In [1]:
```python
from PortfolioOptimizer import *
```

```
C:\ProgramData\Anaconda3\lib\site-packages\pandas_datareader\compat\__init__.py:7: FutureWarning: pandas.util.testing is deprecated. Use the functions in the public API at pandas.testing inste
ad.
  from pandas.util.testing import assert_frame_equal
```

引入資料

初始化

In [2]:
```python
start_date = '2010-01-01'
end_date = '2019-12-31'

code_list=[
    '0050.TW',
    '3008.TW',
    '2330.TW',
    '1216.TW',
    '1301.TW',
    '2002.TW',
    'MSFT',
    'AAPL',
]
```

In [3]:
```python
df = Portfolio.get_price_table(code_list, start=start_date, end=end_date)
```

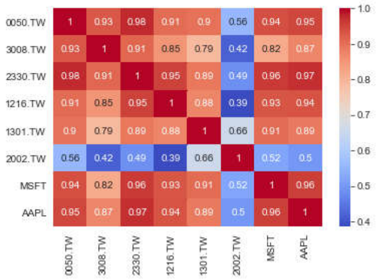
```
Finding  0050.TW
Finding  3008.TW
Finding  2330.TW
Finding  1216.TW
Finding  1301.TW
Finding  2002.TW
Finding  MSFT
Finding  AAPL
```

建立Portfolio物件

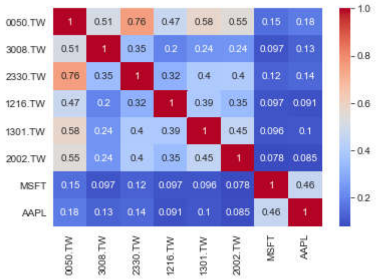
In [4]:
```python
port=Portfolio(df)
```

相關性分析

In [5]:
```python
port.price_corr_map()
```



In [6]:
```python
port.return_corr_map()
```



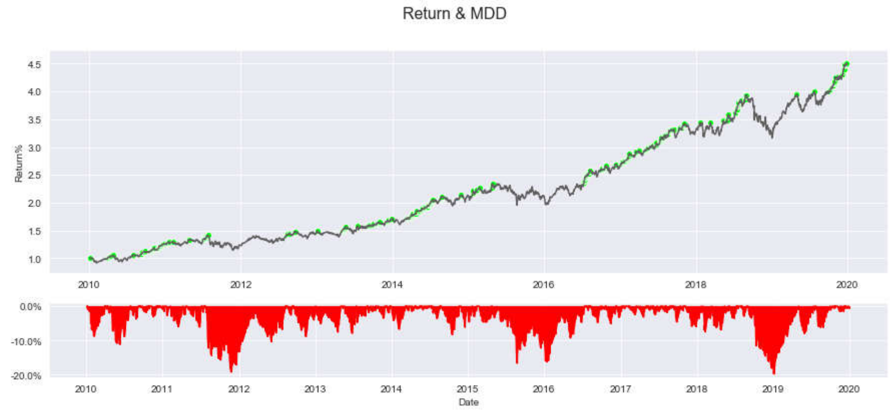
Equal-Weight 投組分析

In [7]:
```
port.Summary()
```

```
          Period
From 2010-01-04  to 2019-12-31, 3648 days.
------------------------------------------------------------
        Weights of Portfolio:
------------------------------------------------------------
0050.TW                  12.50%
3008.TW                  12.50%
2330.TW                  12.50%
1216.TW                  12.50%
1301.TW                  12.50%
2002.TW                  12.50%
MSFT                    12.50%
AAPL                    12.50%
------------------------------------------------------------


         Technical Indicator:
------------------------------------------------------------
Average Return :                        0.159
Average Standard Deviation :            0.147
Sharpe Ratio :                          0.746
Sotino Ratio :                          1.025
Maximum Drop Down :                     0.197
------------------------------------------------------------
```

