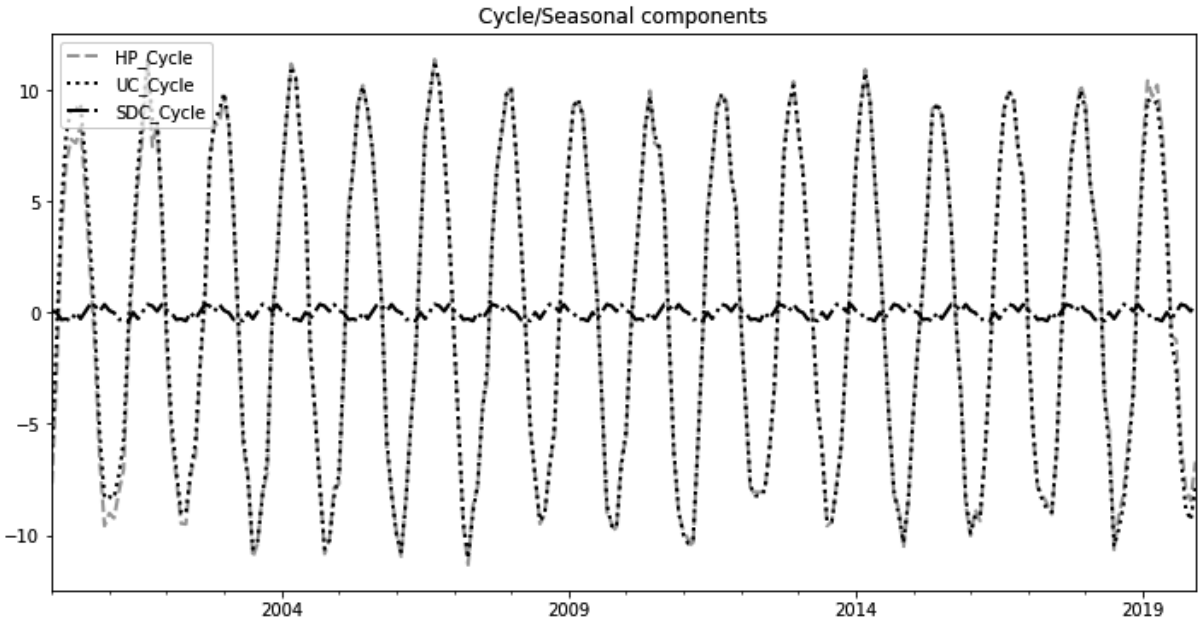


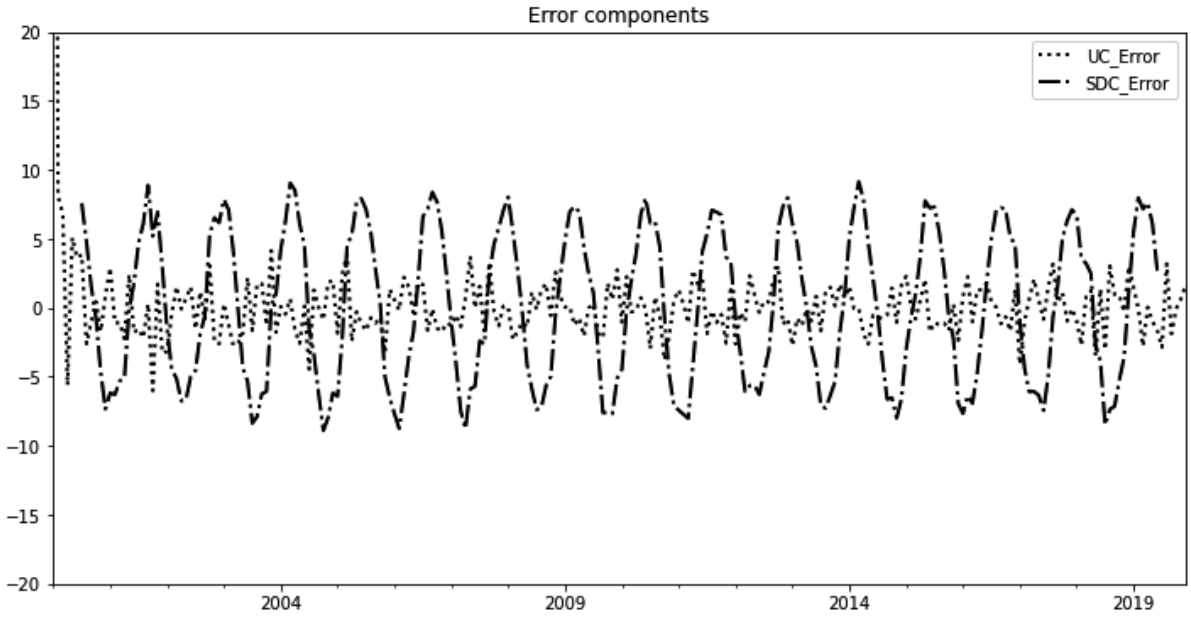


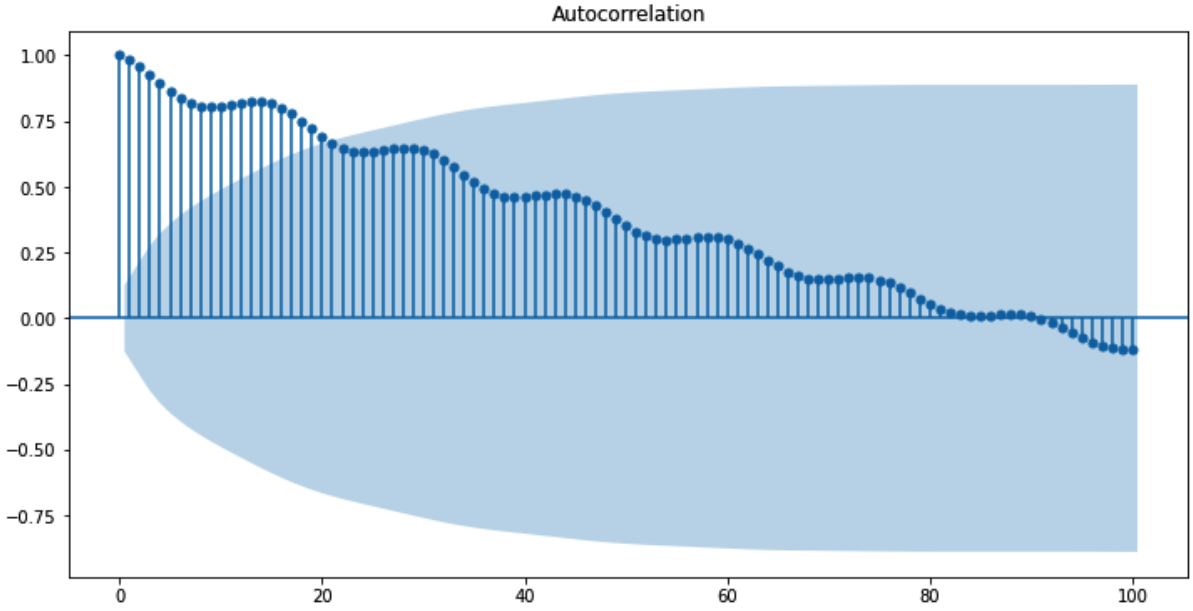

Sample Quantiles
Theoretical Quantiles
4
3
2
1
0
−1
−2
−3
−4
−3
−2
−1
0
1
2
3

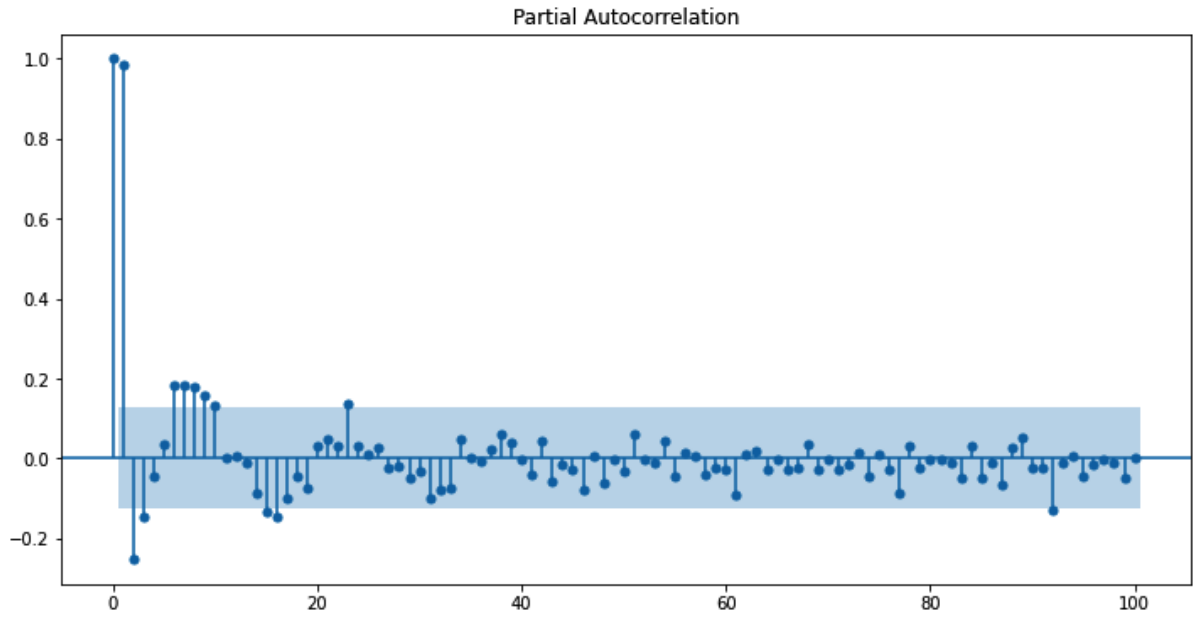

Price
200
180
160
140
120
100
2004
2009
2014
2019

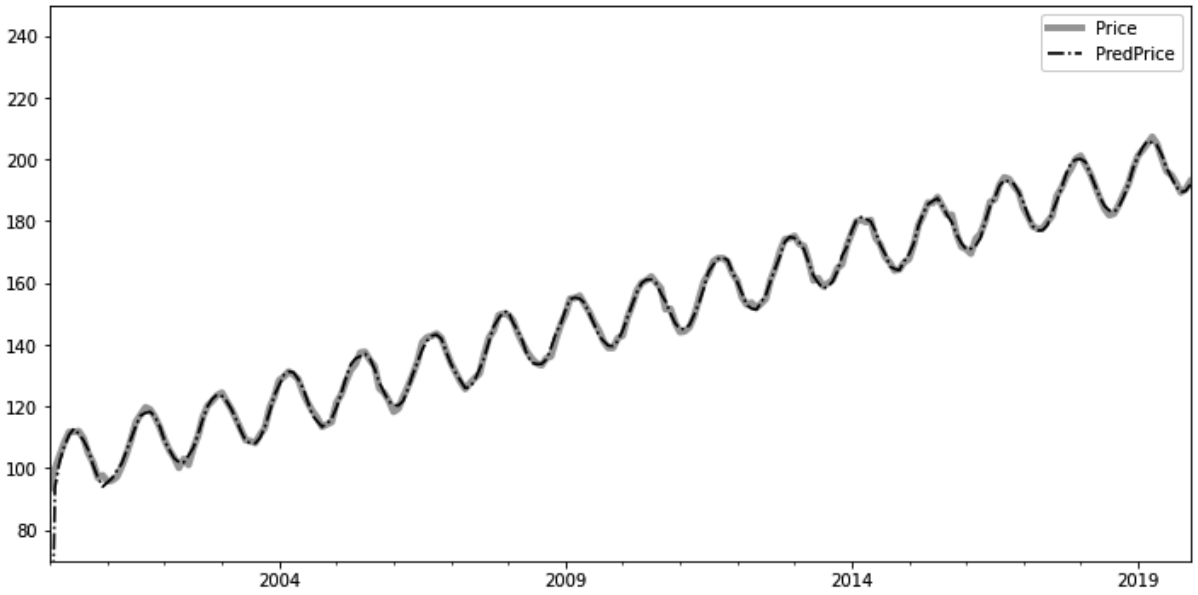

Trend components
Price
HP_Trend
UC_Trend
SDC_Trend
200
180
160
140
120
100
2004
2009
2014
2019

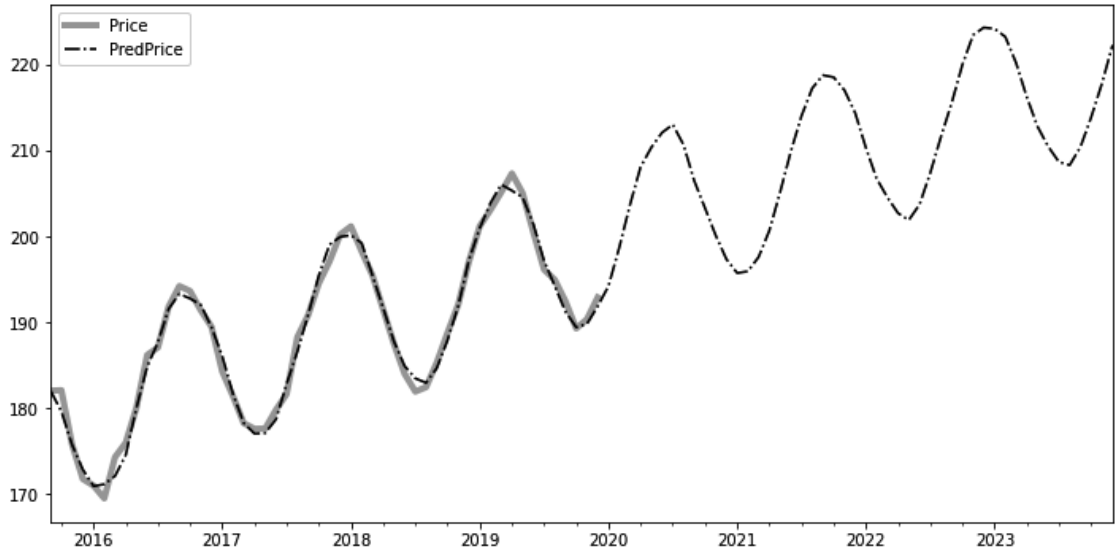

Cycle/Seasonal components
HP_Cycle
UC_Cycle
SDC_Cycle
10
5
0
−5
−10
2004
2009
2014
2019


Error components
UC_Error
SDC_Error
20
15
10
5
0
−5
−10
−15
−20
2004
2009
2014
2019


Autocorrelation
1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
0
20
40
60
80
100


Partial Autocorrelation
1.0
0.8
0.6
0.4
0.2
0.0
−0.2
0
20
40
60
80
100


Price
PredPrice
240
220
200
180
160
140
120
100
80
2004
2009
2014
2019



Parameter	Statistical Tests
d = trend difference order	Kwiatkowski-Phillips-Schmidt-Shin (KPSS) Augmented Dickey-Fuller (ADF) Phillips-Perron (PP)
D = seasonal difference order	Canova-Hansen (CH)

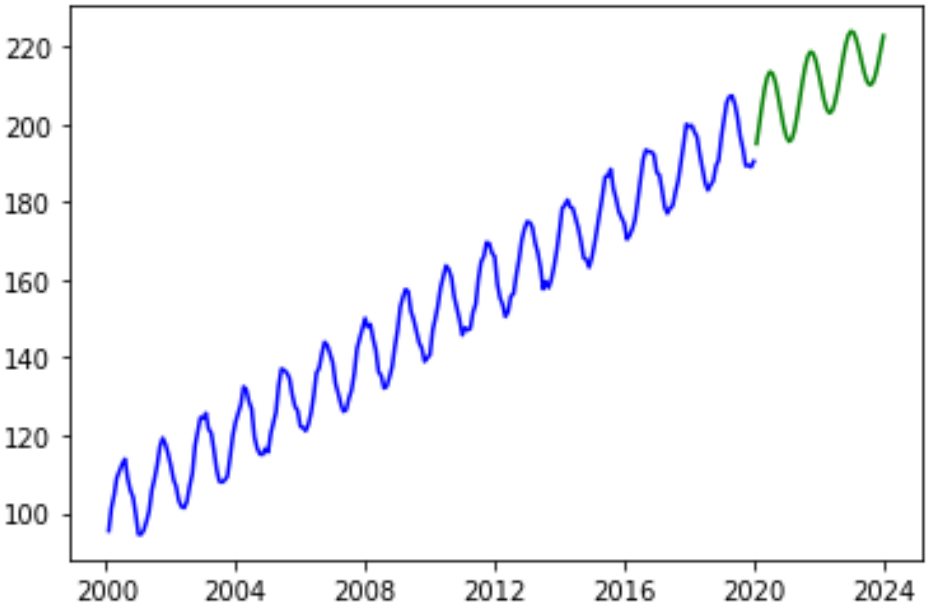
SARIMAX Results

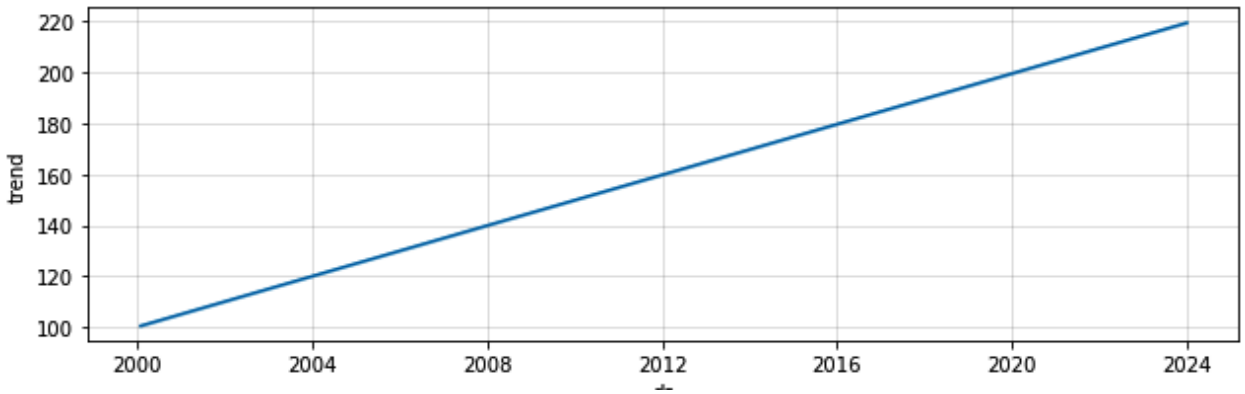
Dep. Variable:	y	No. Observations:	240
Model:	SARIMAX(4, 1, 2)	Log Likelihood	-392.059
Date:	Thu, 18 Mar 2021	AIC	800.119
Time:	11:15:38	BIC	827.930
Sample:	0	HQIC	811.326
	- 240		
Covariance Type:	opg		

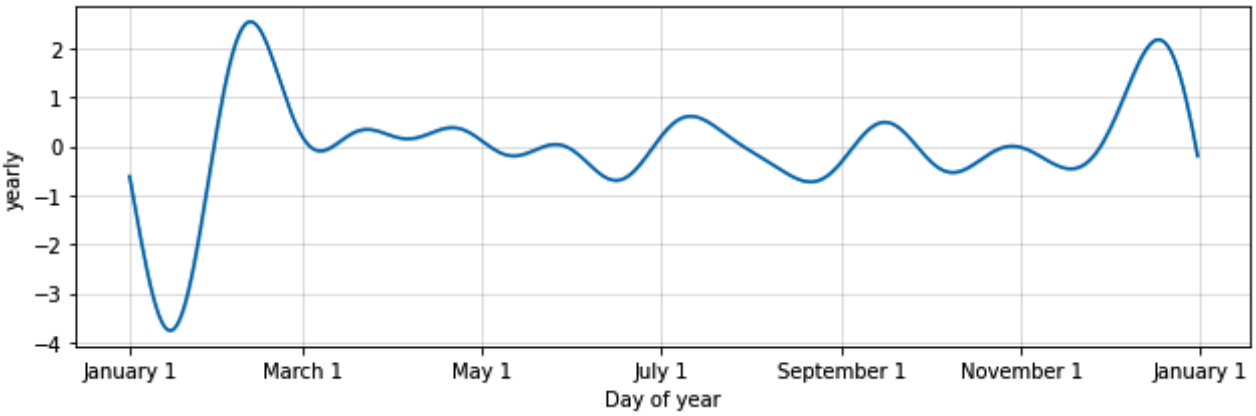
	coef	std err	z	P>|z|	[0.025	0.975]
intercept	0.1222	0.013	9.356	0.000	0.097	0.148
ar.L1	1.2502	0.096	13.059	0.000	1.063	1.438
ar.L2	-0.0985	0.135	-0.732	0.464	-0.362	0.165
ar.L3	-0.3111	0.126	-2.479	0.013	-0.557	-0.065
ar.L4	-0.1326	0.089	-1.487	0.137	-0.307	0.042
ma.L1	-1.8235	0.061	-30.098	0.000	-1.942	-1.705
ma.L2	0.8357	0.060	13.874	0.000	0.718	0.954
sigma2	1.6801	0.203	8.263	0.000	1.282	2.079

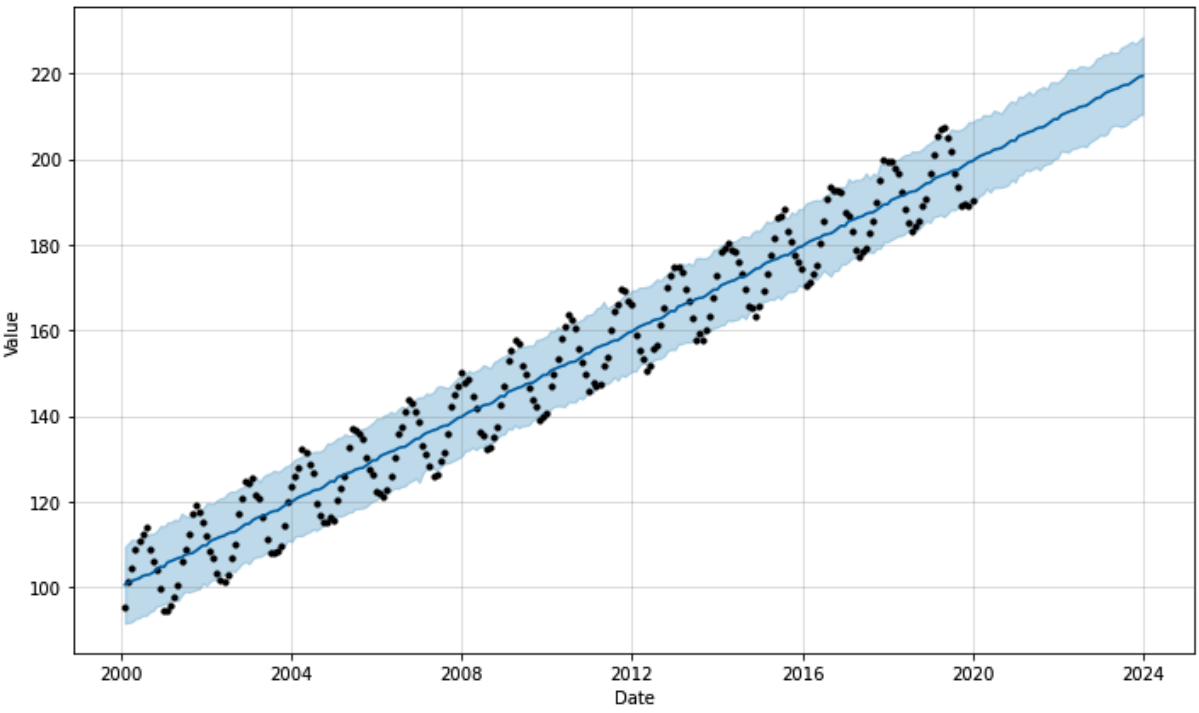
Ljung-Box (Q):	55.54	Jarque-Bera (JB):	1.44
Prob(Q):	0.05	Prob(JB):	0.49
Heteroskedasticity (H):	0.77	Skew:	0.06
Prob(H) (two-sided):	0.25	Kurtosis:	2.64

Warnings:
[1] Covariance matrix calculated using the outer product of gradients (complex-step).