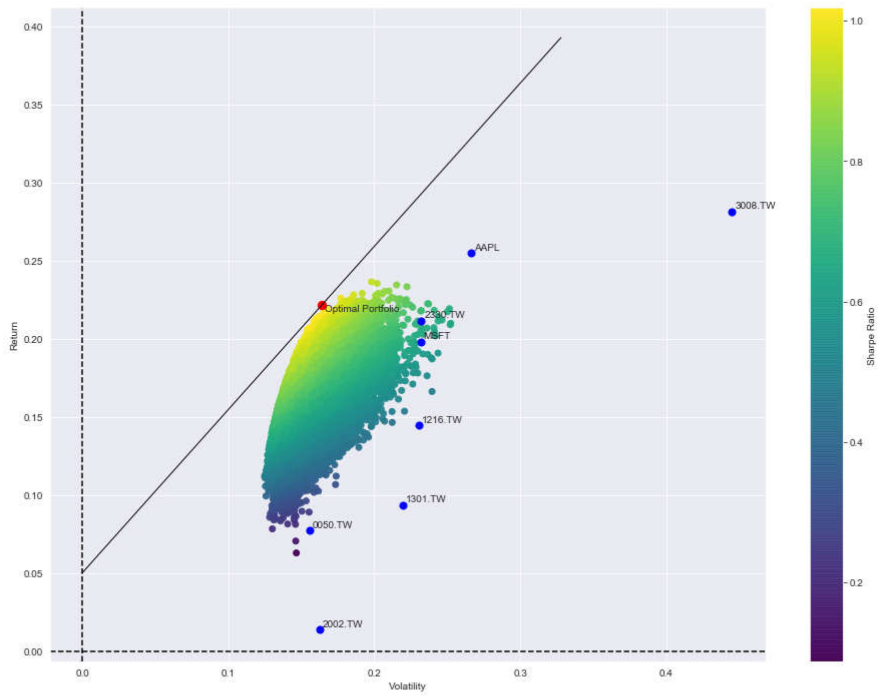
In [8]:
```
port.Return_Plot()
```



效率前緣

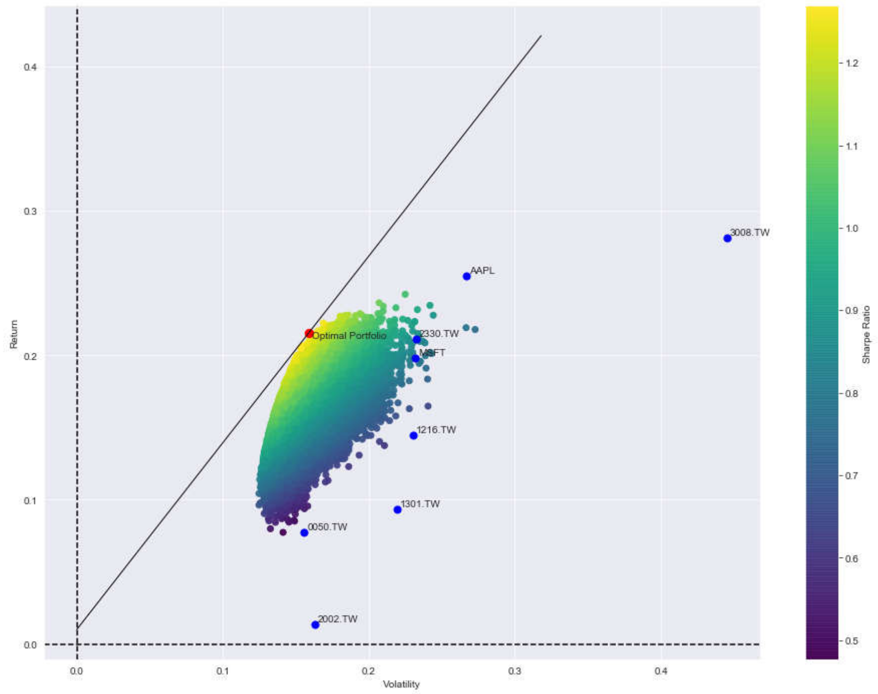
In [9]:
```
port.set_optimize()
port.optimize_set()
port.Plot_Effcient_Frontier()
```

```
Begin :  2010-01-04 00:00:00
End :  2019-12-31 00:00:00
Rf :  0.05
```



可透過修改rf得到不同的切點投組

In [10]:
```
port.set_optimize(rf=0.01)
port.Plot_Effcient_Frontier()
```



權重最佳化求解

Sharpe Ratio

In [11]:
```
port.Get_Best_Portfolio()
```

Out[11]:
```
(1.2943168880909697,
 [0.0,
  0.06741464259927395,
  0.2998366301093722,
  0.1387337641482547,
  2.3421440412870856e-17,
  0.0,
  0.2216246213142663,
  0.27239034182883304])
```

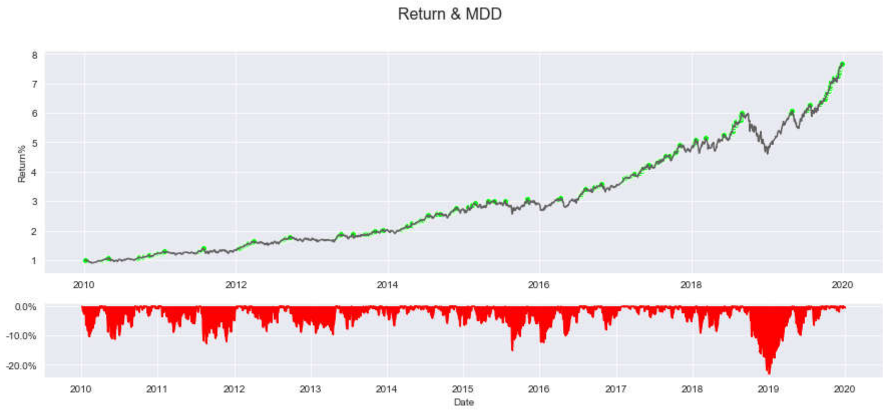
In [12]:
```
port.set_weights(port.Get_Best_Portfolio()[1])
```

In [13]:
```
port.Summary()
```

```
           Period
From 2010-01-04  to 2019-12-31, 3648 days.
--------------------------------------------------------
        Weights of Portfolio:
--------------------------------------------------------
0050.TW                 0.00%
3008.TW                 6.74%
2330.TW                29.98%
1216.TW                13.87%
1301.TW                 0.00%
2002.TW                 0.00%
MSFT                   22.16%
AAPL                   27.24%
--------------------------------------------------------


        Technical Indicator:
--------------------------------------------------------
Average Return :                            0.216
Average Standard Deviation :                0.159
Sharpe Ratio :                              1.043
Sotino Ratio :                              1.428
Maximum Drop Down :                         0.231
--------------------------------------------------------
```

In [14]:
```
port.Return_Plot()
```



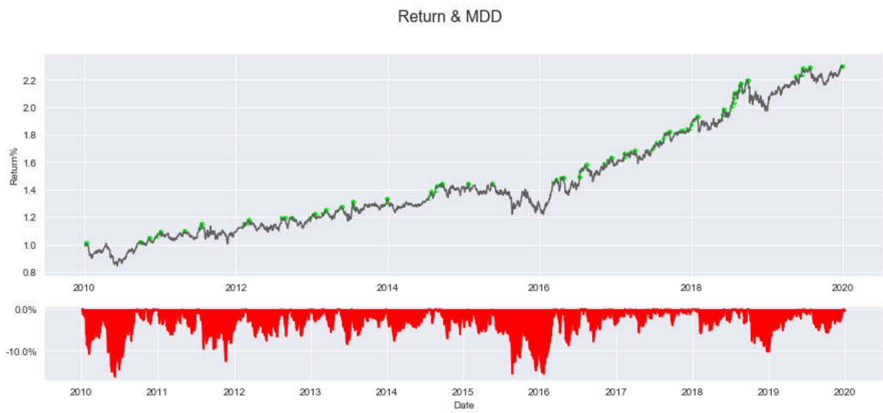
MDD

In [15]:
```
port.set_weights(port.Get_Best_Portfolio(method='mdd')[1])
port.Summary()
```

```
            Period
From 2010-01-04  to 2019-12-31, 3648 days.
------------------------------------------------------------
        Weights of Portfolio:
------------------------------------------------------------
0050.TW                        0.00%
3008.TW                        0.00%
2330.TW                        0.00%
1216.TW                       28.46%
1301.TW                        1.58%
2002.TW                       50.54%
MSFT                          19.42%
AAPL                           0.00%
------------------------------------------------------------


        Technical Indicator:
------------------------------------------------------------
Average Return :                                0.088
Average Standard Deviation :                    0.136
Sharpe Ratio :                                  0.279
Sotino Ratio :                                  0.391
Maximum Drop Down :                             0.163
------------------------------------------------------------
```