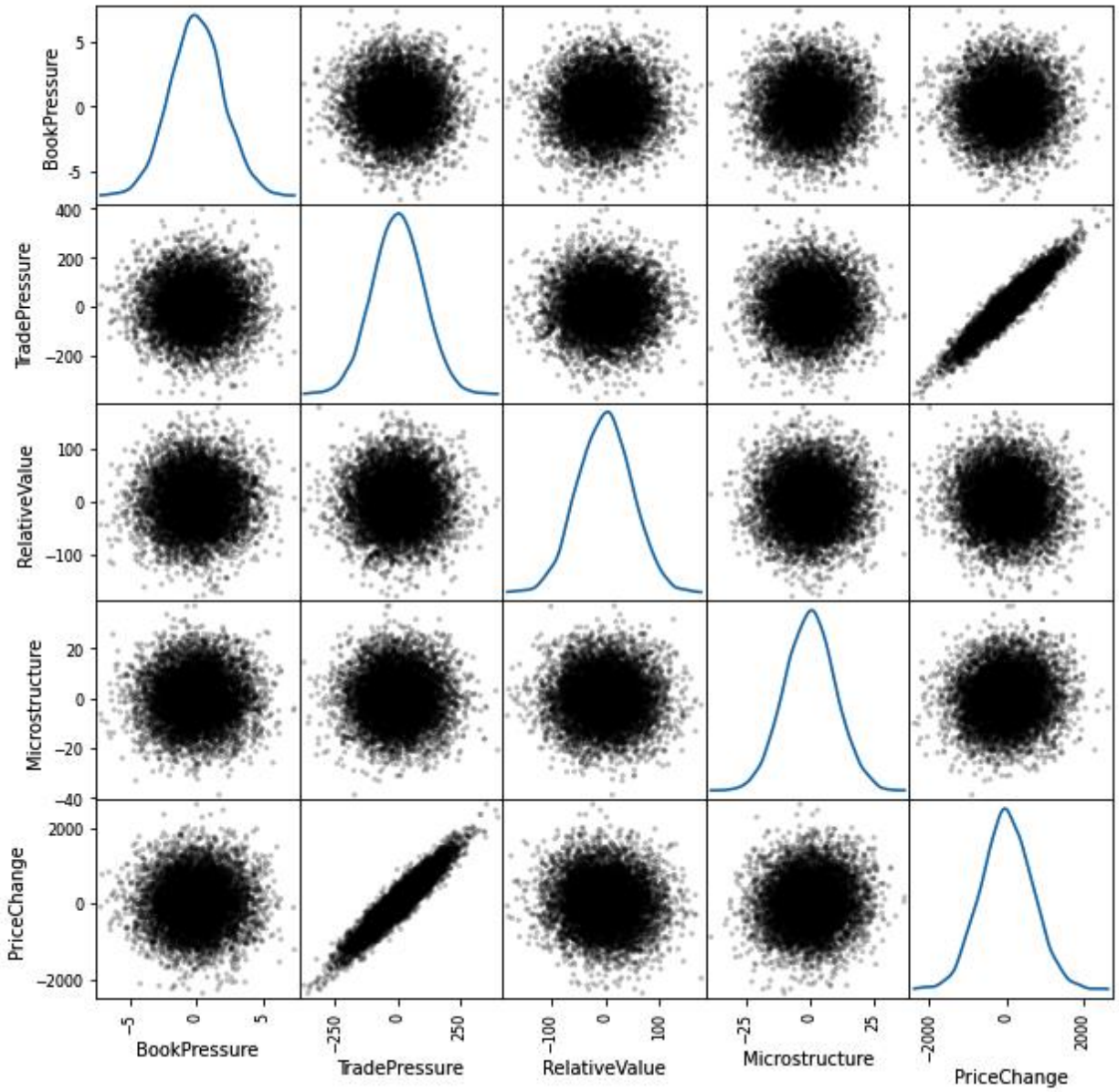

220
200
180
160
140
120
100
2000
2004
2008
2012
2016
2020
2024

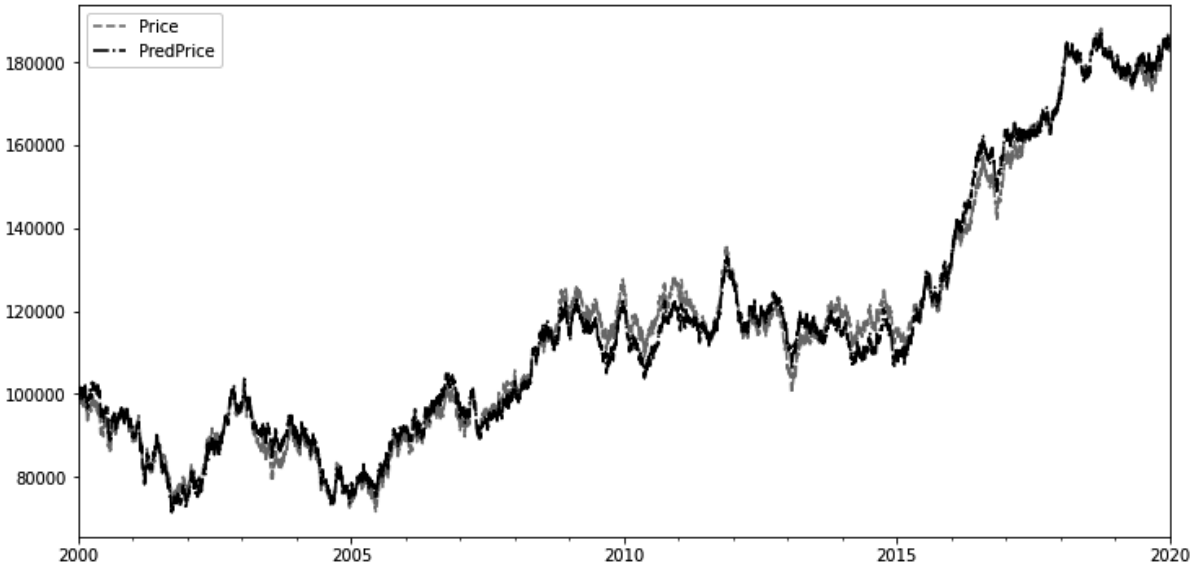

trend
220
200
180
160
140
120
100
2000
2004
2008
2012
2016
2020
2024

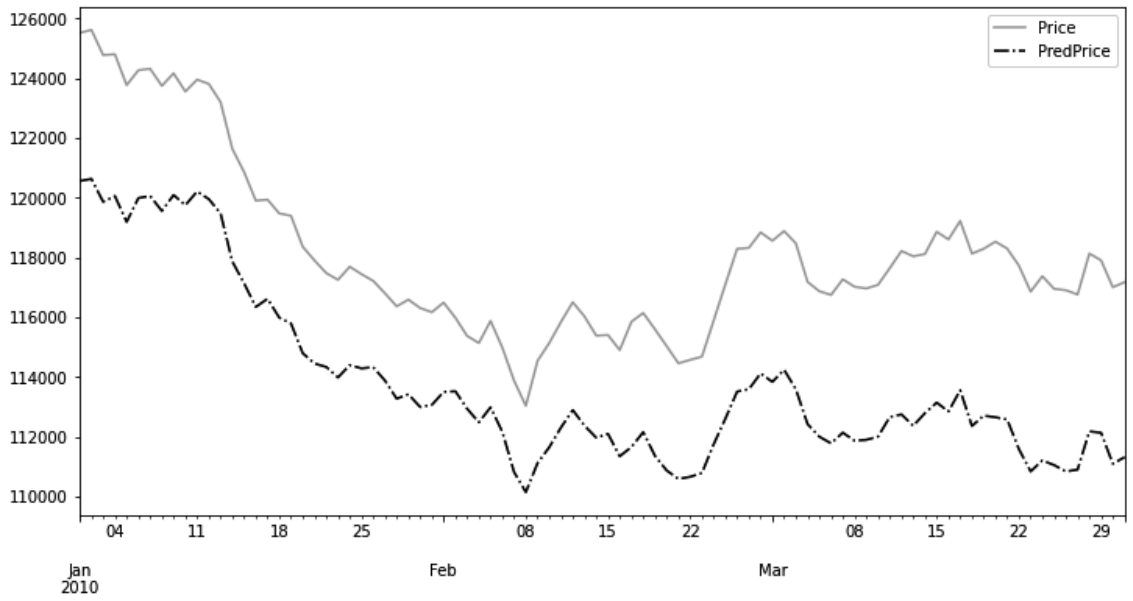

yearly
2
1
0
−1
−2
−3
−4
January 1
March 1
May 1
July 1
September 1
November 1
January 1
Day of year

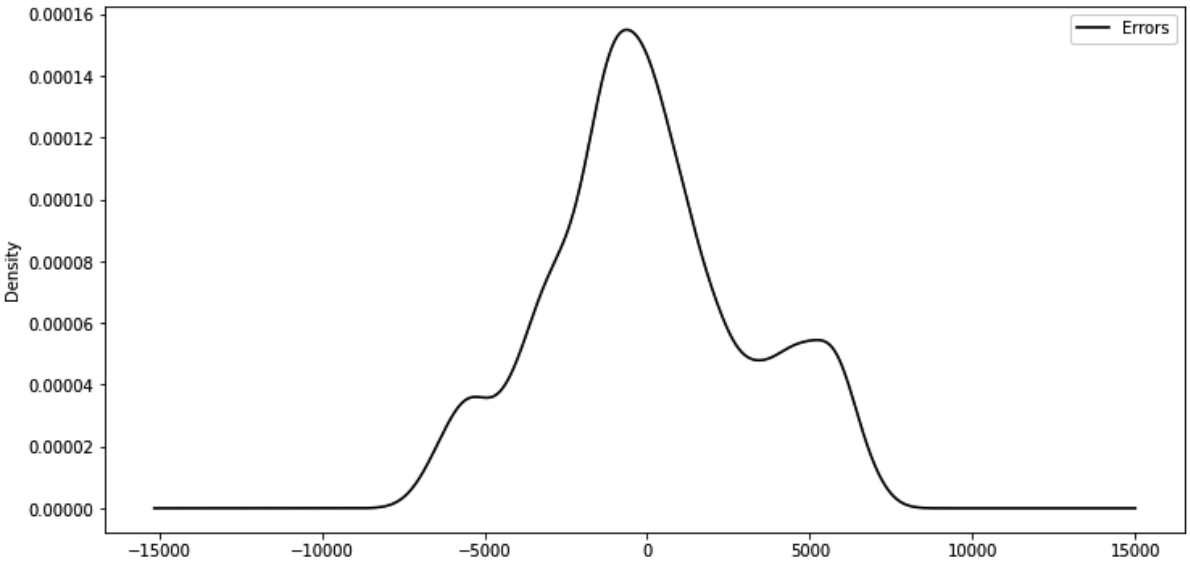

Value
Date
220
200
180
160
140
120
100
2000
2004
2008
2012
2016
2020
2024

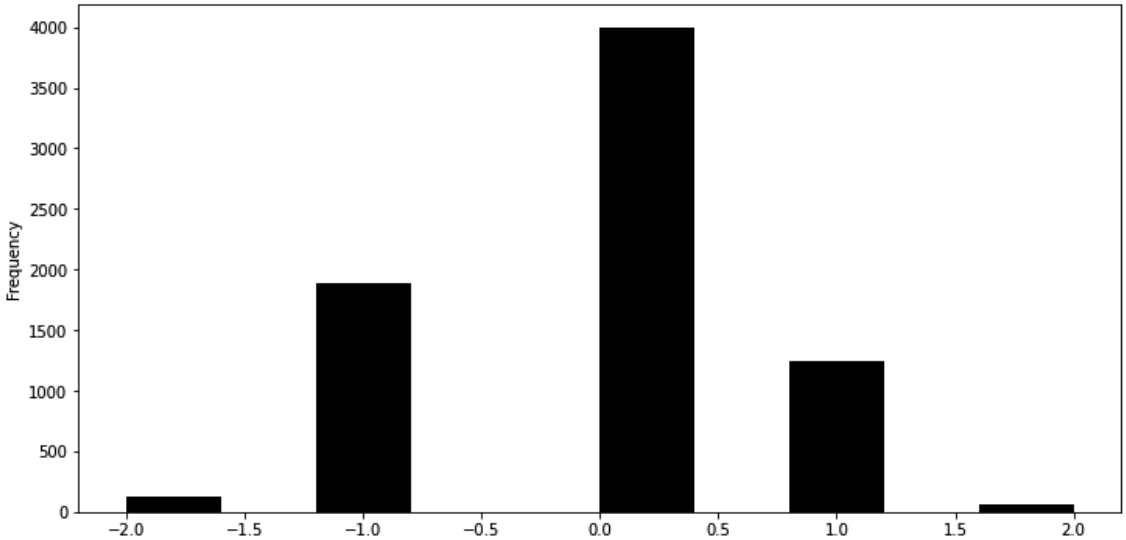

Price
180000
160000
140000
120000
100000
80000
2000
2005
2010
2015
2020

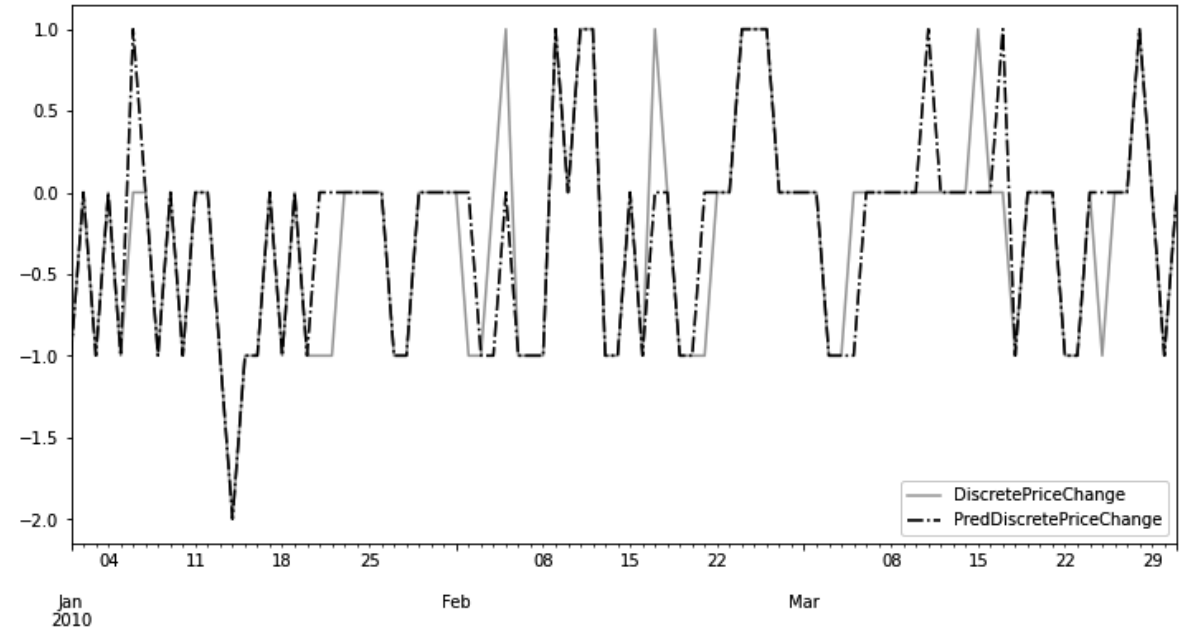

BookPressure
TradePressure
RelativeValue
Microstructure
PriceChange

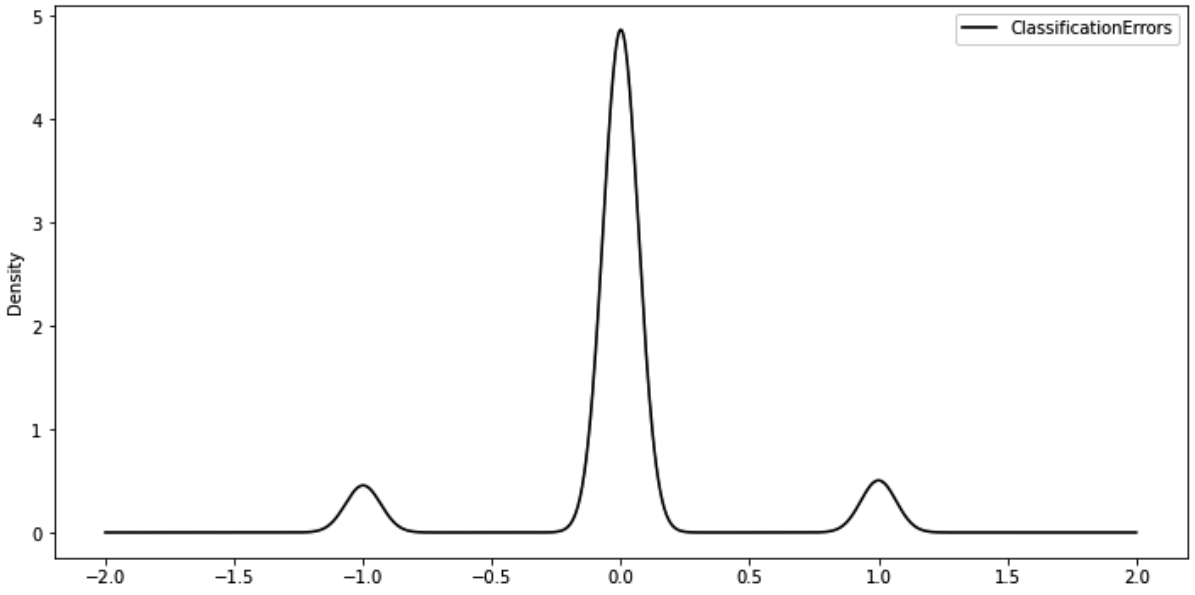

Price
PredPrice
180000
160000
140000
120000
100000
80000
2000
2005
2010
2015
2020


Price
PredPrice
126000
124000
122000
120000
118000
116000
114000
112000
110000
04
11
18
25
08
15
22
08
15
22
29
Jan
2010
Feb
Mar

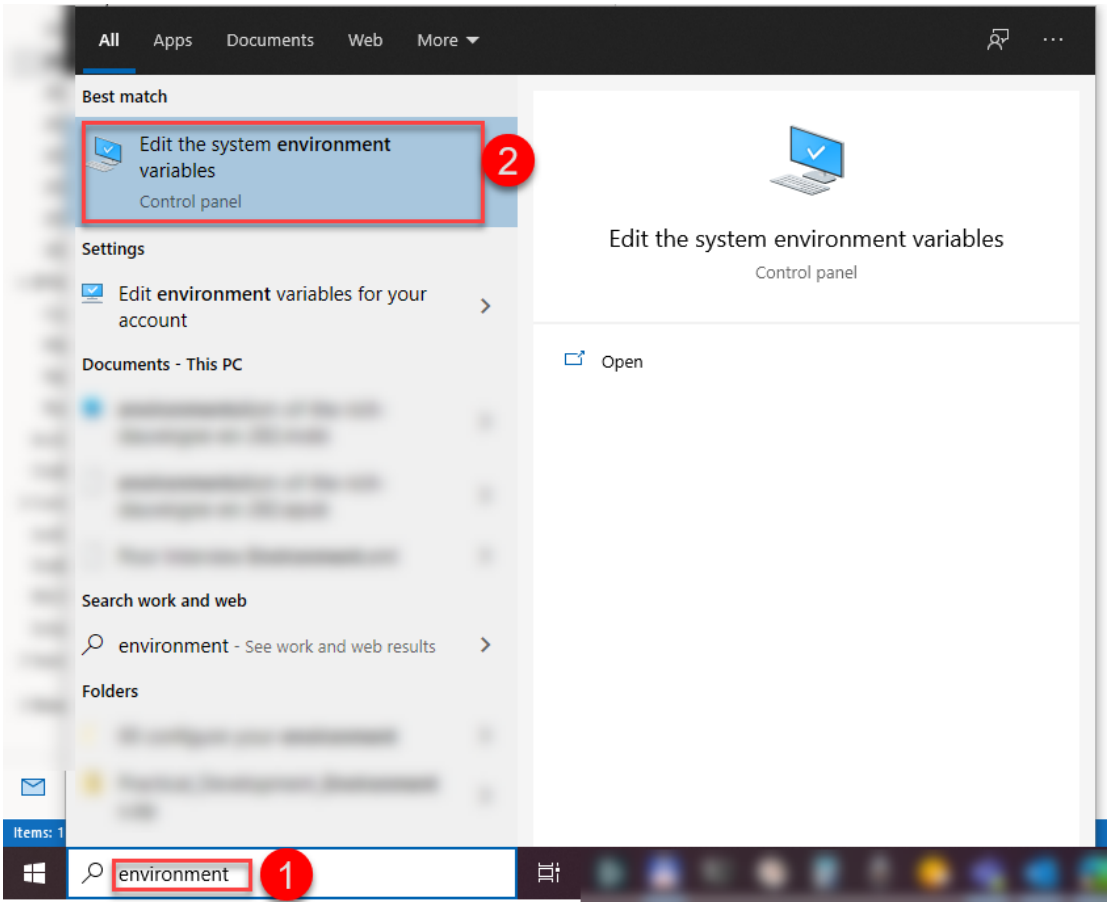

Errors
Density
0.00016
0.00014
0.00012
0.00010
0.00008
0.00006
0.00004
0.00002
0.00000
−15000
−10000
−5000
0
5000
10000
15000

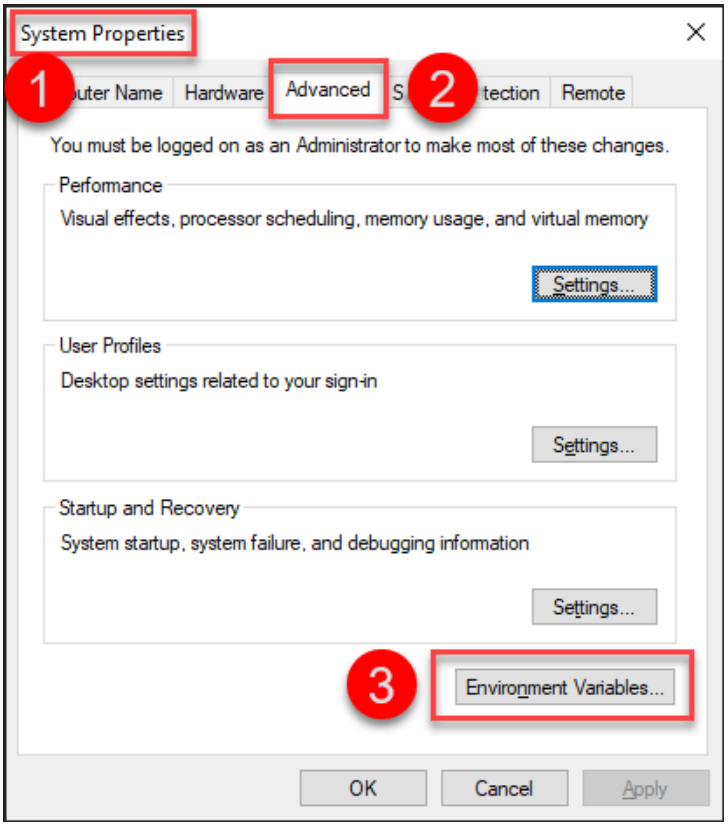

Frequency
4000
3500
3000
2500
2000
1500
1000
500
0
−2.0
−1.5
−1.0
−0.5
0.0
0.5
1.0
1.5
2.0