In [16]:
```
port.Return_Plot()
```



Vol

In [17]:
```
port.set_weights(port.Get_Best_Portfolio(method='std')[1])
port.Summary()
```

```
            Period
From 2010-01-04  to 2019-12-31, 3648 days.
------------------------------------------------------------
        Weights of Portfolio:
------------------------------------------------------------
0050.TW                       30.06%
3008.TW                        0.00%
2330.TW                        0.00%
1216.TW                        7.59%
1301.TW                        1.95%
2002.TW                       33.87%
MSFT                          18.02%
AAPL                           8.51%
------------------------------------------------------------


        Technical Indicator:
------------------------------------------------------------
Average Return :                                0.098
Average Standard Deviation :                    0.124
Sharpe Ratio :                                  0.388
Sotino Ratio :                                  0.534
Maximum Drop Down :                             0.200
------------------------------------------------------------
```

In [18]:
```
port.Return_Plot()
```

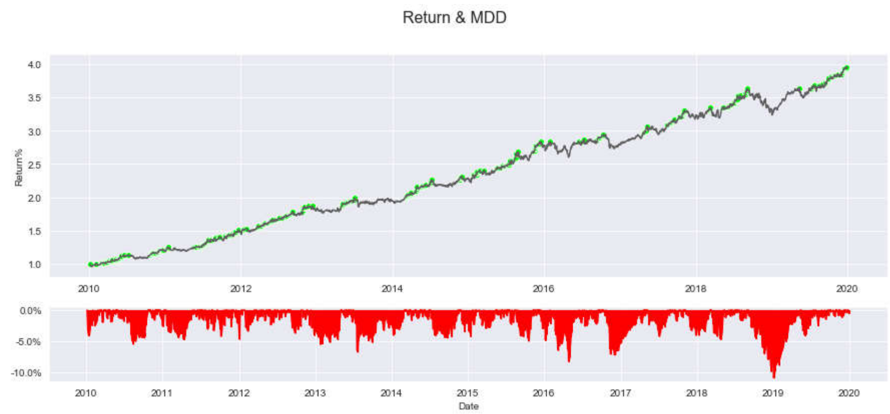
Hedge(作業的Alpha策略)

In [19]:
```
port.set_weights(port.Get_Best_Portfolio(hedge=True)[1])
port.Summary()
```

```
           Period
From 2010-01-04  to 2019-12-31, 3648 days.
------------------------------------------------------------
        Weights of Portfolio:
------------------------------------------------------------
0050.TW                  -72.94%
3008.TW                   11.02%
2330.TW                   44.36%
1216.TW                   14.90%
1301.TW                    7.53%
2002.TW                  -27.07%
MSFT                      7.46%
AAPL                     14.74%
------------------------------------------------------------


        Technical Indicator:
------------------------------------------------------------
Average Return :                          0.146
Average Standard Deviation :              0.102
Sharpe Ratio :                            0.943
Sotino Ratio :                            1.328
Maximum Drop Down :                       0.109
------------------------------------------------------------
```

In [20]:
```
port.Return_Plot()
```



假設權重正反兩方各自可超過一

In [21]:
```
port.set_weights(port.Get_Best_Portfolio(hedge=True, hedge_con=False)[1])
port.Summary()
```

```
           Period
From 2010-01-04  to 2019-12-31, 3648 days.
------------------------------------------------------------
        Weights of Portfolio:
------------------------------------------------------------
0050.TW                 -100.00%
3008.TW                   15.50%
2330.TW                   62.94%
1216.TW                   21.68%
1301.TW                   11.61%
2002.TW                  -43.90%
MSFT                     11.00%
AAPL                     21.16%
------------------------------------------------------------


        Technical Indicator:
------------------------------------------------------------
Average Return :                          0.212
Average Standard Deviation :              0.148
Sharpe Ratio :                            1.094
Sotino Ratio :                            1.535
Maximum Drop Down :                       0.157
------------------------------------------------------------
```