DiscretePriceChange
PredDiscretePriceChange
Jan
2010
Feb
Mar


ClassificationErrors
Density

Chapter 8: Introduction to Zipline and PyFolio






```
(zipline_env) D:\src\handson-algorithmic-trading-with-python>zipline ingest -b packt-csvdir-bundle
[2021-02-06 10:38:25.930064] INFO: zipline.data.bundles.core: Ingesting packt-csvdir-bundle.
 | A: sid 0
```

```
(zipline_env) D:\>zipline ingest -b quandl_eod
[2021-02-06 07:33:19.400913] INFO: zipline.data.bundles.core: Ingesting quandl_eod.
[2021-02-06 07:33:19.400913] INFO: zipline.data.bundles.quandl_eod: Downloading WIKI metadata.
Downloading WIKI Prices table from Quandl  [####################################]  100%
[2021-02-06 07:34:27.756702] INFO: zipline.data.bundles.quandl_eod: Parsing raw data.
[2021-02-06 07:35:42.937049] INFO: zipline.data.bundles.quandl_eod: Generating asset metadata.
Merging daily equity files:  [---------#-------------------------]  8705d:\Anaconda3\envs\zipline_env\lib\site-packages
\zipline\data\bcolz_daily_bars.py:367: UserWarning: Ignoring 1 values because they are out of bounds for uint32:
     open  high   low  close        volume  ex_dividend  split_ratio
2011-04-11  1.79  1.84  1.55    1.7  6.674913e+09          0.0          1.0
  winsorise_uint32(raw_data, invalid_data_behavior, 'volume', *OHLC)
Merging daily equity files:  [####################################]
[2021-02-06 08:02:13.650207] INFO: zipline.data.bundles.quandl_eod: Parsing split data.
[2021-02-06 08:02:14.765205] INFO: zipline.data.bundles.quandl_eod: Parsing dividend data.
[2021-02-06 08:02:19.162204] WARNING: zipline.data.adjustments: Couldn't compute ratio for dividend sid=135, ex_date=199
6-01-02, amount=1.000
[2021-02-06 08:02:19.163204] WARNING: zipline.data.adjustments: Couldn't compute ratio for dividend sid=471, ex_date=201
6-06-29, amount=0.438
[2021-02-06 08:02:19.164205] WARNING: zipline.data.adjustments: Couldn't compute ratio for dividend sid=474, ex_date=201
3-06-26, amount=0.020
[2021-02-06 08:02:19.164205] WARNING: zipline.data.adjustments: Couldn't compute ratio for dividend sid=756, ex_date=201
5-09-28, amount=0.391
[2021-02-06 08:02:19.164205] WARNING: zipline.data.adjustments: Couldn't compute ratio for dividend sid=954, ex_date=201
5-11-04, amount=8.578
[2021-02-06 08:02:19.165202] WARNING: zipline.data.adjustments: Couldn't compute ratio for dividend sid=1153, ex_date=19
98-08-05, amount=0.607
[2021-02-06 08:02:19.165202] WARNING: zipline.data.adjustments: Couldn't compute ratio for dividend sid=1364, ex_date=20
15-09-28, amount=0.450
[2021-02-06 08:02:19.165202] WARNING: zipline.data.adjustments: Couldn't compute ratio for dividend sid=1502, ex_date=20
15-09-30, amount=0.220
[2021-02-06 08:02:19.166204] WARNING: zipline.data.adjustments: Couldn't compute ratio for dividend sid=2294, ex_date=20
11-06-08, amount=0.410
[2021-02-06 08:02:19.166204] WARNING: zipline.data.adjustments: Couldn't compute ratio for dividend sid=2357, ex_date=20
14-09-22, amount=0.500
[2021-02-06 08:02:19.166204] WARNING: zipline.data.adjustments: Couldn't compute ratio for dividend sid=2376, ex_date=19
```

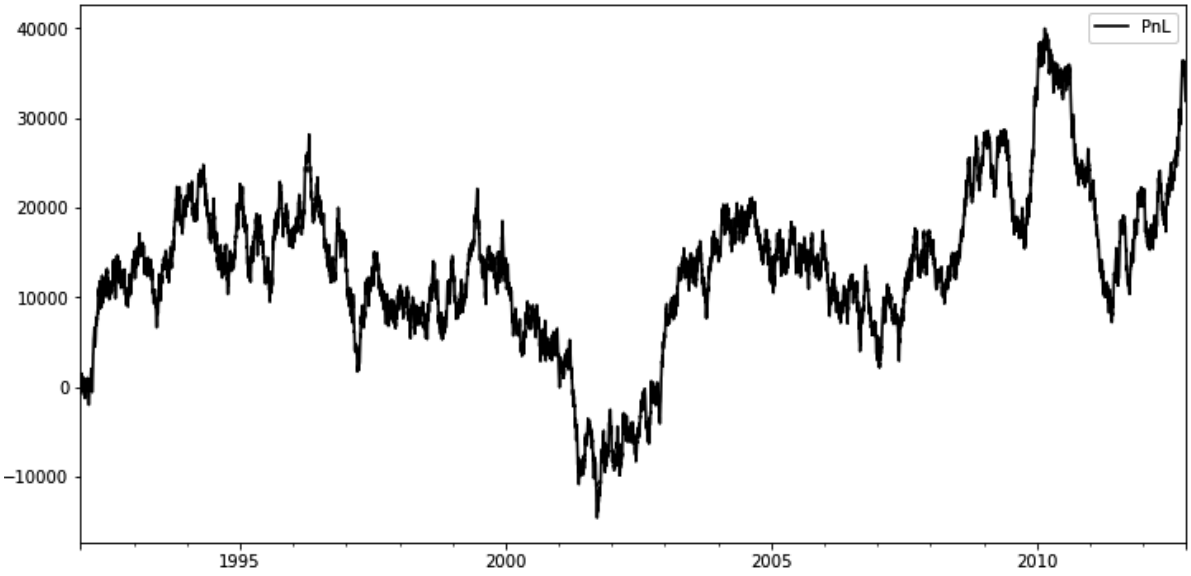
```
(zipline_env) D:\src\handson-algorithmic-trading-with-python>zipline ingest -b yahoo_direct
[2021-02-06 12:46:37.649754] INFO: zipline.data.bundles.core: Ingesting yahoo_direct.
[2021-02-06 12:46:37.650754] INFO: zipline.data.bundles.ingester: symbols are: ('GE', 'AAPL', 'MSFT', 'GOOG')
[2021-02-06 12:46:37.652753] INFO: zipline.data.bundles.ingester: writing data...
               close       high        low       open    volume  dividend  \
2010-01-04  14.855769  15.038462  14.567308  14.634615  69763096         0
2010-01-05  14.932692  15.067308  14.855769  14.865385  67132624         0
2010-01-06  14.855769  15.019231  14.846154  14.932692  57683496         0

            split
2010-01-04      1
2010-01-05      1
2010-01-06      1
Downloading from YAHOO:   [#########---------------------------]   25%  00:00:04               close      high       lo
      open     volume  dividend  split
2010-01-04  7.643214  7.660714  7.585000  7.622500  493729600         0      1
2010-01-05  7.656429  7.699643  7.616071  7.664286  601904800         0      1
2010-01-06  7.534643  7.686786  7.526786  7.656429  552160000         0      1
Downloading from YAHOO:   [##################-----------------]   50%  00:00:02                close   high        low
      open    volume  dividend  split
2010-01-04  30.950001  31.10  30.590000  30.620001  38409100         0      1
2010-01-05  30.959999  31.10  30.639999  30.850000  49749600         0      1
2010-01-06  30.770000  31.08  30.520000  30.879999  58182400         0      1
Downloading from YAHOO:   [##########################---------]   75%  00:00:01                 close        high
   low        open    volume  dividend  \
2010-01-04  312.204773  313.579620  310.954468  312.304413  3927065         0
2010-01-05  310.829926  312.747742  309.609497  312.418976  6031925         0
2010-01-06  302.994293  311.761444  302.047852  311.761444  7987226         0

            split
2010-01-04      1
2010-01-05      1
2010-01-06      1
Downloading from YAHOO:   [####################################]  100%
Merging daily equity files:  [####################################]
[2021-02-06 12:46:40.064301] INFO: zipline.data.bundles.ingester: meta data:
  start_date   end_date auto_close_date symbol exchange
0 2010-01-04 2019-12-31      2020-01-01     GE    YAHOO
1 2010-01-04 2019-12-31      2020-01-01   AAPL    YAHOO
2 2010-01-04 2019-12-31      2020-01-01   MSFT    YAHOO
3 2010-01-04 2019-12-31      2020-01-01   GOOG    YAHOO
[2021-02-06 12:46:40.502593] INFO: zipline.data.bundles.ingester: writing completed
```

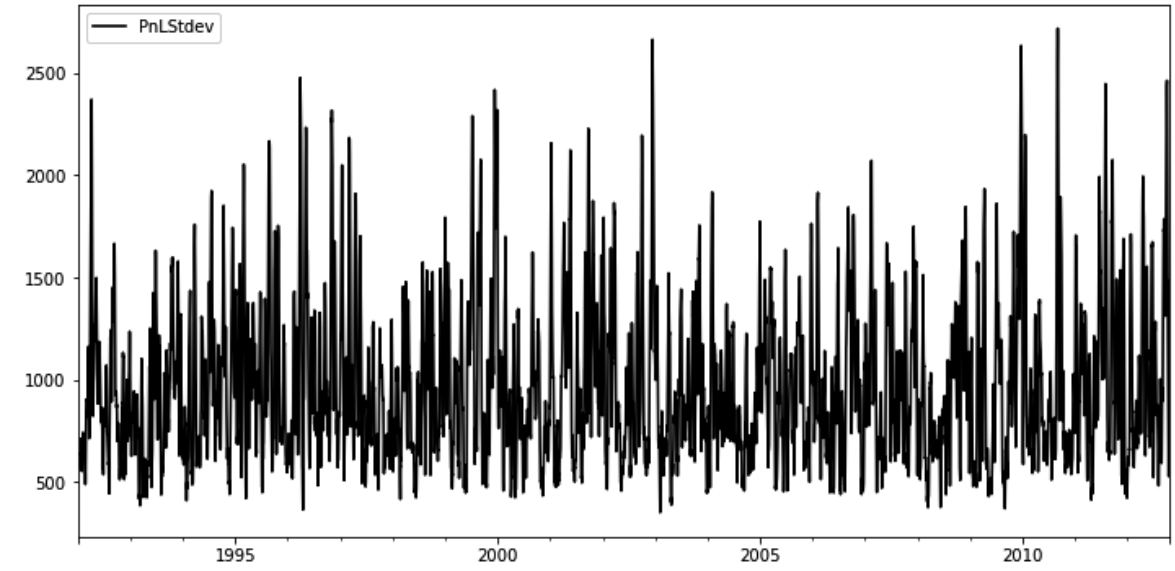
```
(zipline_env) D:\src\handson-algorithmic-trading-with-python>set IEX_SYM_LST=GOOG,AAPL,GE,MSFT

(zipline_env) D:\src\handson-algorithmic-trading-with-python>zipline ingest -b iex
[2021-02-06 13:06:15.243864] INFO: zipline.data.bundles.core: Ingesting iex.
[2021-02-06 13:06:15.243864] INFO: zipline.data.bundles.ingester: symbols are: ('GOOG', 'AAPL', 'MSFT', 'GE')
[2021-02-06 13:06:15.246865] INFO: zipline.data.bundles.ingester: writing data...
Downloading from IEX Cloud:   [####################################]  100%
Merging daily equity files:  [####################################]
[2021-02-06 13:06:20.014374] INFO: zipline.data.bundles.ingester: meta data:
  start_date   end_date auto_close_date symbol   exchange
0 2020-01-02 2021-02-05      2021-02-06   GOOG  IEX Cloud
1 2020-01-02 2021-02-05      2021-02-06   AAPL  IEX Cloud
2 2020-01-02 2021-02-05      2021-02-06   MSFT  IEX Cloud
3 2020-01-02 2021-02-05      2021-02-06     GE  IEX Cloud
[2021-02-06 13:06:20.509529] INFO: zipline.data.bundles.ingester: writing completed
```

Start date	2000-01-03
End date	2017-12-29
Total months	215

	Backtest
Annual return	24.9%
Cumulative returns	5324.2%
Annual volatility	29.9%
Sharpe ratio	0.89
Calmar ratio	0.42
Stability	0.92
Max drawdown	-59.4%
Omega ratio	1.21
Sortino ratio	1.37
Skew	0.41
Kurtosis	7.82
Tail ratio	1.16
Daily value at risk	-3.7%

Worst drawdown periods	Net drawdown in %	Peak date	Valley date	Recovery date	Duration
0	59.37	2000-03-22	2003-03-24	2004-10-14	1192
1	31.34	2015-02-23	2016-09-09	2017-05-09	577
2	25.44	2005-02-16	2005-07-18	2005-10-20	177
3	24.14	2006-01-13	2006-02-09	2006-10-23	202
4	21.45	2012-04-09	2013-07-19	2013-12-03	432


PnL
40000
30000
20000
10000
0
−10000
1995
2000
2005
2010


PnLStdev
2500
2000
1500
1000
500
1995
2000
2005
2010

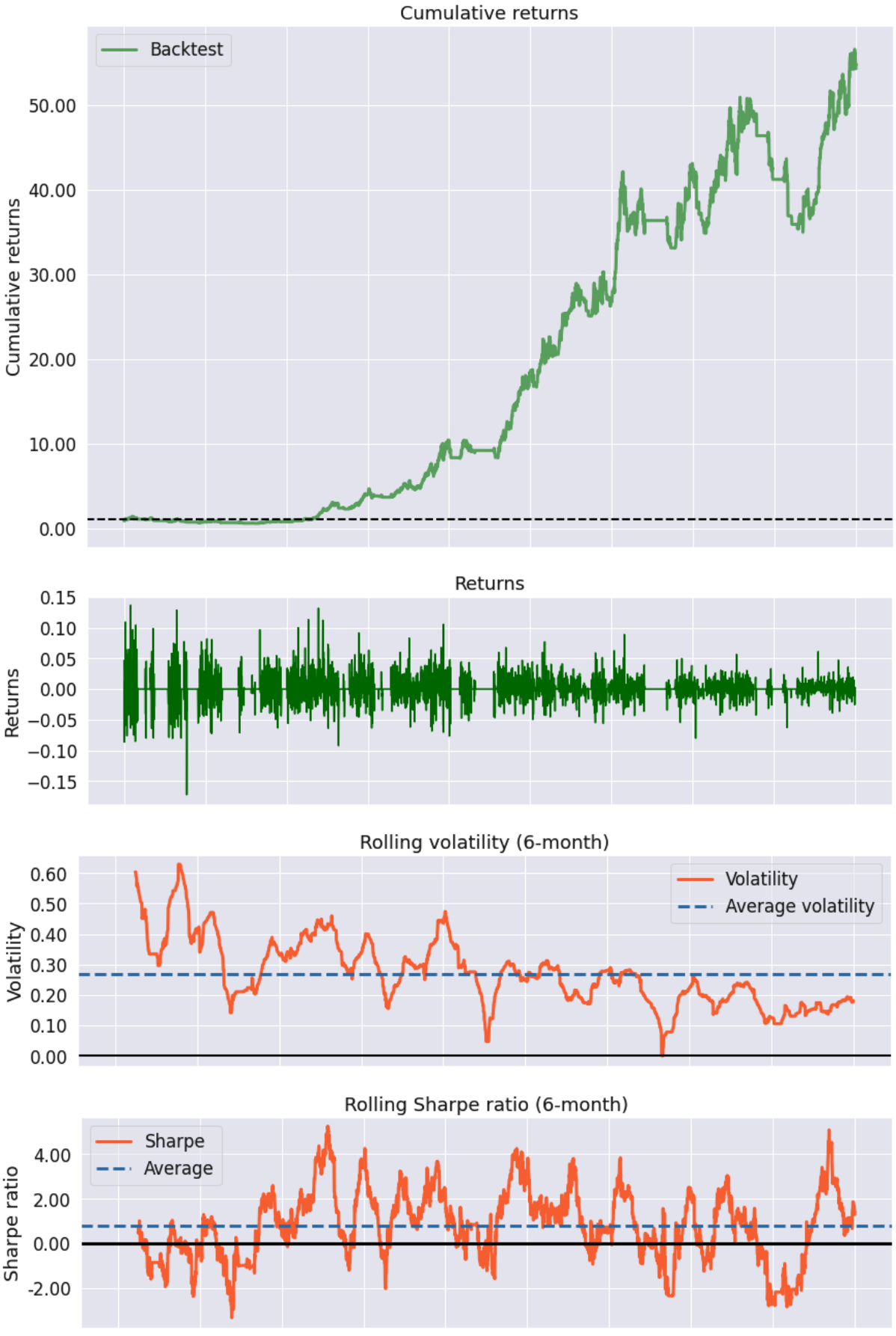

PnL
PeakPnLBeforeDrawdown
TroughPnLAfterDrawdown
MaxDrawdown
40000
30000
20000
10000
0
−10000
1995
2000
2005
2010

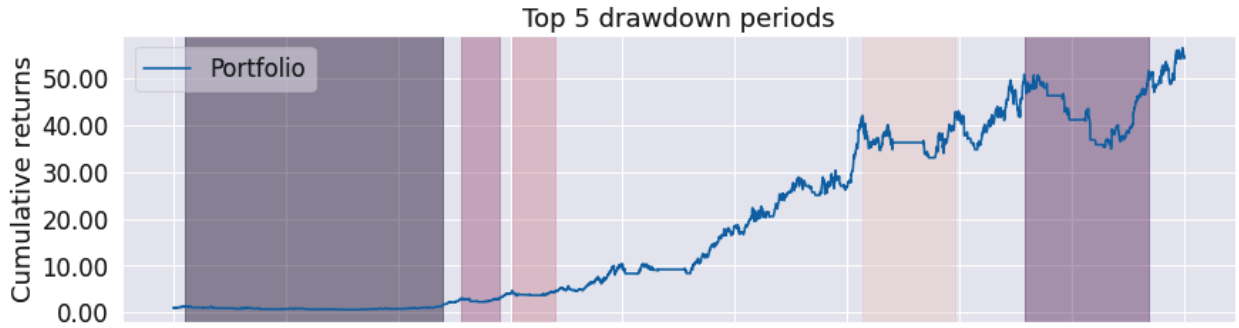
Chapter 9: Fundamental Algorithmic Trading Strategies

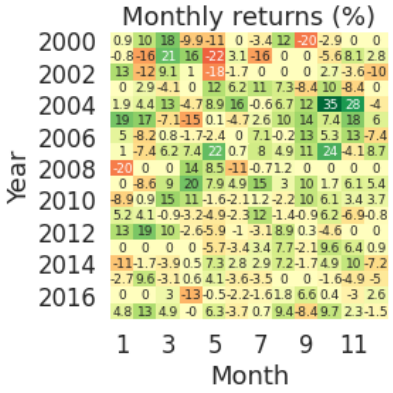
Start date	2000-01-03
End date	2017-12-29
Total months	215

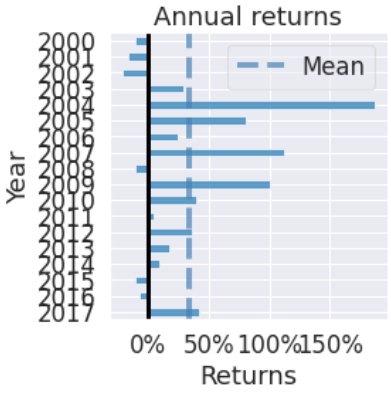
	Backtest
Annual return	24.9%
Cumulative returns	5324.2%
Annual volatility	29.9%
Sharpe ratio	0.89
Calmar ratio	0.42
Stability	0.92
Max drawdown	-59.4%
Omega ratio	1.21
Sortino ratio	1.37
Skew	0.41
Kurtosis	7.82
Tail ratio	1.16
Daily value at risk	-3.7%

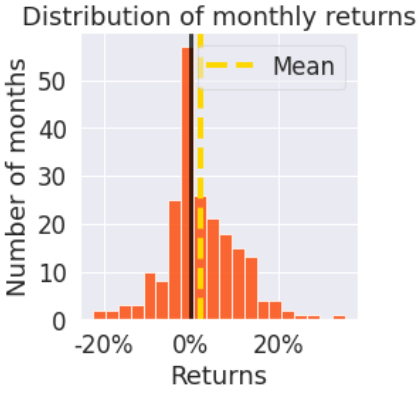
Worst drawdown periods	Net drawdown in %	Peak date	Valley date	Recovery date	Duration
0	59.37	2000-03-22	2003-03-24	2004-10-14	1192
1	31.34	2015-02-23	2016-09-09	2017-05-09	577
2	25.44	2005-02-16	2005-07-18	2005-10-20	177
3	24.14	2006-01-13	2006-02-09	2006-10-23	202
4	21.45	2012-04-09	2013-07-19	2013-12-03	432


Cumulative returns
Backtest
50.00
40.00
30.00
20.00
10.00
0.00
Cumulative returns
Returns
0.15
0.10
0.05
0.00
−0.05
−0.10
−0.15
Returns
Rolling volatility (6-month)
Volatility
Average volatility
0.60
0.50
0.40
0.30
0.20
0.10
0.00
Volatility
Rolling Sharpe ratio (6-month)
Sharpe
Average
4.00
2.00
0.00
-2.00
Sharpe ratio





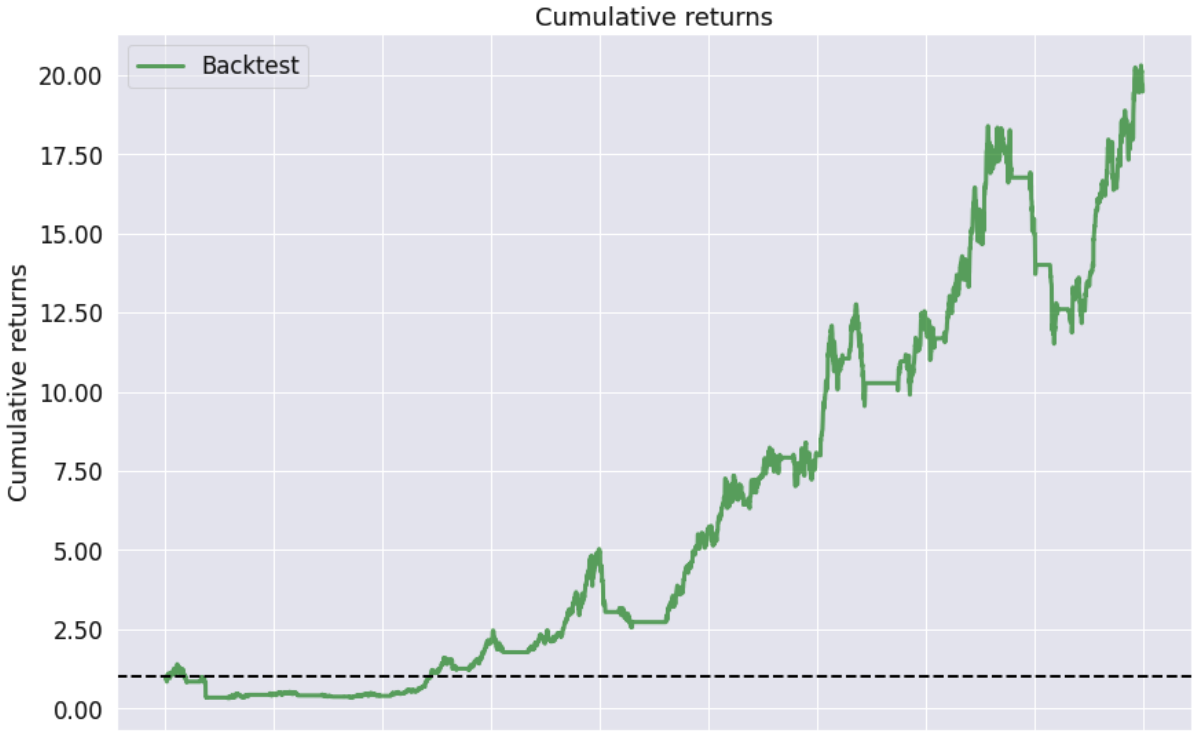


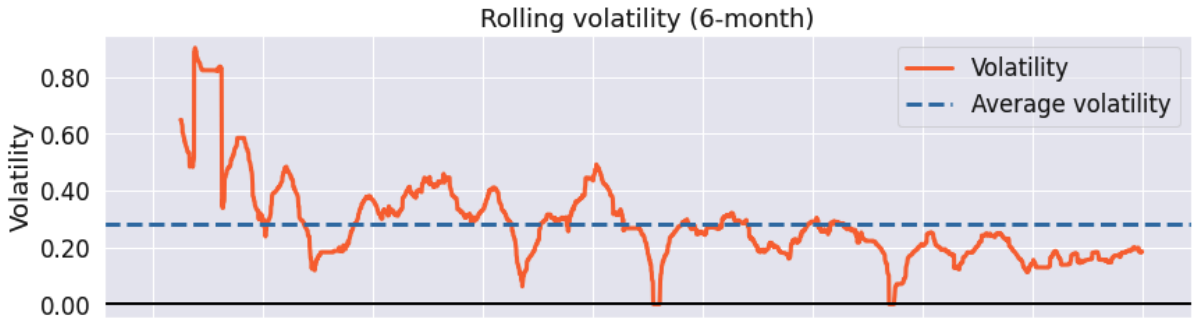


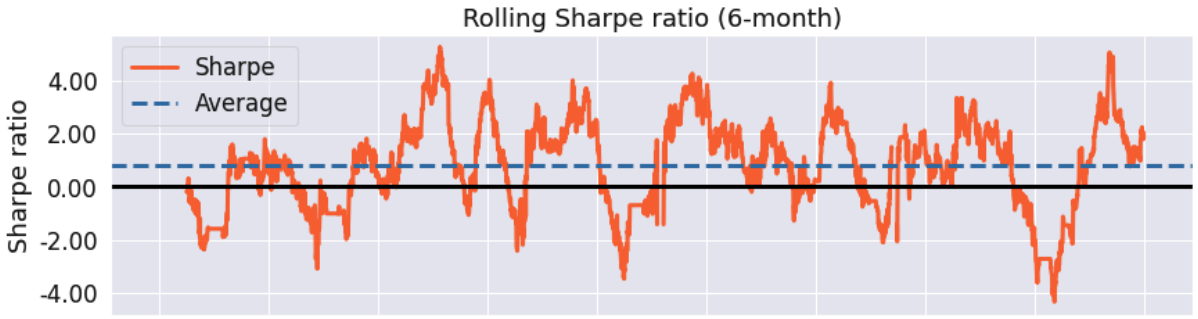
Start date	2000-01-03
End date	2017-12-29
Total months	215

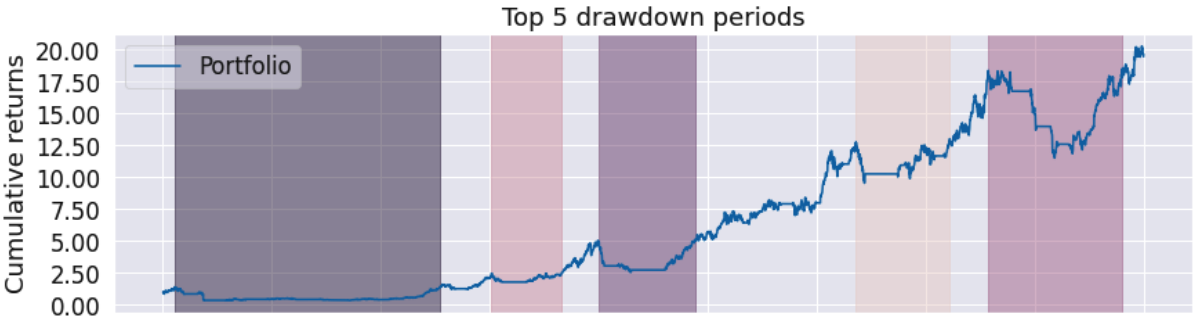
	Backtest
Annual return	18.0%
Cumulative returns	1847.4%
Annual volatility	32.6%
Sharpe ratio	0.68
Calmar ratio	0.23
Stability	0.91
Max drawdown	-76.8%
Omega ratio	1.17
Sortino ratio	0.96
Skew	-3.14
Kurtosis	95.12
Tail ratio	1.13
Daily value at risk	-4.0%

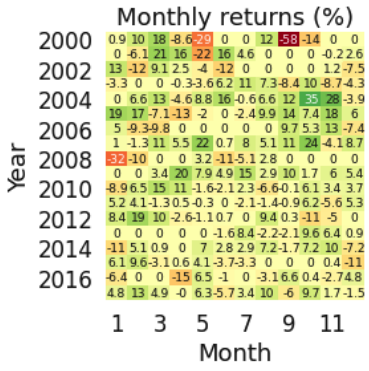
Worst drawdown periods	Net drawdown in %	Peak date	Valley date	Recovery date	Duration
0	76.79	2000-03-22	2001-02-28	2005-02-02	1271
1	49.17	2007-12-28	2008-08-04	2009-10-06	463
2	37.37	2015-02-23	2016-05-12	2017-08-08	642
3	27.88	2006-01-13	2006-09-06	2007-04-26	335
4	25.17	2012-09-19	2012-11-15	2014-06-05	447

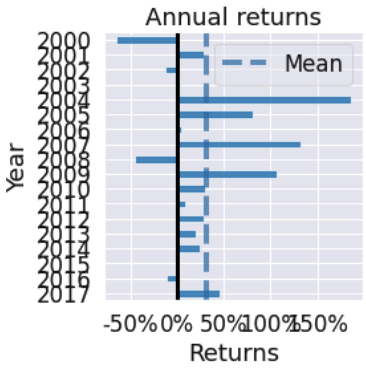


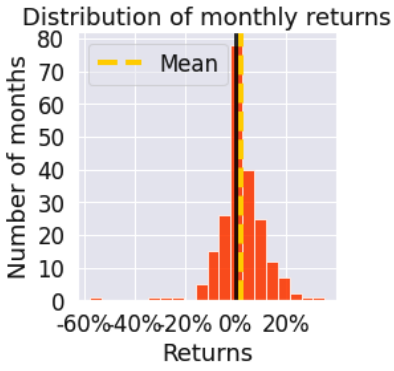



Rolling Sharpe ratio (6-month)
Sharpe
Average
Sharpe ratio
4.00
2.00
0.00
-2.00
-4.00


Top 5 drawdown periods
Portfolio
Cumulative returns
20.00
17.50
15.00
12.50
10.00
7.50
5.00
2.50
0.00


Monthly returns (%)
Year
2000
2002
2004
2006
2008
2010
2012
2014
2016
1
3
5
7
9
11
Month

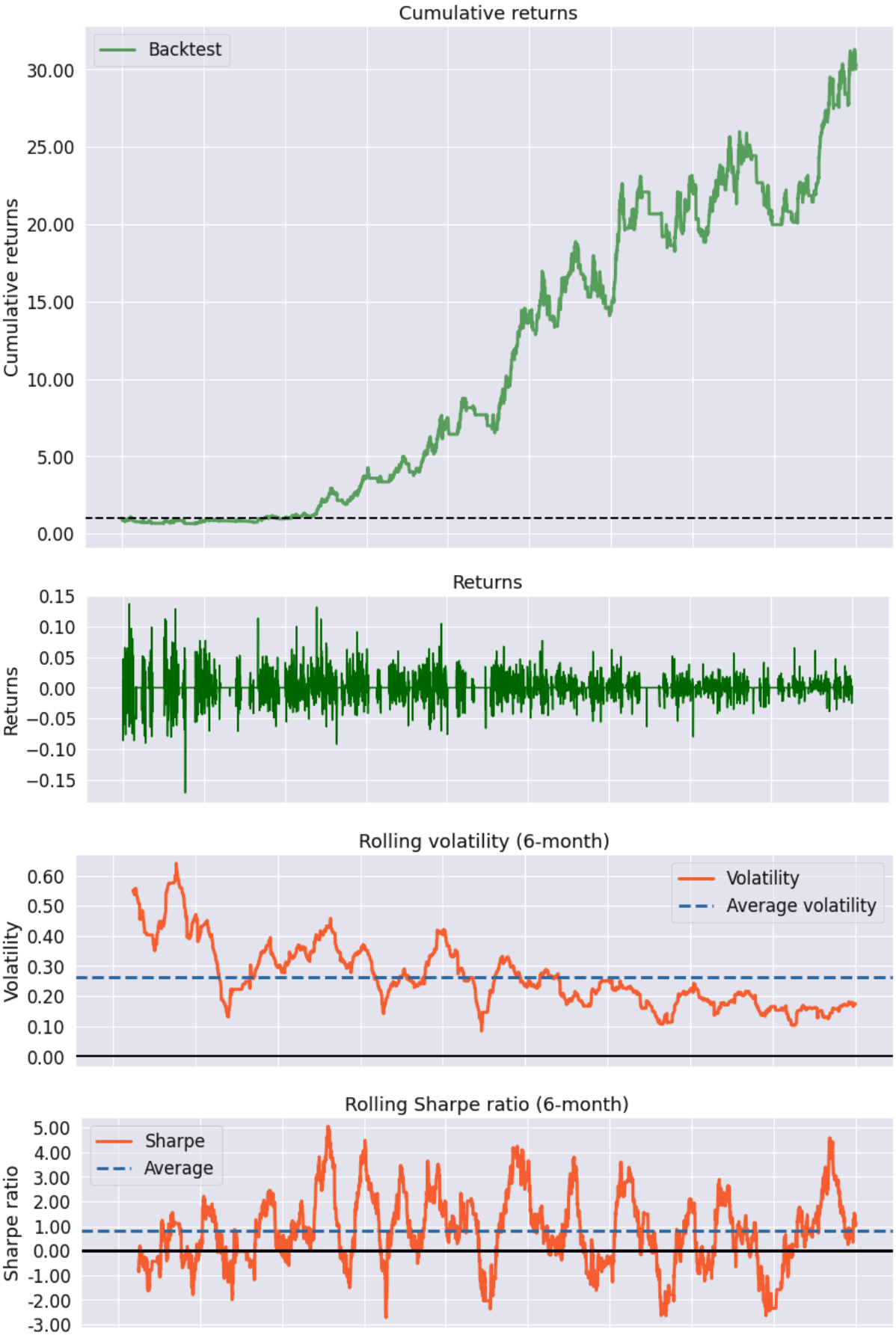

Annual returns
Mean
Year
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
-50%
0%
50%
100%
150%
Returns

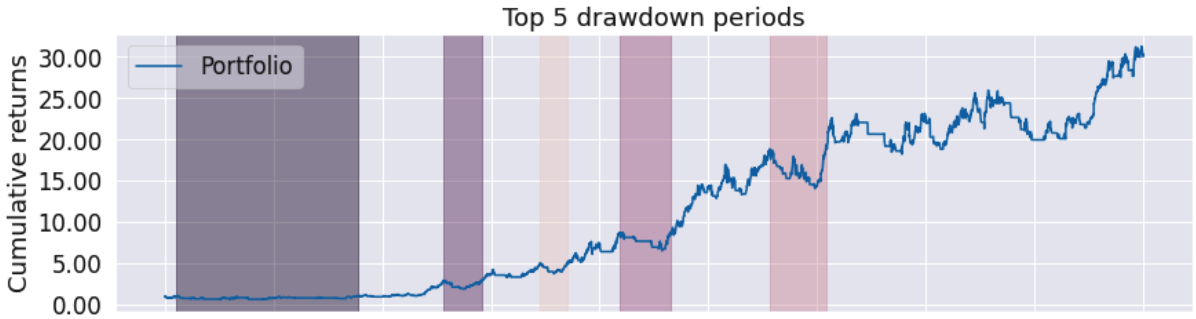

Distribution of monthly returns
Mean
Number of months
80
70
60
50
40
30
20
10
0
-60%
-40%
-20%
0%
20%
Returns

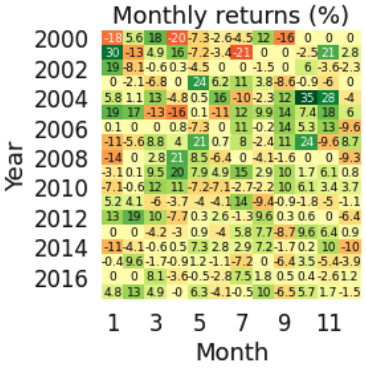
Start date	2000-01-03
End date	2017-12-29
Total months	215

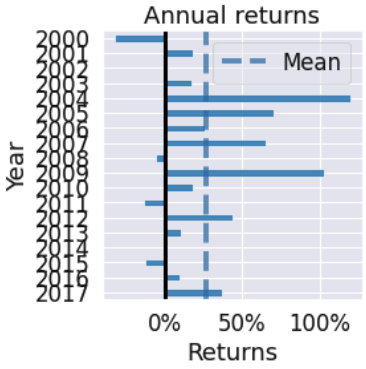
	Backtest
Annual return	20.8%
Cumulative returns	2902.2%
Annual volatility	29.0%
Sharpe ratio	0.80
Calmar ratio	0.48
Stability	0.92
Max drawdown	-43.4%
Omega ratio	1.20
Sortino ratio	1.21
Skew	0.43
Kurtosis	8.91
Tail ratio	1.12
Daily value at risk	-3.6%

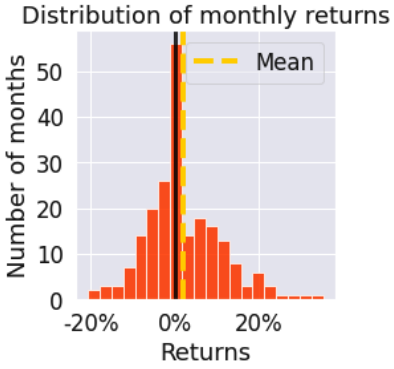
Worst drawdown periods	Net drawdown in %	Peak date	Valley date	Recovery date	Duration
0	43.44	2000-03-22	2001-10-17	2003-07-25	873
1	35.83	2005-02-16	2005-06-27	2005-11-02	186
2	25.53	2008-05-13	2009-02-23	2009-04-23	248
3	25.31	2011-02-16	2011-12-21	2012-02-28	270
4	24.99	2006-11-28	2007-02-27	2007-05-30	132


Cumulative returns
Backtest
30.00
25.00
20.00
15.00
10.00
5.00
0.00
Cumulative returns
Returns
0.15
0.10
0.05
0.00
−0.05
−0.10
−0.15
Returns
Rolling volatility (6-month)
Volatility
Average volatility
0.60
0.50
0.40
0.30
0.20
0.10
0.00
Volatility
Rolling Sharpe ratio (6-month)
Sharpe
Average
5.00
4.00
3.00
2.00
1.00
0.00
-1.00
-2.00
-3.00
Sharpe ratio





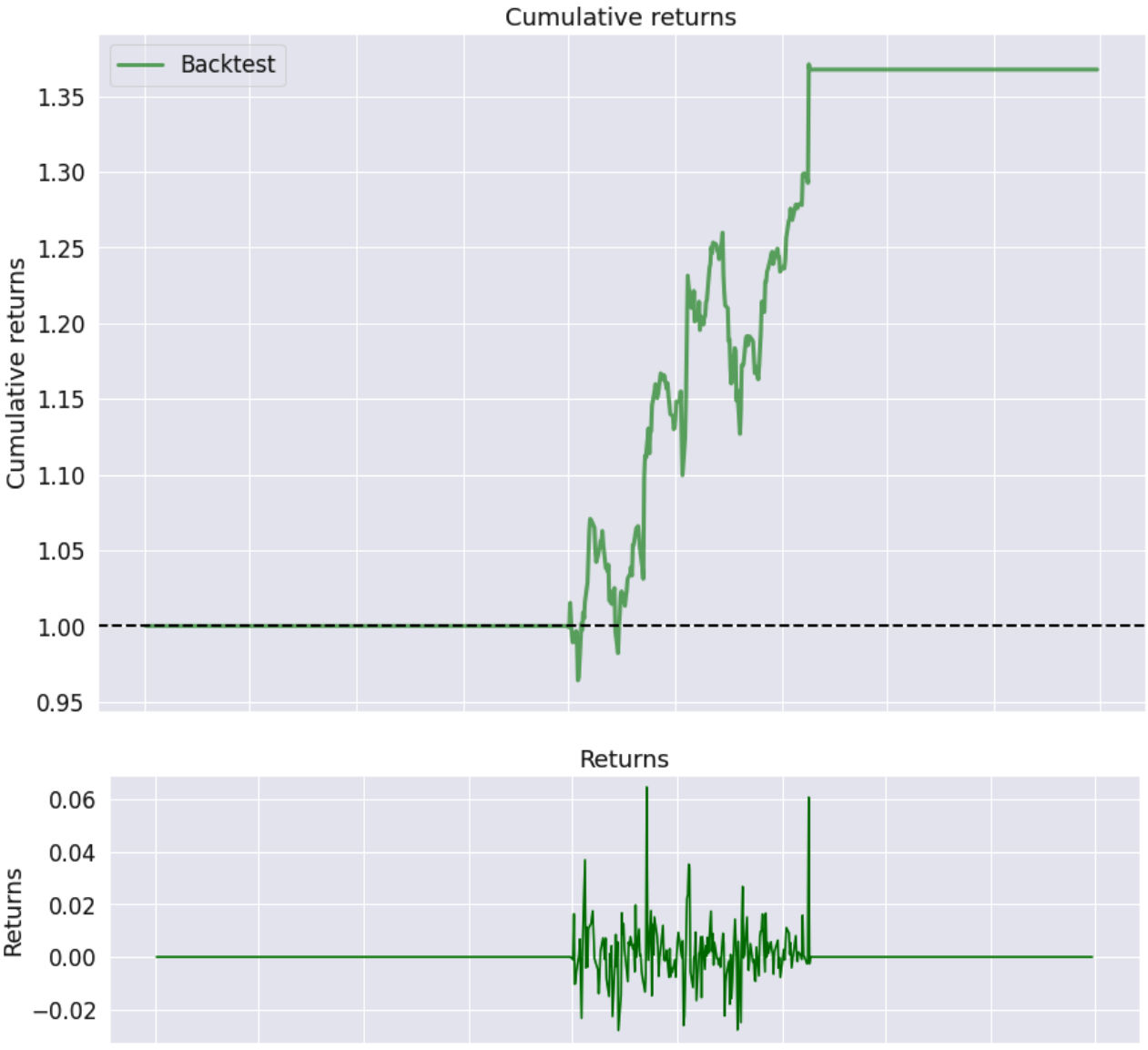


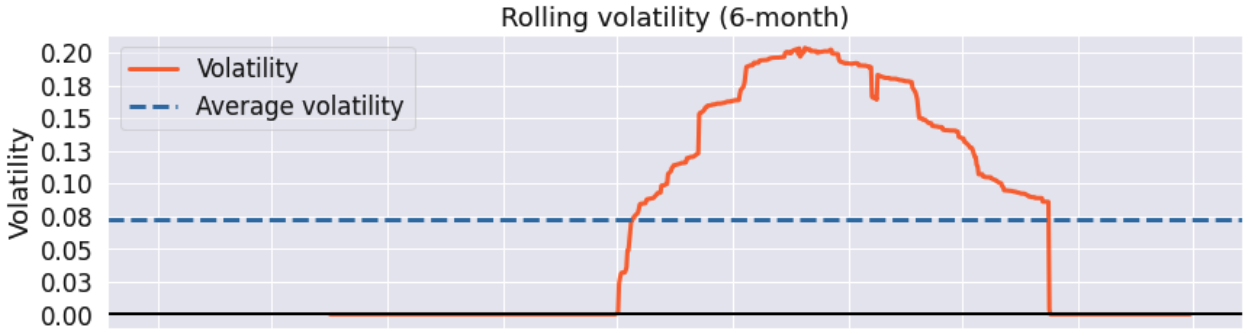


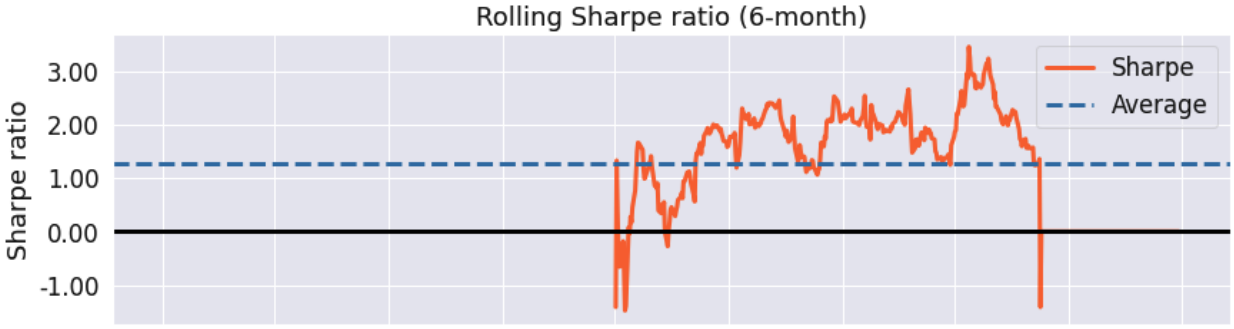
Start date	2015-01-02
End date	2017-12-29
Total months	35

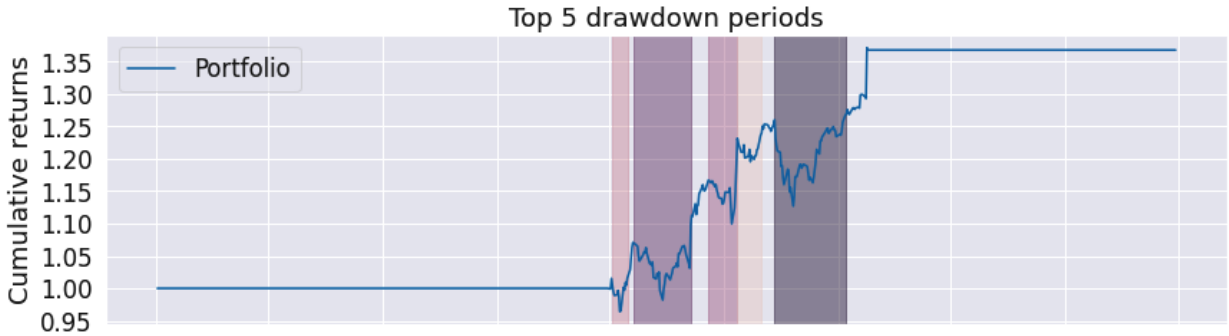
	Backtest
Annual return	11.0%
Cumulative returns	36.8%
Annual volatility	9.9%
Sharpe ratio	1.11
Calmar ratio	1.04
Stability	0.84
Max drawdown	-10.6%
Omega ratio	1.52
Sortino ratio	2.00
Skew	3.03
Kurtosis	33.05
Tail ratio	1.44
Daily value at risk	-1.2%