In [22]:
```
port.Return_Plot()
```

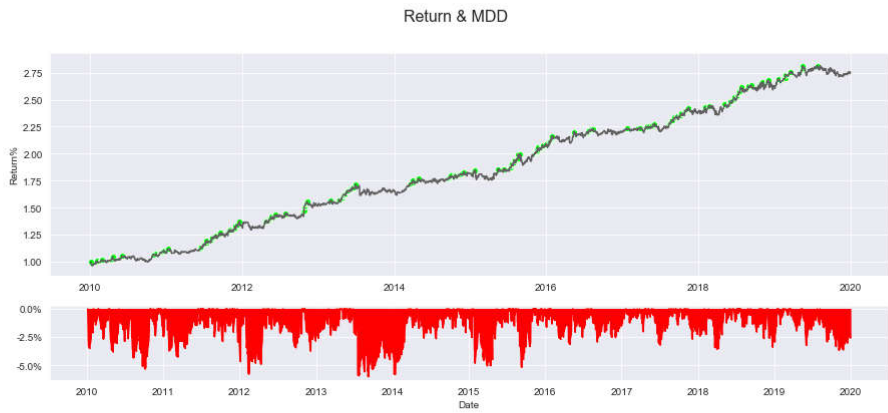
以MDD為優化目標的Alpha策略

In [23]:
```
port.set_weights(port.Get_Best_Portfolio(hedge=True, method='mdd')[1])
port.Summary()
```

```
              Period
From 2010-01-04  to 2019-12-31, 3648 days.
------------------------------------------------------------
         Weights of Portfolio:
------------------------------------------------------------
0050.TW                   -97.70%
3008.TW                    11.20%
2330.TW                    38.75%
1216.TW                    15.91%
1301.TW                     6.59%
2002.TW                     4.65%
MSFT                       22.90%
AAPL                       -2.30%
------------------------------------------------------------


         Technical Indicator:
------------------------------------------------------------
Average Return :                        0.107
Average Standard Deviation :            0.094
Sharpe Ratio :                          0.608
Sotino Ratio :                          0.875
Maximum Drop Down :                     0.060
------------------------------------------------------------
```

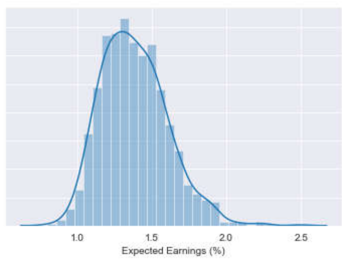
In [24]:
```
port.Return_Plot()
```



蒙地卡羅

In [25]:
```
# port.Get_Monte_Carlo_Forecast(capital=1, path=1000, period=3, yearly=None)
port.Get_Monte_Carlo_Forecast()
```

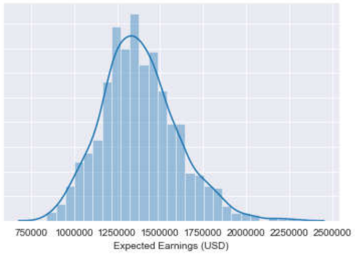
```
Minimum :        79.896%
5  Percentile :  106.665%
25 Percentile :  121.934%
Median :         136.261%
Mean :           138.377%
75 Percentile :  152.220%
Maximum :        249.409%
```



<Figure size 1152x576 with 0 Axes>

In [26]:
```
port.Get_Monte_Carlo_Forecast(capital=1000000)
```

```
Minimum :        839991.154
5  Percentile :  1035062.258
25 Percentile :  1229685.538
Median :         1360022.981
Mean :           1378949.879
75 Percentile :  1506335.178
Maximum :        2289910.117
```




```
<Figure size 1152x576 with 0 Axes>
```

滾動回測

透過前一期的報酬以及波動，形成最佳化權重後，投資下一期

Positive

In [27]:

```
port.set_optimize()
port.Rolling_test(show=True)
```

Period

From 2010-12-31 to 2011-12-31, 365 days.