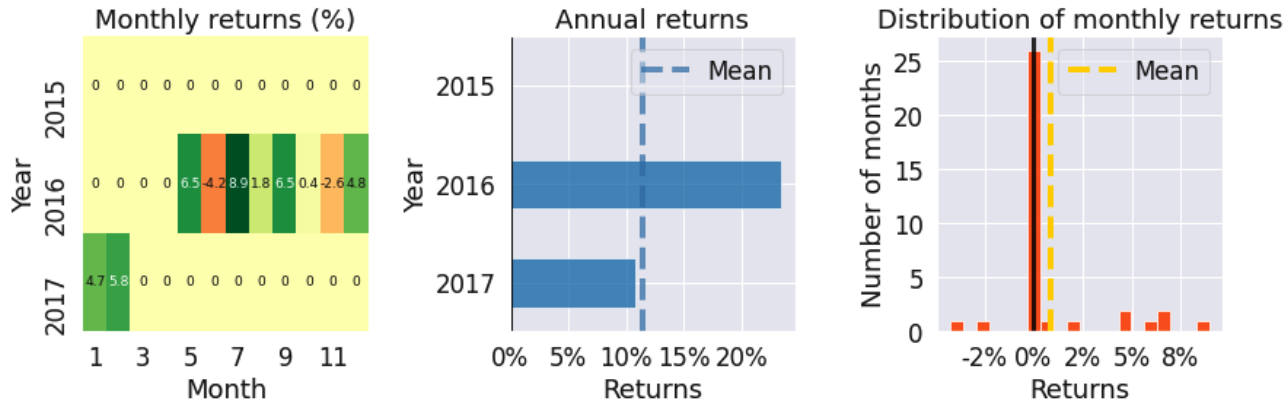
Worst drawdown periods	Net drawdown in %	Peak date	Valley date	Recovery date	Duration
0	10.55	2016-10-25	2016-11-14	2017-01-09	55
1	8.29	2016-05-26	2016-06-27	2016-07-27	45
2	5.77	2016-08-15	2016-09-09	2016-09-14	23
3	5.05	2016-05-03	2016-05-12	2016-05-20	14
4	2.92	2016-09-15	2016-09-29	2016-10-10	18




Rolling volatility (6-month)
Volatility
Average volatility
Volatility
0.20
0.18
0.15
0.13
0.10
0.08
0.05
0.03
0.00


Rolling Sharpe ratio (6-month)
Sharpe
Average
Sharpe ratio
3.00
2.00
1.00
0.00
-1.00

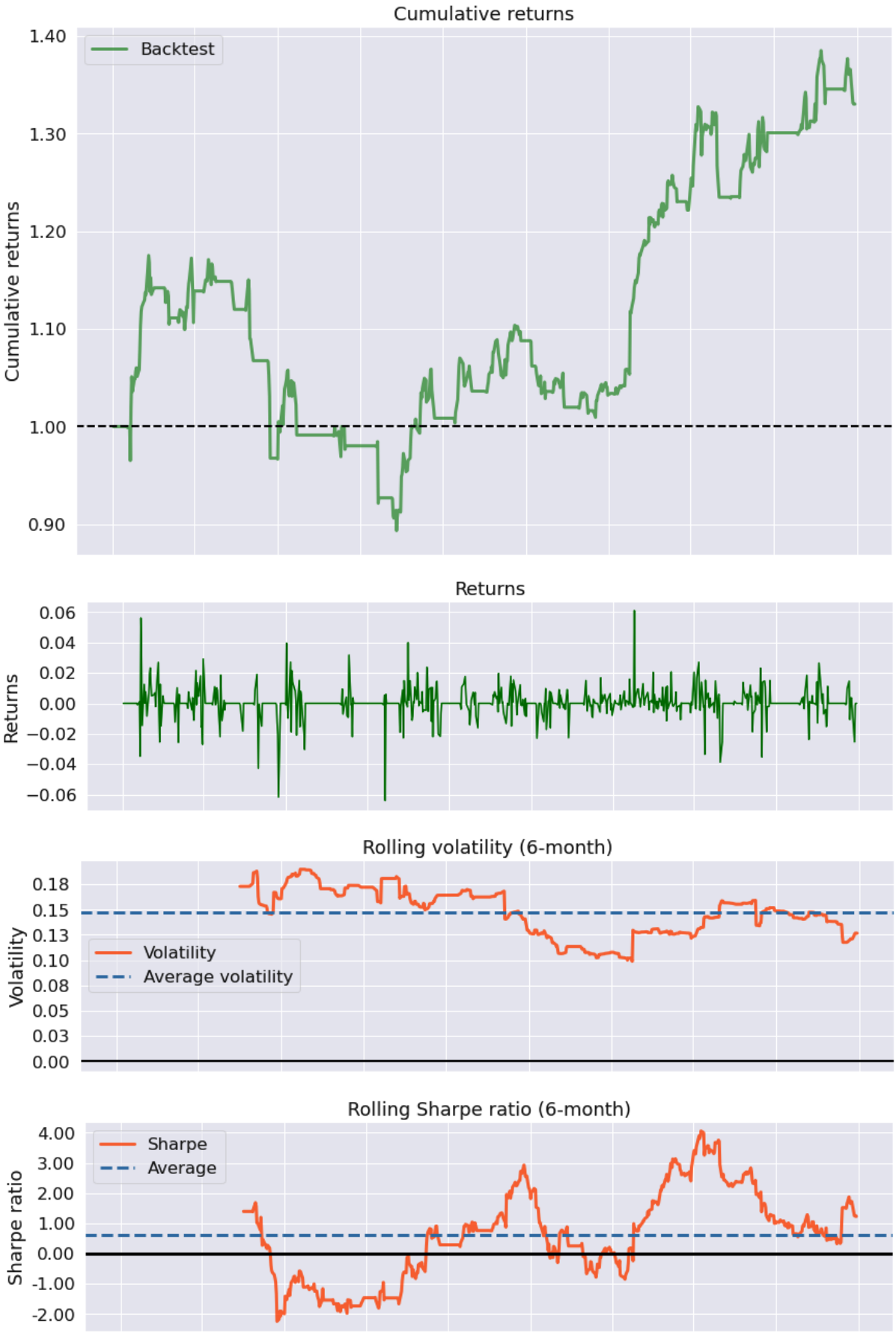

Top 5 drawdown periods
Portfolio
Cumulative returns
1.35
1.30
1.25
1.20
1.15
1.10
1.05
1.00
0.95

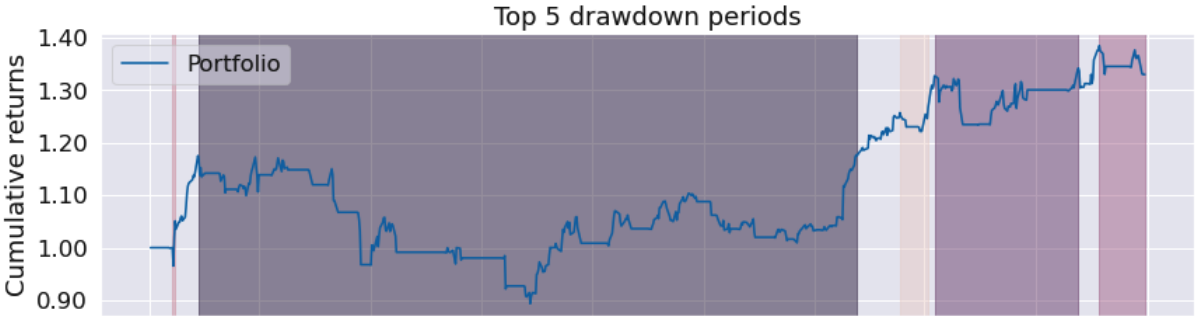

Monthly returns (%)
Year
2015
2016
2017
Month
1 3 5 7 9 11
Annual returns
Mean
Year
2015
2016
2017
0% 5% 10% 15% 20%
Returns
Distribution of monthly returns
Mean
Number of months
25
20
15
10
5
0
-2% 0% 2% 5% 8%
Returns

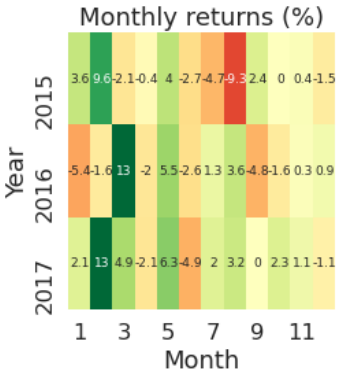
Start date	2015-01-02
End date	2017-12-29
Total months	35

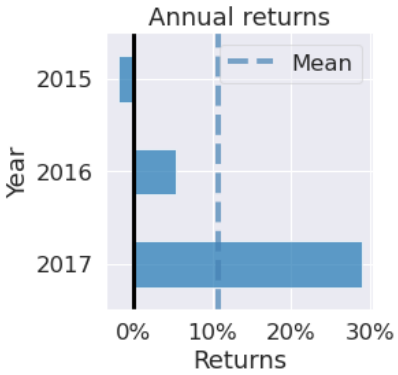
	Backtest
Annual return	10.0%
Cumulative returns	33.0%
Annual volatility	15.2%
Sharpe ratio	0.70
Calmar ratio	0.42
Stability	0.41
Max drawdown	-24.0%
Omega ratio	1.19
Sortino ratio	1.00
Skew	-0.33
Kurtosis	10.99
Tail ratio	1.00
Daily value at risk	-1.9%

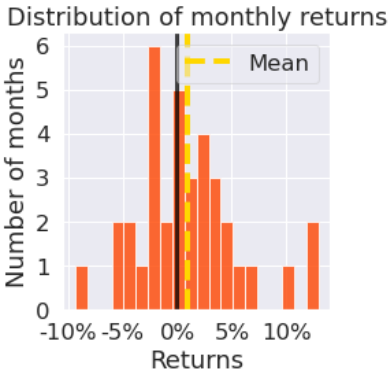
Worst drawdown periods	Net drawdown in %	Peak date	Valley date	Recovery date	Duration
0	23.97	2015-02-23	2016-02-23	2017-02-15	518
1	7.07	2017-05-12	2017-06-29	2017-10-16	112
2	3.96	2017-11-09	2017-12-27	NaT	NaN
3	3.48	2015-01-26	2015-01-27	2015-01-28	3
4	2.83	2017-04-04	2017-04-28	2017-05-05	24


Cumulative returns
Backtest
Cumulative returns
1.40
1.30
1.20
1.10
1.00
0.90
Returns
Returns
0.06
0.04
0.02
0.00
−0.02
−0.04
−0.06
Rolling volatility (6-month)
Volatility
Volatility
Average volatility
0.18
0.15
0.13
0.10
0.08
0.05
0.03
0.00
Rolling Sharpe ratio (6-month)
Sharpe ratio
Sharpe
Average
4.00
3.00
2.00
1.00
0.00
-1.00
-2.00





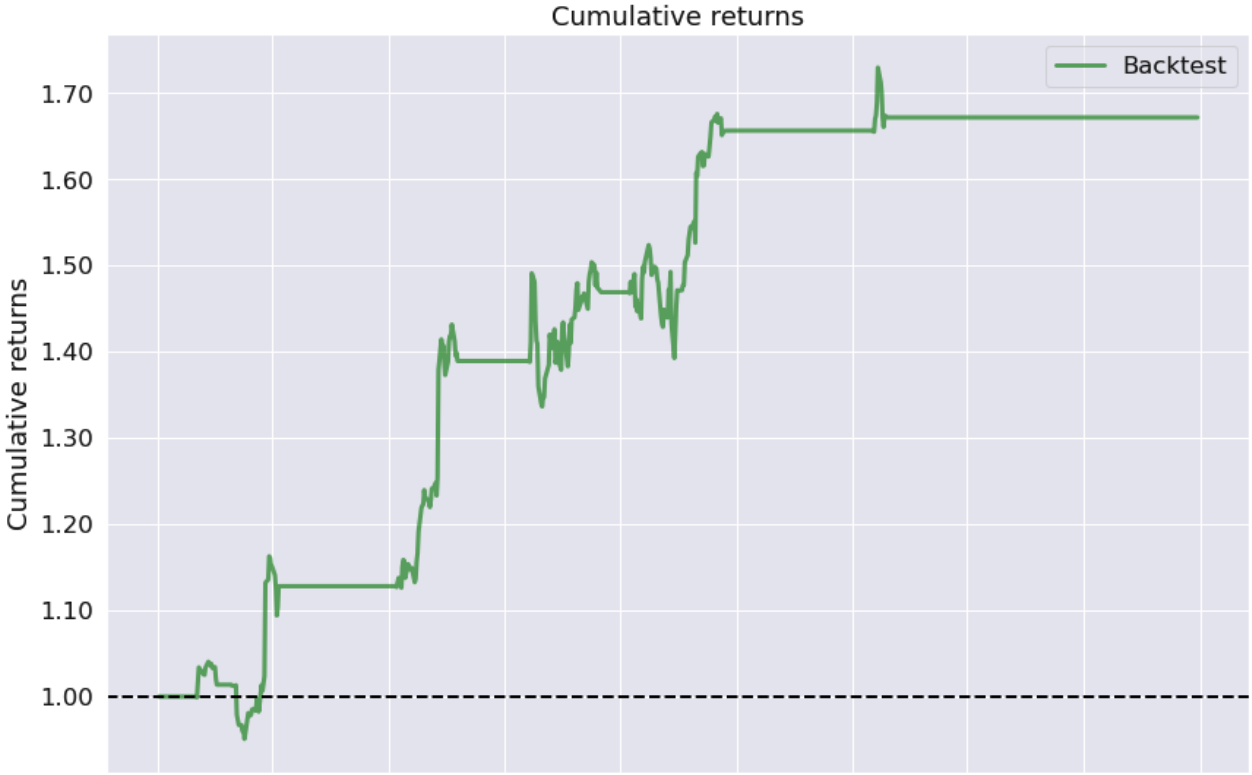


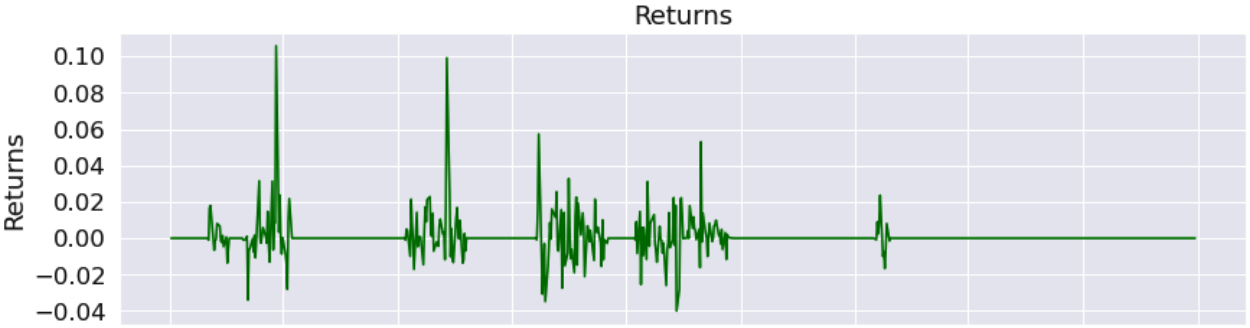


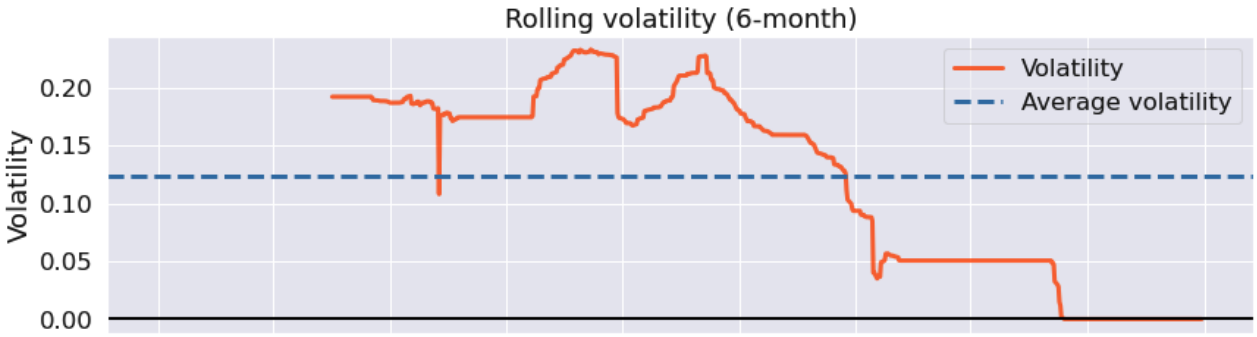
Start date	2015-01-02
End date	2017-12-29
Total months	35

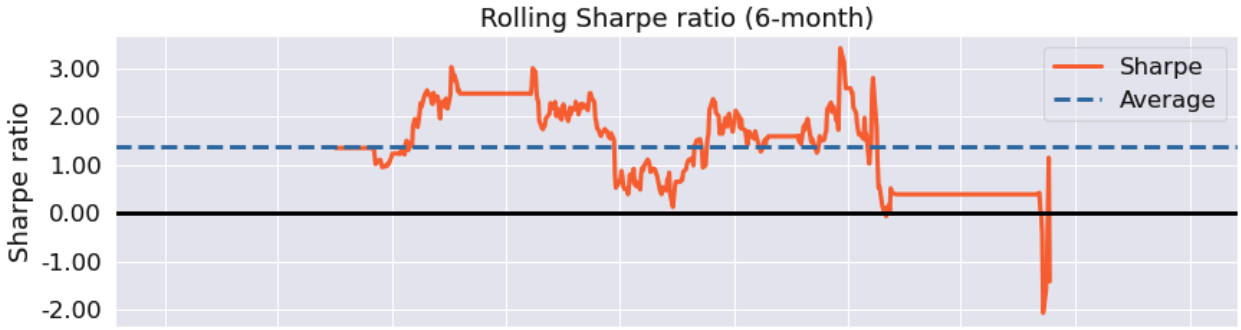
	Backtest
Annual return	18.7%
Cumulative returns	67.2%
Annual volatility	14.3%
Sharpe ratio	1.27
Calmar ratio	1.81
Stability	0.84
Max drawdown	-10.4%
Omega ratio	1.59
Sortino ratio	2.52
Skew	4.33
Kurtosis	47.86
Tail ratio	1.39
Daily value at risk	-1.7%

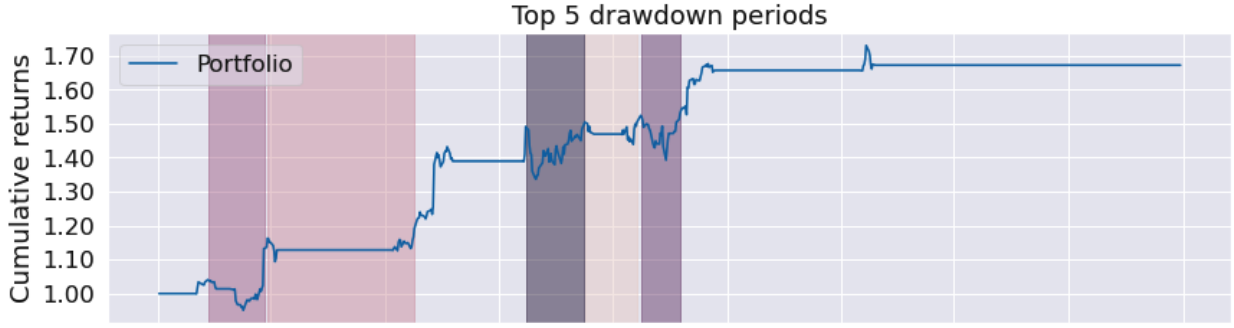
Worst drawdown periods	Net drawdown in %	Peak date	Valley date	Recovery date	Duration
0	10.36	2016-01-29	2016-02-09	2016-03-31	45
1	8.61	2016-05-31	2016-06-27	2016-07-12	31
2	8.61	2015-02-23	2015-04-02	2015-04-24	45
3	5.91	2015-04-28	2015-05-06	2015-10-01	113
4	4.34	2016-04-01	2016-05-23	2016-05-27	41

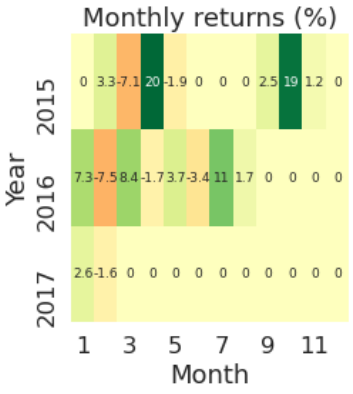


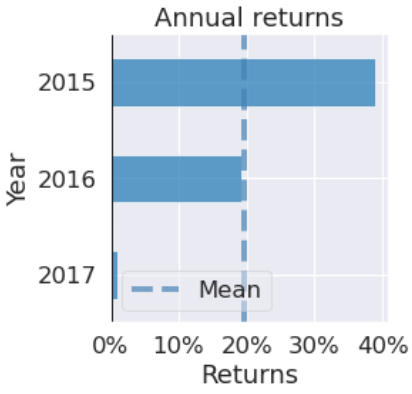


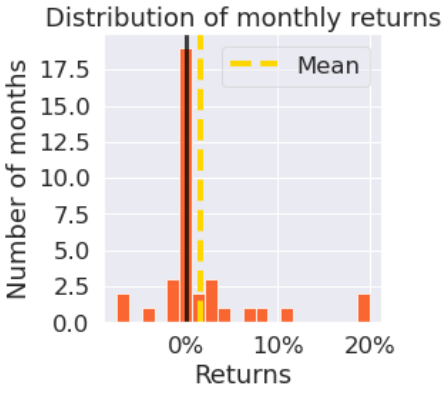

Rolling volatility (6-month)
Volatility
Average volatility
Volatility
0.20
0.15
0.10
0.05
0.00


Rolling Sharpe ratio (6-month)
Sharpe
Average
Sharpe ratio
3.00
2.00
1.00
0.00
-1.00
-2.00


Top 5 drawdown periods
Portfolio
Cumulative returns
1.70
1.60
1.50
1.40
1.30
1.20
1.10
1.00


Monthly returns (%)
Year
2015
2016
2017
0 3.3 -7.1 20 -1.9 0 0 0 2.5 19 1.2 0
7.3 -7.5 8.4 -1.7 3.7 -3.4 11 1.7 0 0 0 0
2.6 -1.6 0 0 0 0 0 0 0 0 0 0
1 3 5 7 9 11
Month

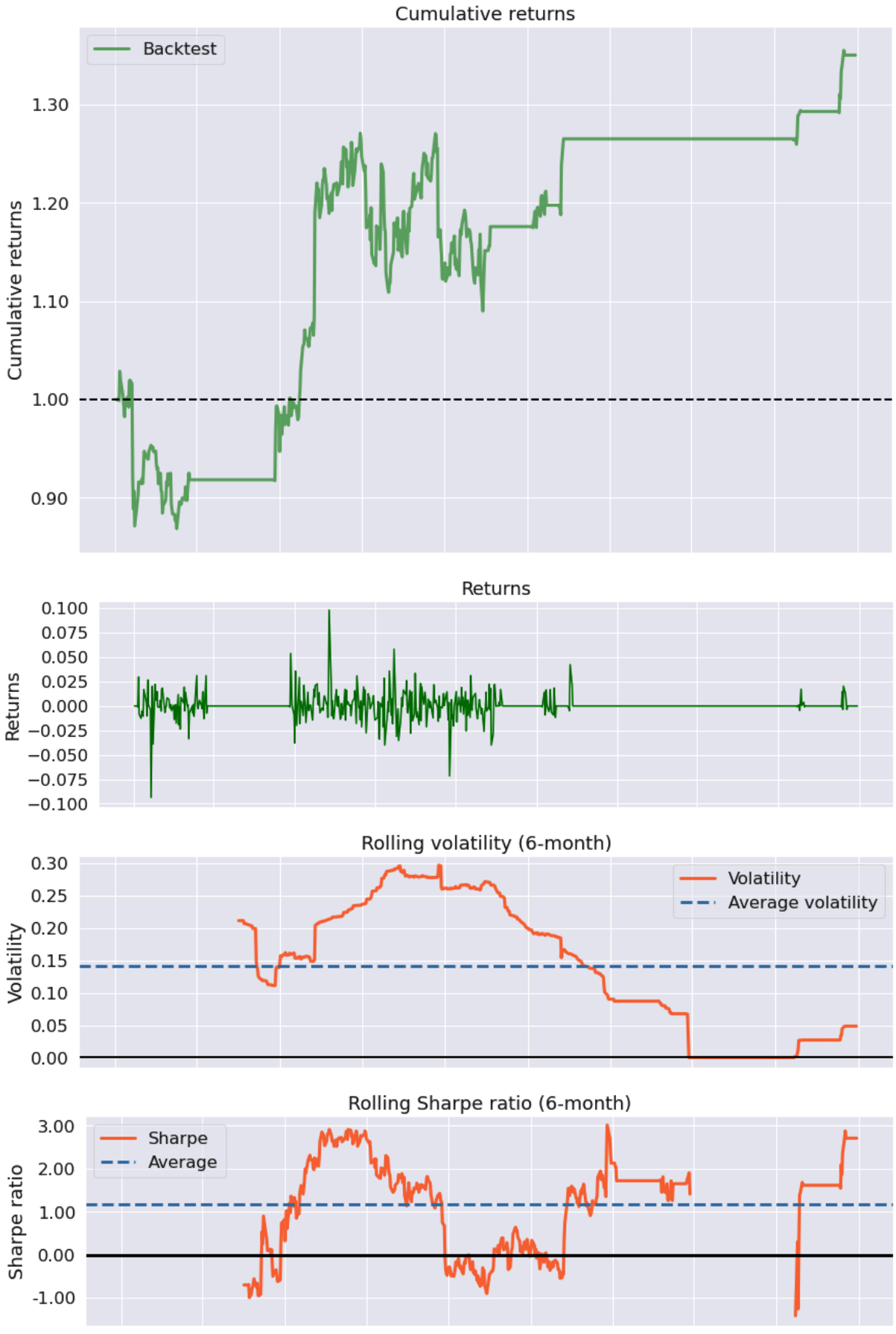

Annual returns
Year
2015
2016
2017
Mean
0% 10% 20% 30% 40%
Returns

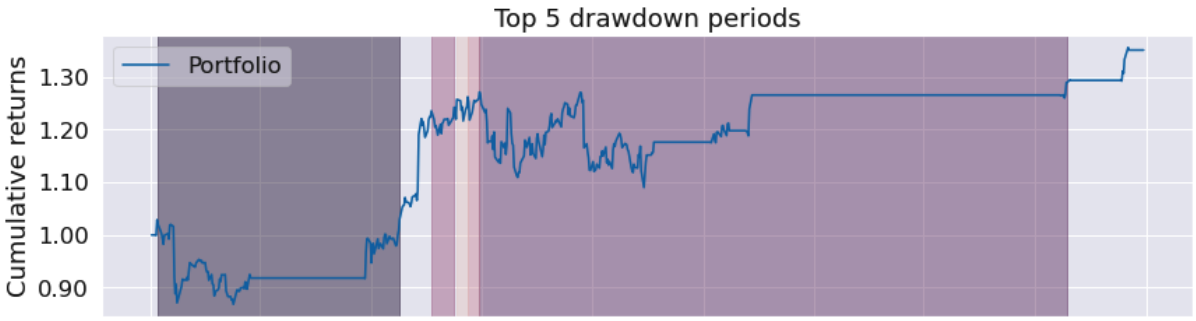

Distribution of monthly returns
Mean
Number of months
17.5
15.0
12.5
10.0
7.5
5.0
2.5
0.0
0% 10% 20%
Returns

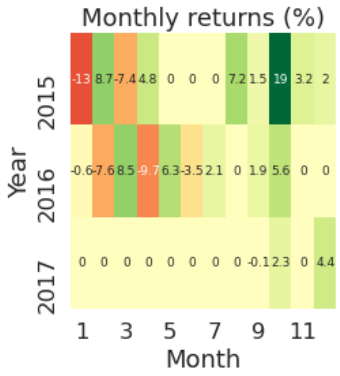
Start date	2015-01-02
End date	2017-12-29
Total months	35

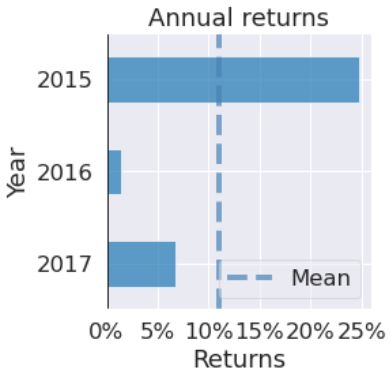
	Backtest
Annual return	10.6%
Cumulative returns	35.1%
Annual volatility	17.6%
Sharpe ratio	0.66
Calmar ratio	0.68
Stability	0.74
Max drawdown	-15.6%
Omega ratio	1.20
Sortino ratio	0.97
Skew	0.04
Kurtosis	19.96
Tail ratio	1.19
Daily value at risk	-2.2%

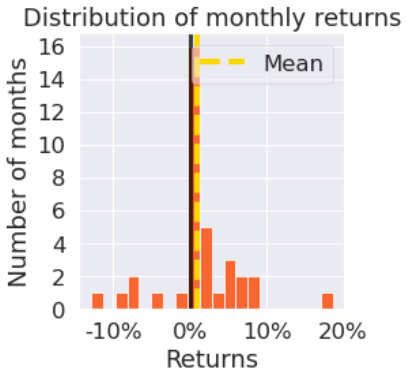
Worst drawdown periods	Net drawdown in %	Peak date	Valley date	Recovery date	Duration
0	15.57	2015-01-08	2015-04-02	2015-10-02	192
1	14.25	2015-12-29	2016-06-27	2017-10-05	463
2	3.70	2015-11-06	2015-11-13	2015-12-01	18
3	3.49	2015-12-16	2015-12-18	2015-12-29	10
4	3.24	2015-12-04	2015-12-11	2015-12-16	9


Cumulative returns
Backtest
1.30
1.20
1.10
1.00
0.90
Cumulative returns
Returns
0.100
0.075
0.050
0.025
0.000
−0.025
−0.050
−0.075
−0.100
Returns
Rolling volatility (6-month)
Volatility
Average volatility
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Volatility
Rolling Sharpe ratio (6-month)
Sharpe
Average
3.00
2.00
1.00
0.00
-1.00
Sharpe ratio





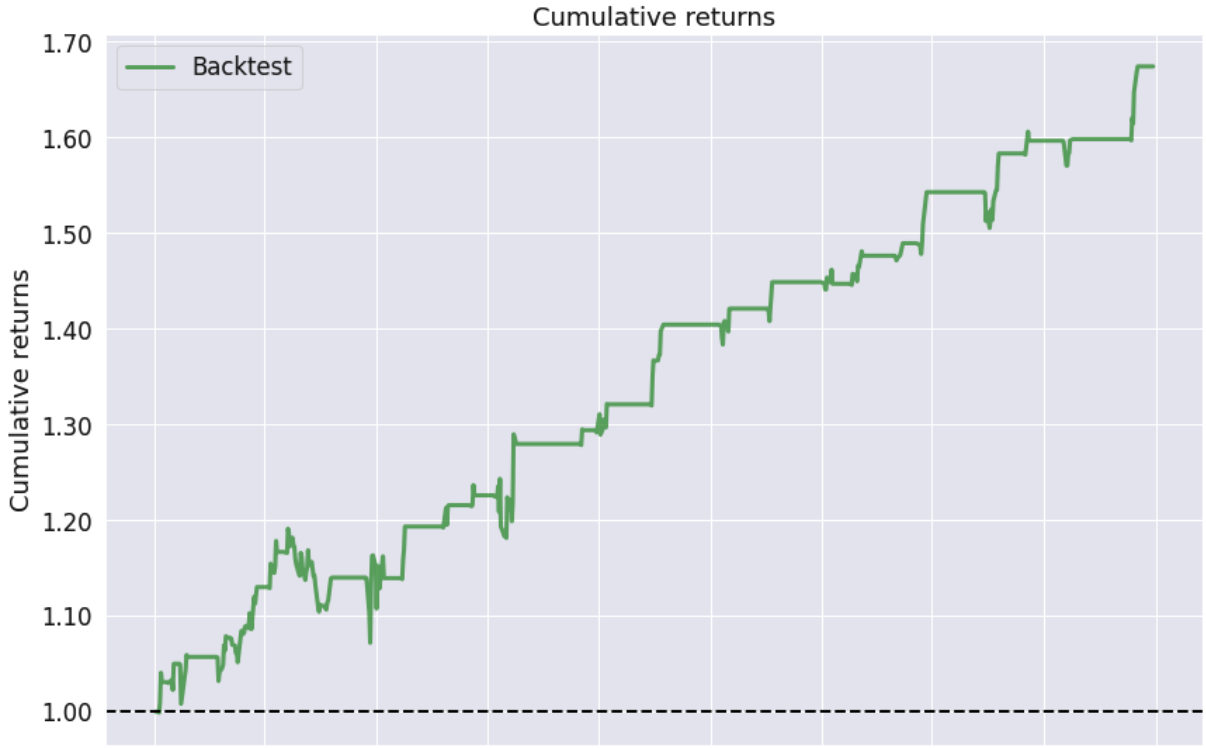


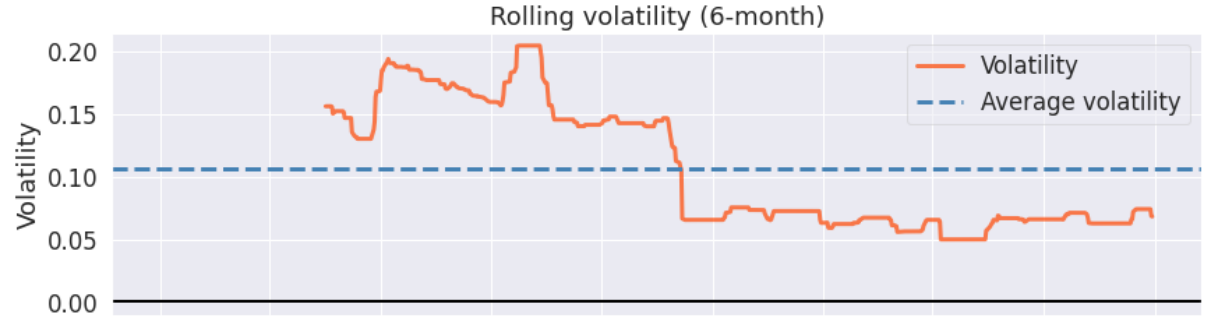


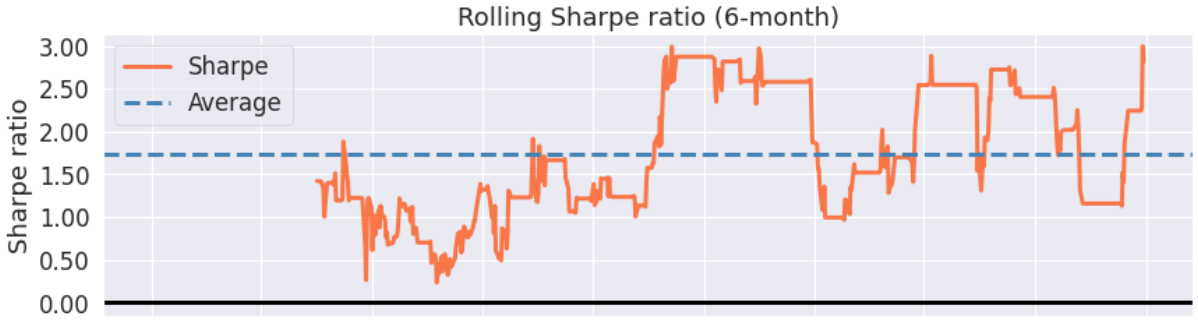
Start date	2015-01-02
End date	2017-12-29
Total months	35

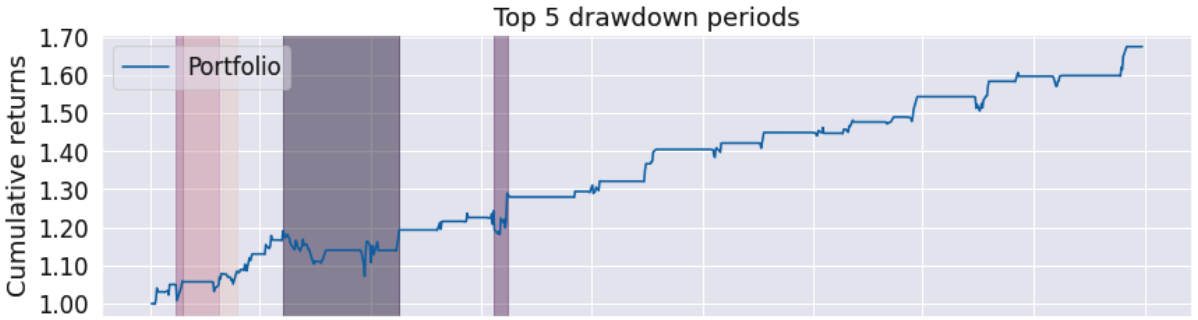
	Backtest
Annual return	18.8%
Cumulative returns	67.4%
Annual volatility	11.7%
Sharpe ratio	1.53
Calmar ratio	1.88
Stability	0.98
Max drawdown	-10.0%
Omega ratio	1.71
Sortino ratio	2.72
Skew	1.50
Kurtosis	16.37
Tail ratio	1.96
Daily value at risk	-1.4%

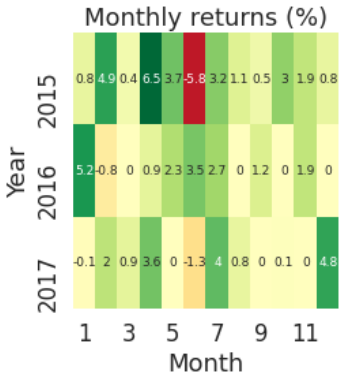
Worst drawdown periods	Net drawdown in %	Peak date	Valley date	Recovery date	Duration
0	10.00	2015-05-27	2015-08-25	2015-10-02	93
1	4.97	2016-01-14	2016-01-21	2016-01-29	12
2	3.99	2015-01-28	2015-01-30	2015-02-05	7
3	2.56	2015-02-05	2015-03-12	2015-03-18	30
4	2.52	2015-03-20	2015-04-02	2015-04-06	12

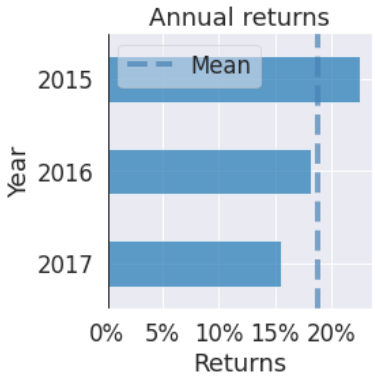


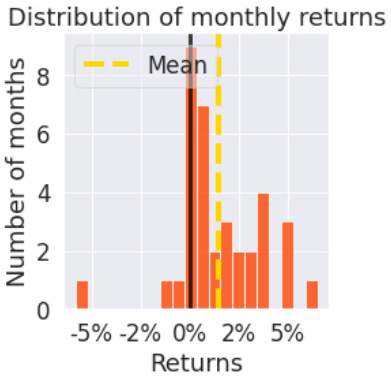



Rolling Sharpe ratio (6-month)
Sharpe ratio
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Sharpe
Average


Top 5 drawdown periods
Cumulative returns
1.70
1.60
1.50
1.40
1.30
1.20
1.10
1.00
Portfolio


Monthly returns (%)
Year
2015
2016
2017
0.8 4.9 0.4 6.5 3.7 -5.8 3.2 1.1 0.5 3 1.9 0.8
5.2 -0.8 0 0.9 2.3 3.5 2.7 0 1.2 0 1.9 0
-0.1 2 0.9 3.6 0 -1.3 4 0.8 0 0.1 0 4.8
1 3 5 7 9 11
Month

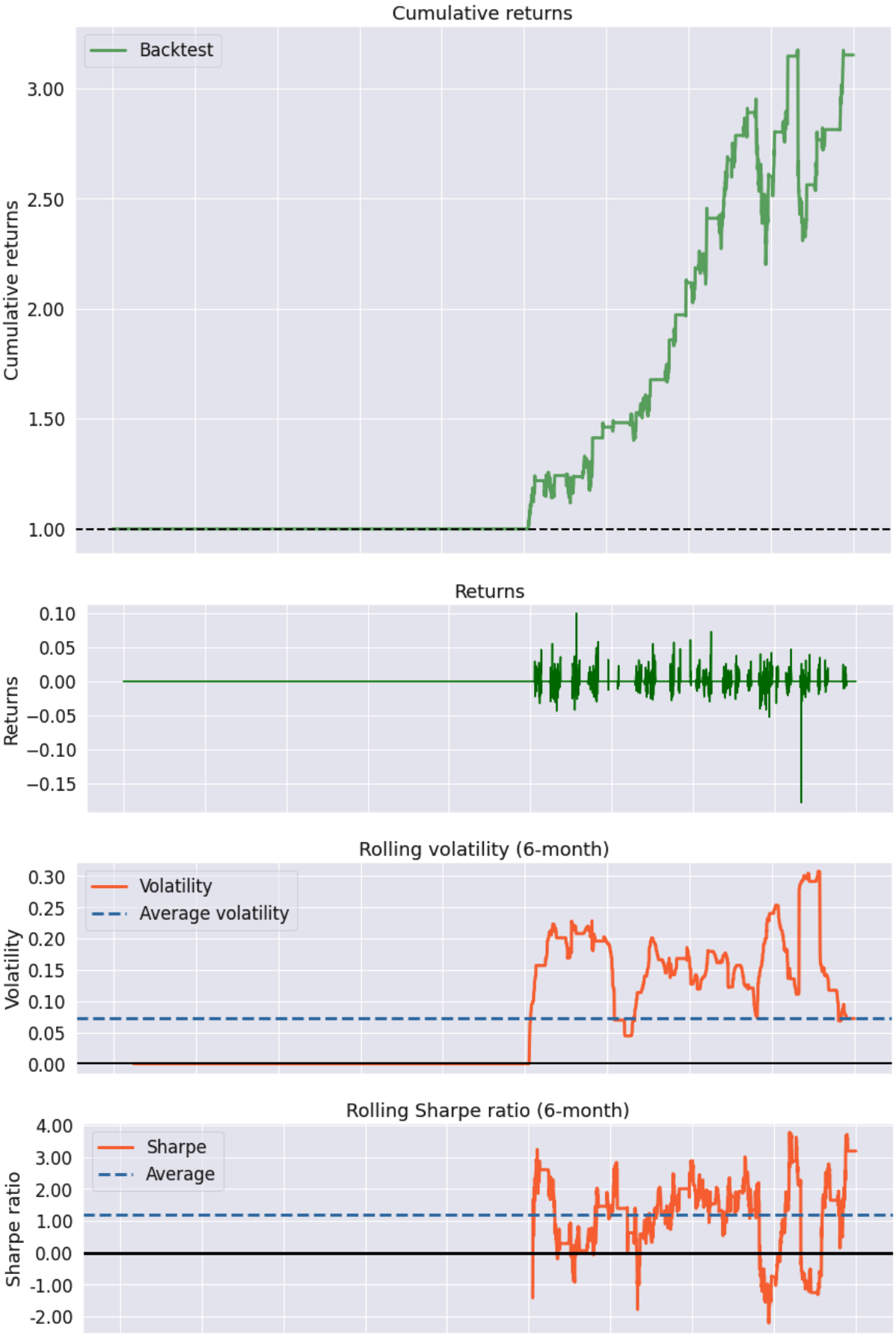

Annual returns
Year
2015
2016
2017
Mean
0% 5% 10% 15% 20%
Returns

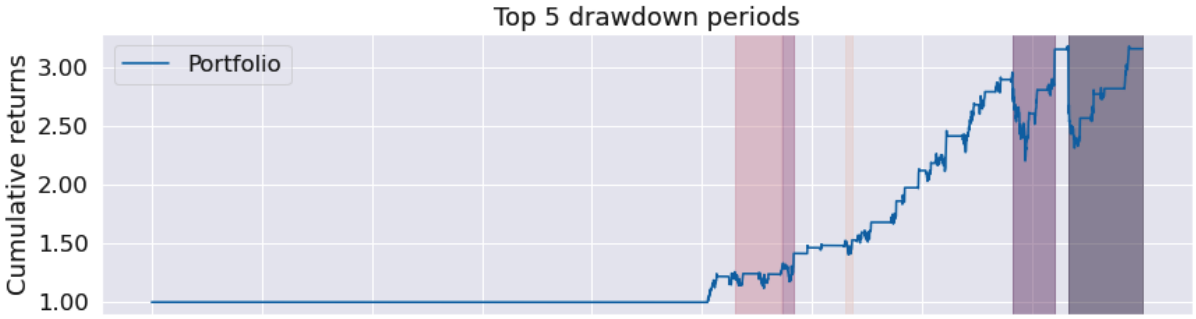

Distribution of monthly returns
Number of months
8
6
4
2
0
Mean
-5% -2% 0% 2% 5%
Returns

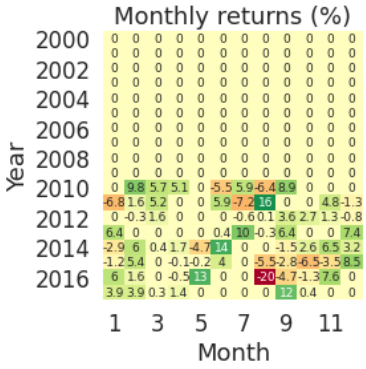
Start date	2000-01-03
End date	2017-12-29
Total months	215

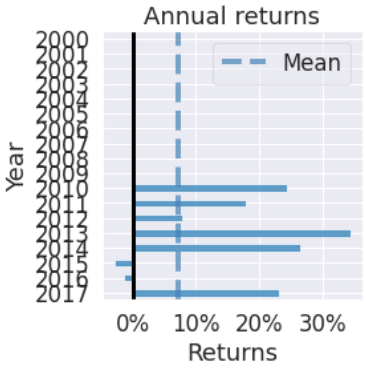
	Backtest
Annual return	6.6%
Cumulative returns	215.2%
Annual volatility	11.4%
Sharpe ratio	0.62
Calmar ratio	0.24
Stability	0.76
Max drawdown	-27.3%
Omega ratio	1.31
Sortino ratio	0.93
Skew	-1.58
Kurtosis	107.60
Tail ratio	1.42
Daily value at risk	-1.4%