Weights of Portfolio:

0050.TW	0.00%
3008.TW	19.98%
2330.TW	0.00%
1216.TW	0.00%
1301.TW	51.00%
2002.TW	0.00%
MSFT	0.00%
AAPL	29.03%

Technical Indicator:

Average Return :	-0.044
Average Standard Deviation :	0.256
Sharpe Ratio :	-0.368
Sotino Ratio :	-0.507
Maximum Drop Down :	0.297

Period

From 2011-12-31 to 2012-12-31, 366 days.

Weights of Portfolio:

0050.TW	0.00%
3008.TW	0.00%
2330.TW	15.63%
1216.TW	10.01%
1301.TW	0.00%
2002.TW	0.00%
MSFT	0.00%
AAPL	74.36%

Technical Indicator:

Average Return :	0.265
Average Standard Deviation :	0.229
Sharpe Ratio :	0.939
Sotino Ratio :	1.406
Maximum Drop Down :	0.190

Period

From 2012-12-31 to 2013-12-31, 365 days.

Weights of Portfolio:

0050.TW	0.00%
3008.TW	13.61%
2330.TW	23.42%
1216.TW	39.84%
1301.TW	0.00%
2002.TW	0.00%
MSFT	0.00%
AAPL	23.14%

Technical Indicator:

Average Return :	0.164
Average Standard Deviation :	0.166
Sharpe Ratio :	0.684
Sotino Ratio :	0.956
Maximum Drop Down :	0.082

Period

From 2013-12-31 to 2014-12-31, 365 days.

Weights of Portfolio:

0050.TW	0.00%
3008.TW	30.27%
2330.TW	0.00%
1216.TW	8.59%
1301.TW	0.00%
2002.TW	0.00%
MSFT	61.14%
AAPL	0.00%

Technical Indicator:

Average Return :	0.372
Average Standard Deviation :	0.186
Sharpe Ratio :	1.732
Sotino Ratio :	2.423
Maximum Drop Down :	0.090

Period

From 2014-12-31 to 2015-12-31, 365 days.

Weights of Portfolio:

0050.TW	0.00%
3008.TW	19.25%
2330.TW	27.92%
1216.TW	0.00%
1301.TW	0.00%
2002.TW	0.00%
MSFT	20.85%
AAPL	31.98%

Technical Indicator:

Average Return :	0.035
Average Standard Deviation :	0.204
Sharpe Ratio :	-0.073
Sotino Ratio :	-0.100
Maximum Drop Down :	0.188

Period

From 2015-12-31 to 2016-12-31, 366 days.

```
------------------------------------------------------------
         Weights of Portfolio:
------------------------------------------------------------
0050.TW                  0.00%
3008.TW                  0.00%
2330.TW                  0.00%
1216.TW                 52.32%
1301.TW                  0.00%
2002.TW                  0.00%
MSFT                    47.68%
AAPL                     0.00%
------------------------------------------------------------


          Technical Indicator:
------------------------------------------------------------
Average Return :                                 0.070
Average Standard Deviation :                     0.161
Sharpe Ratio :                                   0.122
Sotino Ratio :                                   0.170
Maximum Drop Down :                              0.085
------------------------------------------------------------
             Period
From 2016-12-31  to 2017-12-31, 365 days.
------------------------------------------------------------
         Weights of Portfolio:
------------------------------------------------------------
0050.TW                  0.00%
3008.TW                 15.15%
2330.TW                 13.48%
1216.TW                  0.00%
1301.TW                 21.31%
2002.TW                 37.09%
MSFT                    12.97%
AAPL                     0.00%
------------------------------------------------------------


          Technical Indicator:
------------------------------------------------------------
Average Return :                                 0.147
Average Standard Deviation :                     0.102
Sharpe Ratio :                                   0.950
Sotino Ratio :                                   1.354
Maximum Drop Down :                              0.062
------------------------------------------------------------
             Period
From 2017-12-31  to 2018-12-31, 365 days.
------------------------------------------------------------
         Weights of Portfolio:
------------------------------------------------------------
0050.TW                  0.00%
3008.TW                  0.00%
2330.TW                 23.73%
1216.TW                 14.10%
1301.TW                  7.58%
2002.TW                  0.00%
MSFT                    33.27%
AAPL                    21.33%
------------------------------------------------------------


          Technical Indicator:
------------------------------------------------------------
Average Return :                                 0.078
Average Standard Deviation :                     0.190
Sharpe Ratio :                                   0.146
Sotino Ratio :                                   0.194
Maximum Drop Down :                              0.209
------------------------------------------------------------
             Period
From 2018-12-31  to 2019-12-31, 365 days.
------------------------------------------------------------
         Weights of Portfolio:
------------------------------------------------------------
0050.TW                  0.00%
3008.TW                  0.00%
2330.TW                  0.00%
1216.TW                 42.26%
1301.TW                  0.00%
2002.TW                  0.00%
MSFT                    57.74%
AAPL                     0.00%
------------------------------------------------------------


          Technical Indicator:
------------------------------------------------------------
Average Return :                                 0.334
Average Standard Deviation :                     0.140
Sharpe Ratio :                                   2.023
Sotino Ratio :                                   2.883
Maximum Drop Down :                              0.055
------------------------------------------------------------
             Period
From 2019-12-31  to 2019-12-31, 0 days.
------------------------------------------------------------
         Weights of Portfolio:
------------------------------------------------------------
0050.TW                 42.87%
3008.TW                  0.00%
2330.TW                  8.44%
1216.TW                  0.00%
1301.TW                  0.00%
2002.TW                  0.00%
MSFT                    28.33%
AAPL                    20.36%
------------------------------------------------------------


          Technical Indicator:
------------------------------------------------------------
Average Return :                                -0.743
Average Standard Deviation :                       nan
Sharpe Ratio :                                     nan
Sotino Ratio :                                    -inf
Maximum Drop Down :                              0.000
------------------------------------------------------------

D:\ipython\TMBA\PortfolioOptimizer.py:198: RuntimeWarning: divide by zero encountered in double_scalars
  252 / (DownRisk * np.sqrt(252))
```