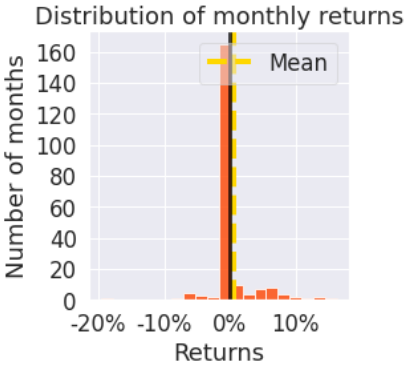
Worst drawdown periods	Net drawdown in %	Peak date	Valley date	Recovery date	Duration
0	27.29	2016-08-24	2016-10-05	NaT	NaN
1	25.47	2015-08-19	2015-11-13	2016-05-26	202
2	11.70	2011-06-21	2011-08-04	2011-08-30	51
3	11.11	2010-08-04	2011-02-14	2011-06-09	222
4	7.93	2012-08-07	2012-08-29	2012-09-21	34


Cumulative returns
Backtest
3.00
2.50
2.00
1.50
1.00
Cumulative returns
Returns
0.10
0.05
0.00
−0.05
−0.10
−0.15
Returns
Rolling volatility (6-month)
Volatility
Average volatility
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Volatility
Rolling Sharpe ratio (6-month)
Sharpe
Average
4.00
3.00
2.00
1.00
0.00
-1.00
-2.00
Sharpe ratio





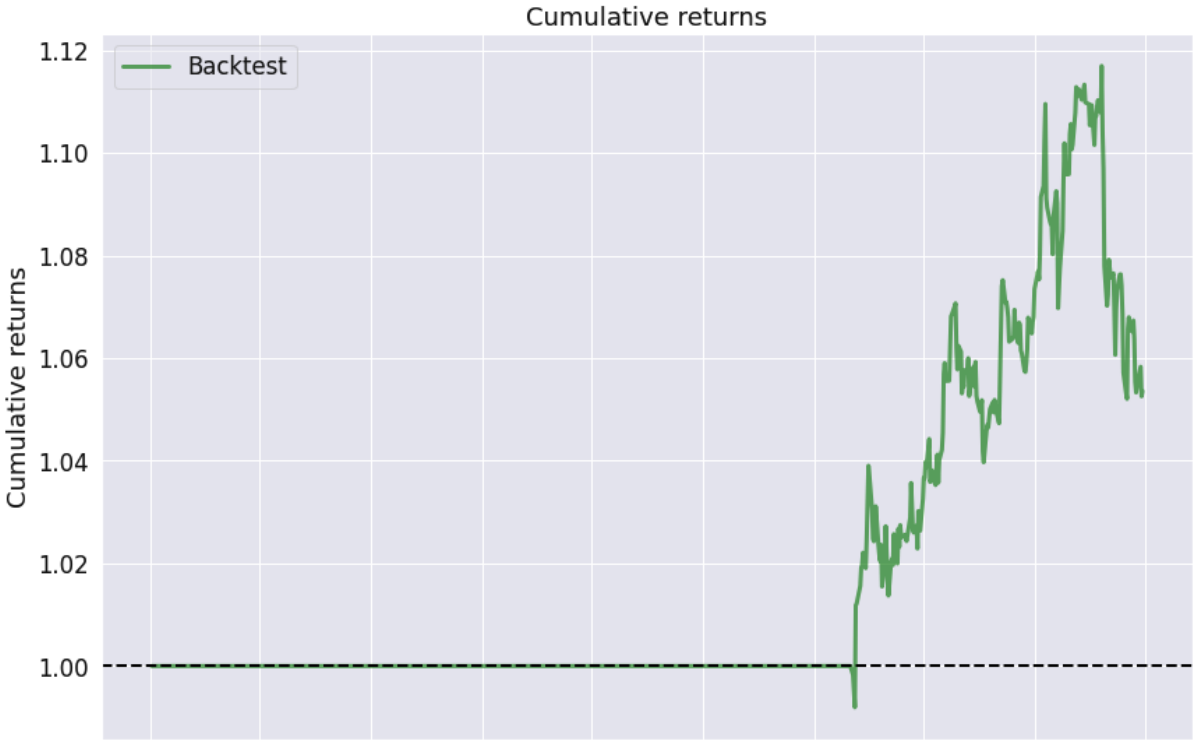


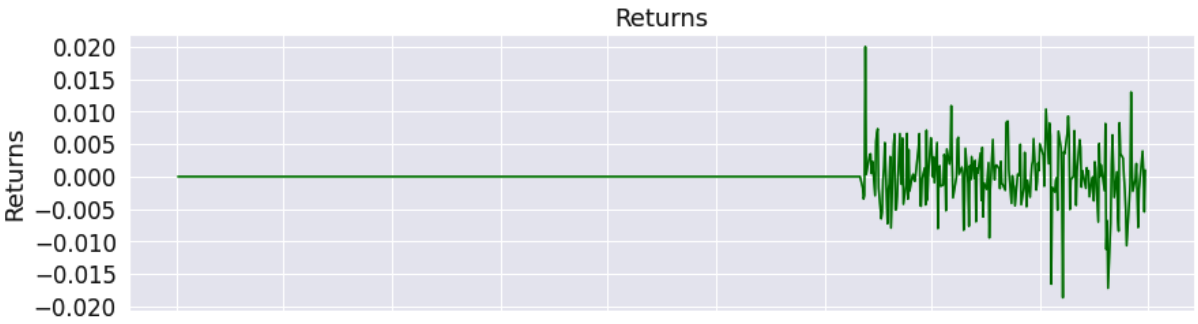


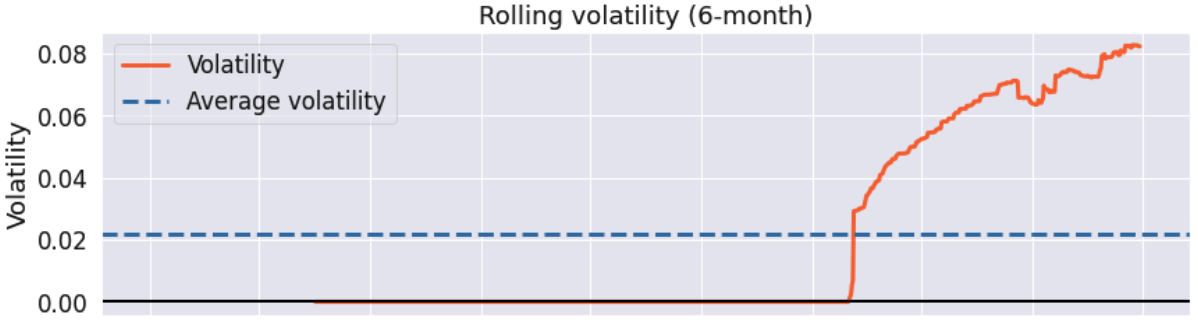
Start date	2015-01-02
End date	2017-12-29
Total months	35

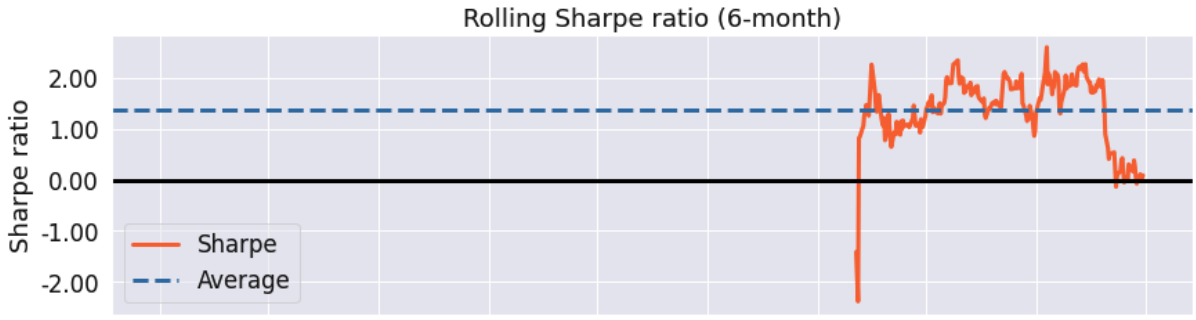
	Backtest
Annual return	1.8%
Cumulative returns	5.4%
Annual volatility	4.3%
Sharpe ratio	0.43
Calmar ratio	0.30
Stability	0.57
Max drawdown	-5.8%
Omega ratio	1.14
Sortino ratio	0.61
Skew	-0.29
Kurtosis	14.23
Tail ratio	1.23
Daily value at risk	-0.5%

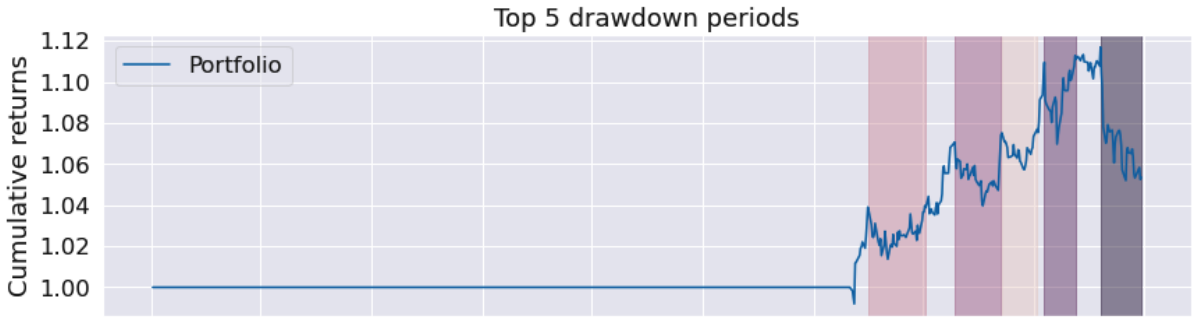
Worst drawdown periods	Net drawdown in %	Peak date	Valley date	Recovery date	Duration
0	5.81	2017-11-14	2017-12-12	NaT	NaN
1	3.59	2017-09-13	2017-09-27	2017-10-17	25
2	2.89	2017-06-06	2017-07-07	2017-07-27	38
3	2.44	2017-03-02	2017-03-24	2017-05-04	46
4	1.67	2017-07-28	2017-08-22	2017-09-05	28

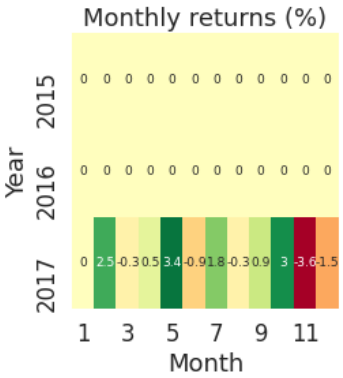


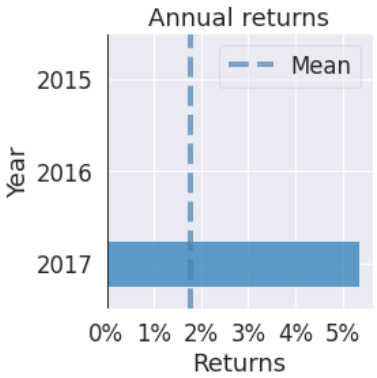


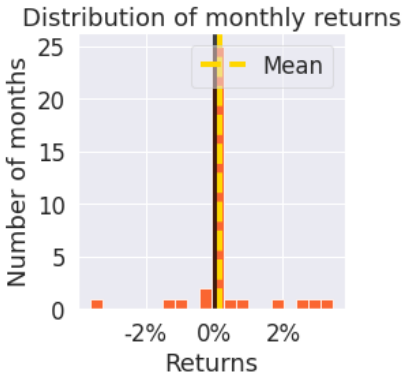



Rolling Sharpe ratio (6-month)
Sharpe ratio
2.00
1.00
0.00
-1.00
-2.00
Sharpe
Average


Top 5 drawdown periods
Cumulative returns
1.12
1.10
1.08
1.06
1.04
1.02
1.00
Portfolio


Monthly returns (%)
Year
2015
2016
2017
Month
1 3 5 7 9 11

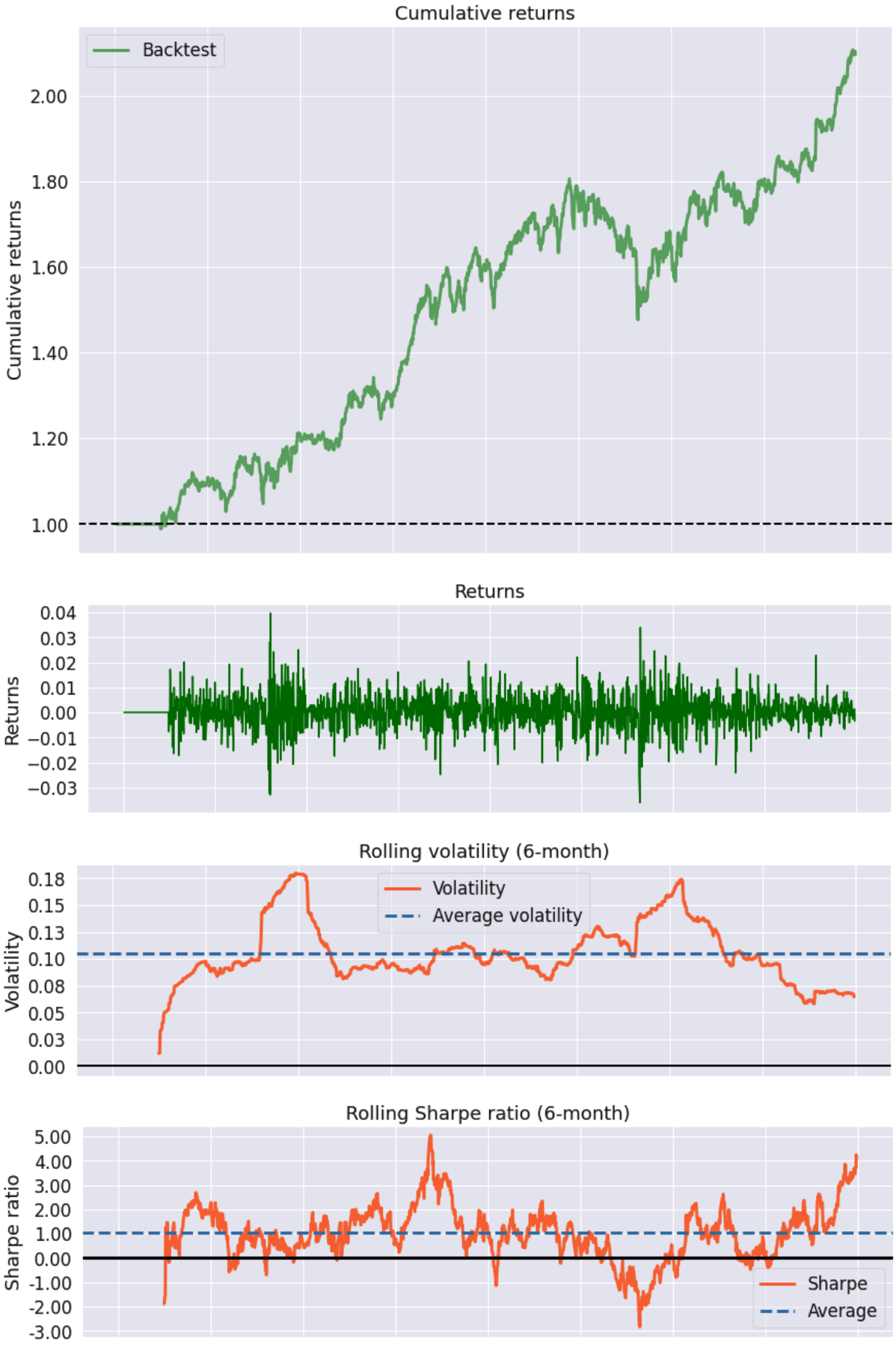

Annual returns
Year
2015
2016
2017
Mean
0% 1% 2% 3% 4% 5%
Returns

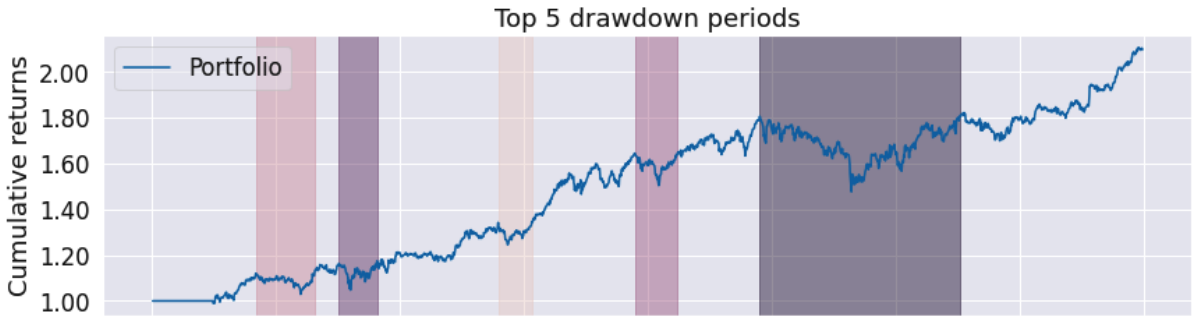

Distribution of monthly returns
Number of months
25
20
15
10
5
0
Mean
-2% 0% 2%
Returns

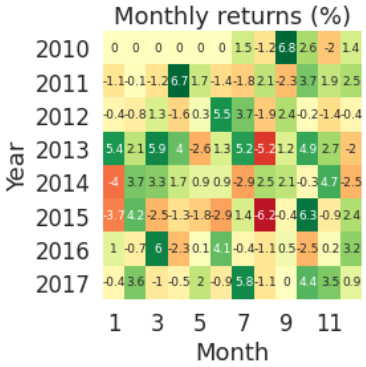
Start date	2010-01-04
End date	2017-12-29
Total months	95

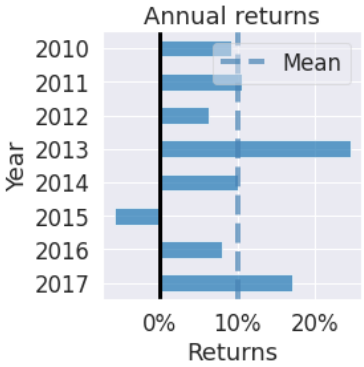
	Backtest
Annual return	9.7%
Cumulative returns	109.6%
Annual volatility	10.6%
Sharpe ratio	0.93
Calmar ratio	0.53
Stability	0.91
Max drawdown	-18.2%
Omega ratio	1.18
Sortino ratio	1.36
Skew	-0.08
Kurtosis	2.98
Tail ratio	1.04
Daily value at risk	-1.3%

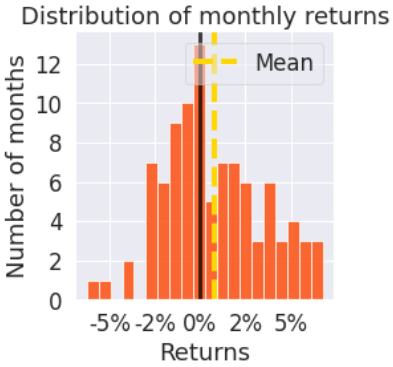
Worst drawdown periods	Net drawdown in %	Peak date	Valley date	Recovery date	Duration
0	18.22	2014-11-28	2015-08-25	2016-07-11	422
1	9.97	2011-07-07	2011-08-10	2011-10-27	81
2	8.56	2013-11-25	2014-02-03	2014-03-31	91
3	8.15	2010-11-04	2011-03-16	2011-04-26	124
4	7.23	2012-10-18	2012-11-15	2013-01-25	72


Cumulative returns
Backtest
2.00
1.80
1.60
1.40
1.20
1.00
Cumulative returns
Returns
0.04
0.03
0.02
0.01
0.00
−0.01
−0.02
−0.03
Returns
Rolling volatility (6-month)
Volatility
Average volatility
0.18
0.15
0.13
0.10
0.08
0.05
0.03
0.00
Volatility
Rolling Sharpe ratio (6-month)
5.00
4.00
3.00
2.00
1.00
0.00
-1.00
-2.00
-3.00
Sharpe ratio
Sharpe
Average





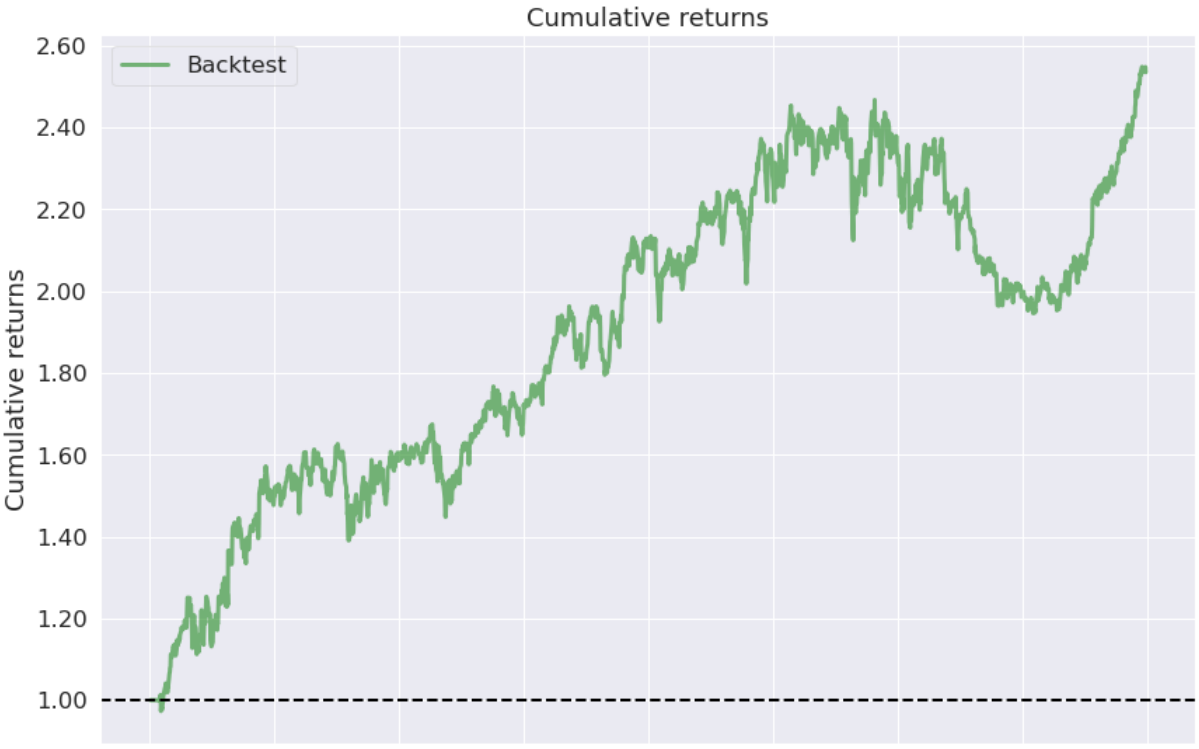


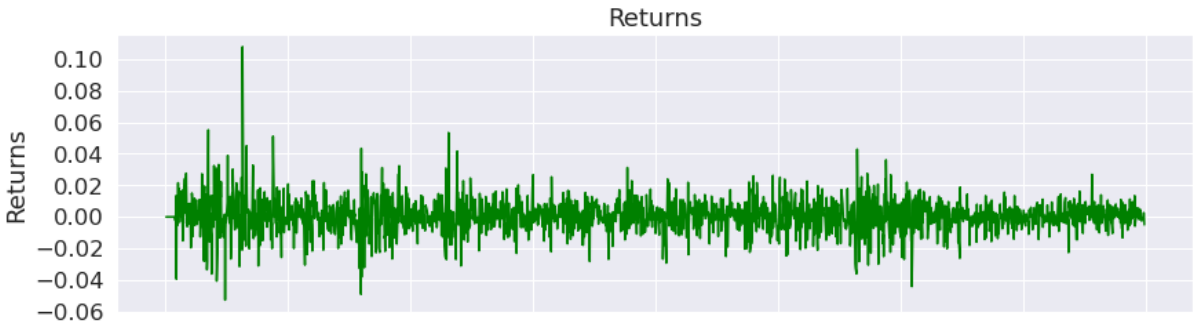


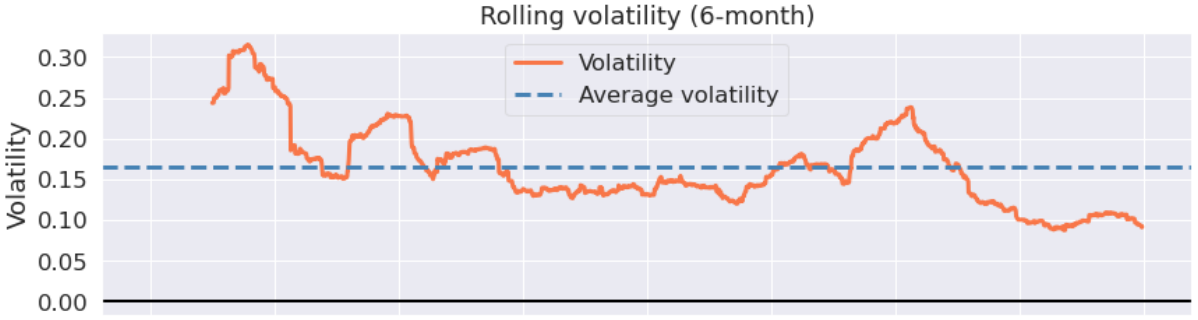
Start date	2010-01-04
End date	2017-12-29
Total months	95

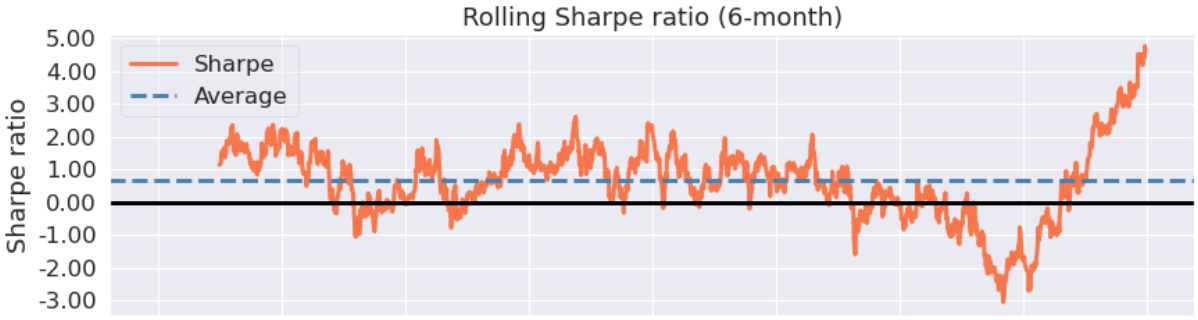
	Backtest
Annual return	12.4%
Cumulative returns	153.5%
Annual volatility	17.0%
Sharpe ratio	0.77
Calmar ratio	0.58
Stability	0.76
Max drawdown	-21.1%
Omega ratio	1.15
Sortino ratio	1.15
Skew	0.48
Kurtosis	7.23
Tail ratio	1.01
Daily value at risk	-2.1%

Worst drawdown periods	Net drawdown in %	Peak date	Valley date	Recovery date	Duration
0	21.14	2015-10-27	2017-02-02	2017-11-30	548
1	14.52	2011-07-07	2011-08-08	2012-03-19	183
2	13.53	2012-04-09	2012-05-18	2012-08-24	100
3	13.42	2015-02-24	2015-08-25	2015-10-27	176
4	11.06	2010-04-23	2010-05-20	2010-06-17	40

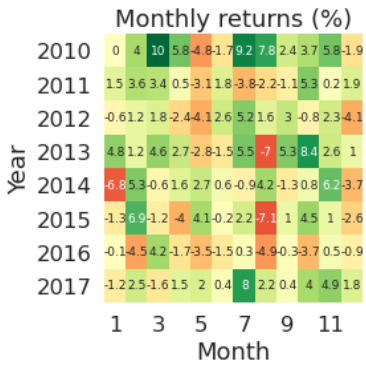


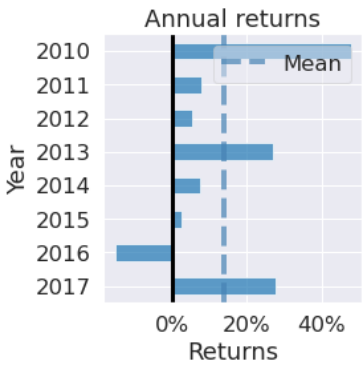


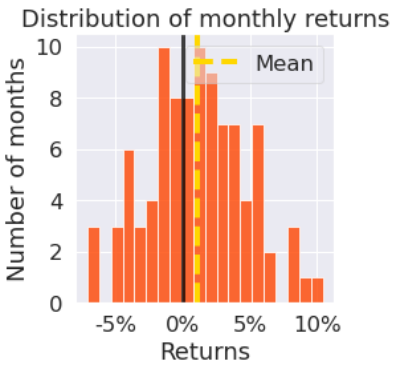



Rolling Sharpe ratio (6-month)
Sharpe
Average
Sharpe ratio
5.00
4.00
3.00
2.00
1.00
0.00
-1.00
-2.00
-3.00


Top 5 drawdown periods
Portfolio
Cumulative returns
2.60
2.40
2.20
2.00
1.80
1.60
1.40
1.20
1.00


Monthly returns (%)
Year
2010
2011
2012
2013
2014
2015
2016
2017
1
3
5
7
9
11
Month

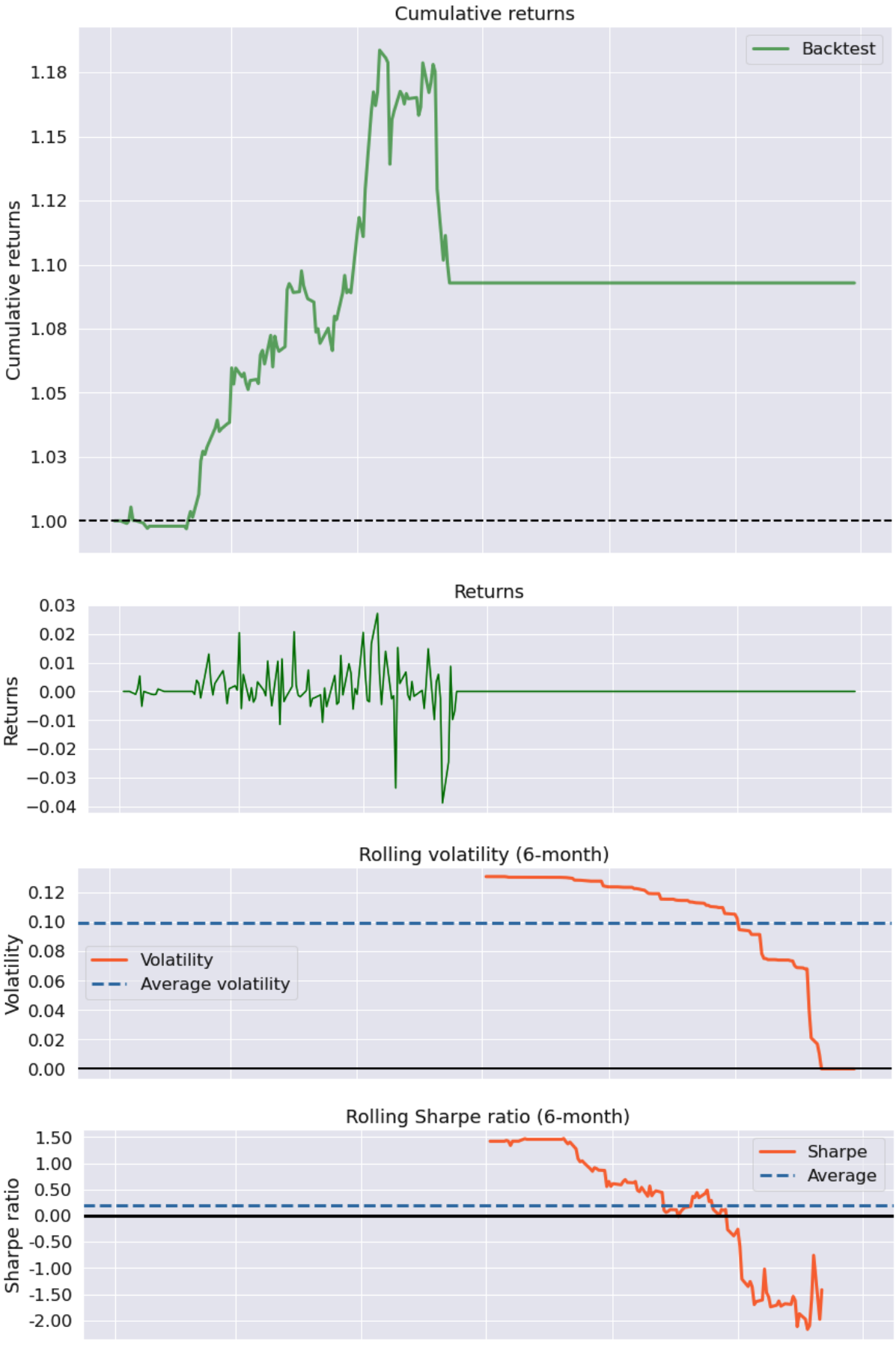

Annual returns
Mean
Year
2010
2011
2012
2013
2014
2015
2016
2017
0%
20%
40%
Returns

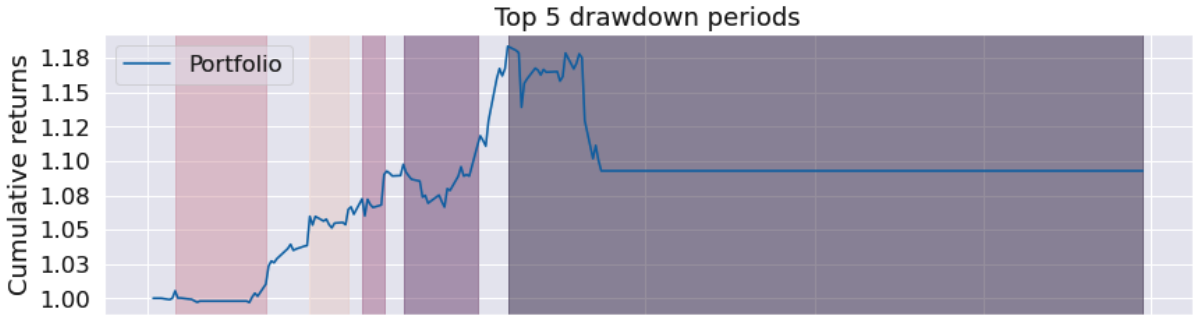

Distribution of monthly returns
Mean
Number of months
10
8
6
4
2
0
-5%
0%
5%
10%
Returns

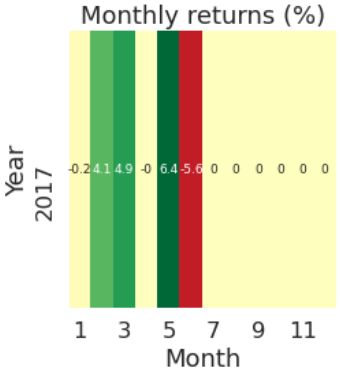
Start date	2017-01-03
End date	2017-12-29
Total months	11

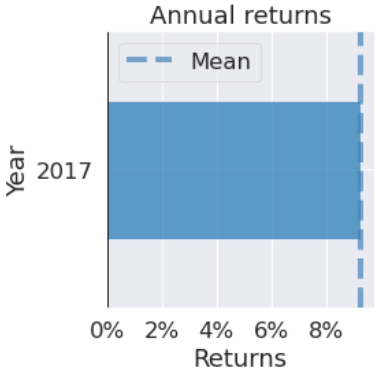
	Backtest
Annual return	9.3%
Cumulative returns	9.3%
Annual volatility	9.3%
Sharpe ratio	1.01
Calmar ratio	1.22
Stability	0.25
Max drawdown	-7.7%
Omega ratio	1.36
Sortino ratio	1.45
Skew	-1.09
Kurtosis	15.97
Tail ratio	1.95
Daily value at risk	-1.1%

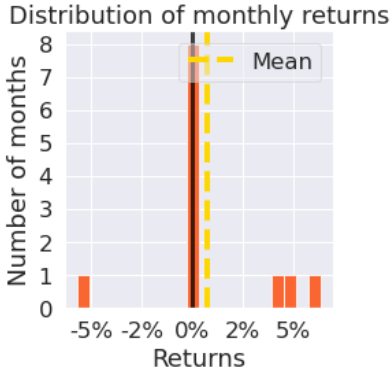
Worst drawdown periods	Net drawdown in %	Peak date	Valley date	Recovery date	Duration
0	7.67	2017-05-12	2017-06-15	NaT	NaN
1	2.83	2017-04-04	2017-04-19	2017-05-01	20
2	1.15	2017-03-20	2017-03-21	2017-03-28	7
3	0.84	2017-01-11	2017-02-07	2017-02-13	24
4	0.80	2017-03-01	2017-03-09	2017-03-15	11


Cumulative returns
Backtest
Cumulative returns
1.18
1.15
1.12
1.10
1.08
1.05
1.03
1.00
Returns
Returns
0.03
0.02
0.01
0.00
−0.01
−0.02
−0.03
−0.04
Rolling volatility (6-month)
Volatility
Average volatility
Volatility
0.12
0.10
0.08
0.06
0.04
0.02
0.00
Rolling Sharpe ratio (6-month)
Sharpe
Average
Sharpe ratio
1.50
1.00
0.50
0.00
-0.50
-1.00
-1.50
-2.00





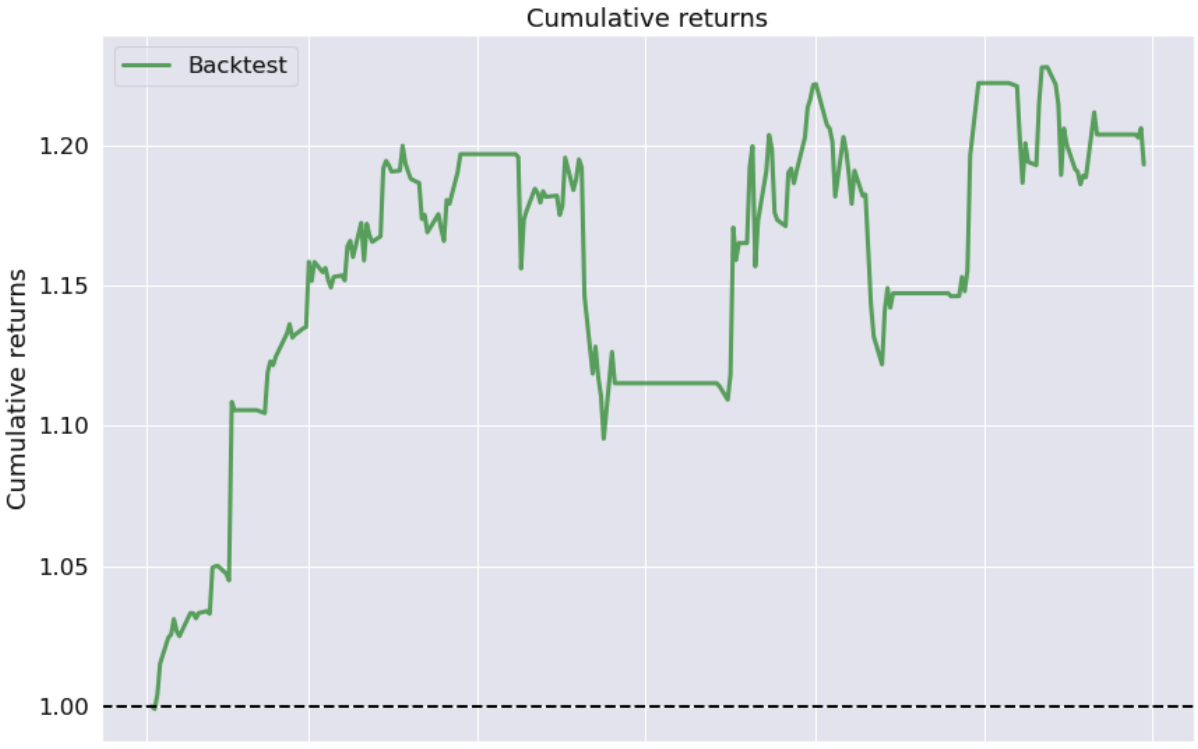


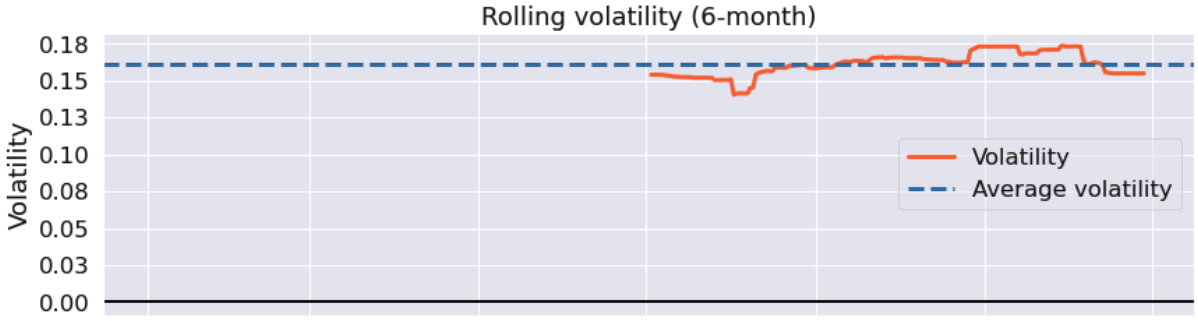


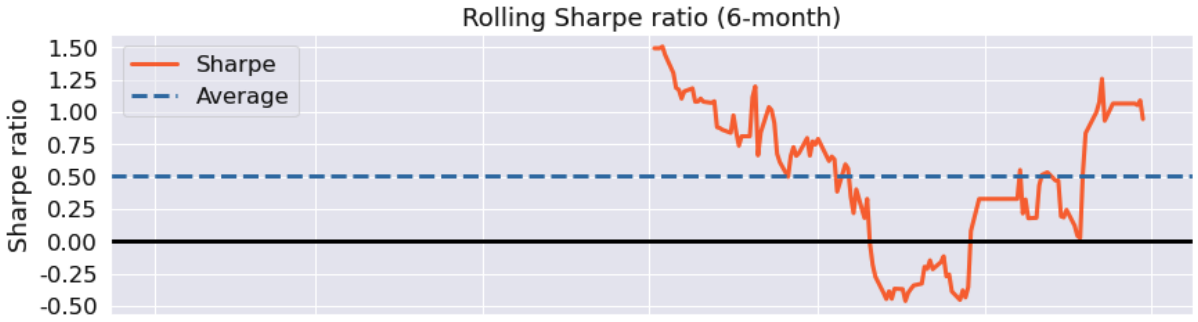
Start date	2017-01-03
End date	2017-12-29
Total months	11

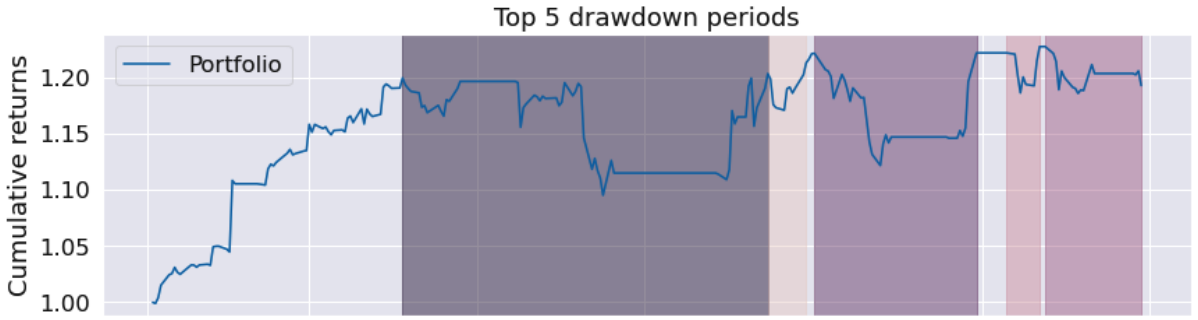
	Backtest
Annual return	19.4%
Cumulative returns	19.3%
Annual volatility	15.5%
Sharpe ratio	1.22
Calmar ratio	2.23
Stability	0.35
Max drawdown	-8.7%
Omega ratio	1.33
Sortino ratio	2.03
Skew	1.07
Kurtosis	9.47
Tail ratio	1.37
Daily value at risk	-1.9%

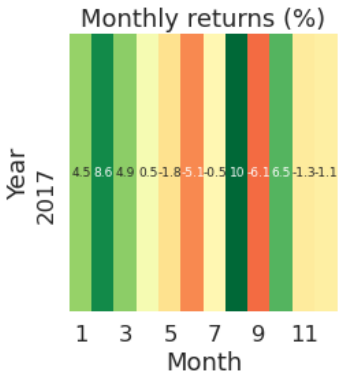
Worst drawdown periods	Net drawdown in %	Peak date	Valley date	Recovery date	Duration
0	8.70	2017-04-04	2017-06-16	2017-08-15	96
1	8.18	2017-09-01	2017-09-25	2017-10-30	42
2	3.40	2017-11-24	2017-12-06	NaT	NaN
3	2.91	2017-11-10	2017-11-15	2017-11-22	9
4	2.70	2017-08-15	2017-08-21	2017-08-29	11

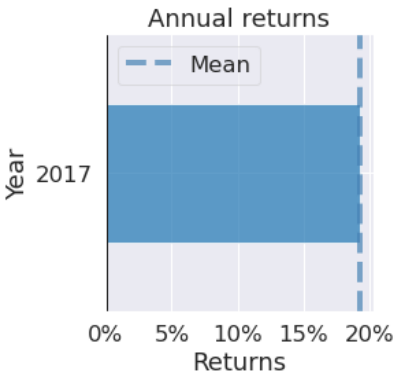


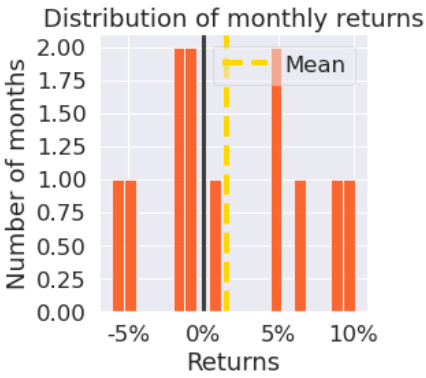



Rolling Sharpe ratio (6-month)
Sharpe
Average
Sharpe ratio
1.50
1.25
1.00
0.75
0.50
0.25
0.00
-0.25
-0.50


Top 5 drawdown periods
Portfolio
Cumulative returns
1.20
1.15
1.10
1.05
1.00


Monthly returns (%)
Year
2017
4.5 8.6 4.9 0.5 -1.8 -5.1 -0.5 10 -6.1 6.5 -1.3 1.1
1 3 5 7 9 11
Month


Annual returns
Mean
Year
2017
0% 5% 10% 15% 20%
Returns


Distribution of monthly returns
Mean
Number of months
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
-5% 0% 5% 10%
Returns