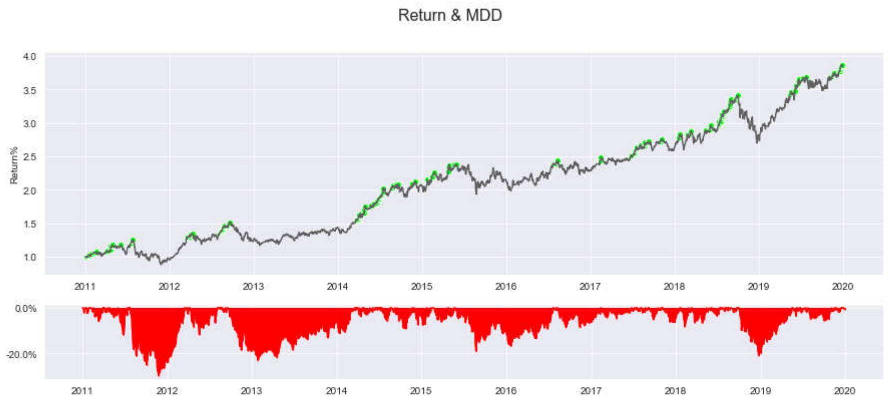
Out[27]:
```
2010-12-31    0.000283
2011-01-03    0.006083
2011-01-04    0.002903
2011-01-05   -0.005094
2011-01-06   -0.001285
                ...
2019-12-24   -0.001806
2019-12-26    0.004714
2019-12-27    0.001054
2019-12-30   -0.004998
2019-12-31   -0.001869
Length: 2134, dtype: float64
```

In [28]:
```
port.Backtest_Summary()
```

```
             Period
From 2010-12-31  to 2019-12-31, 3287 days.
------------------------------------------------------------
      Latest Weights of Portfolio:
------------------------------------------------------------
0050.TW                    42.87%
3008.TW                     0.00%
2330.TW                     8.44%
1216.TW                     0.00%
1301.TW                     0.00%
2002.TW                     0.00%
MSFT                       28.33%
AAPL                       20.36%
------------------------------------------------------------


         Technical Indicator:
------------------------------------------------------------
Average Return :                        0.159
Average Standard Deviation :            0.187
Sharpe Ratio :                          0.582
Sotino Ratio :                          0.809
Maximum Drop Down :                     0.297
------------------------------------------------------------
```

In [29]:
```
port.Return_Plot(backtest=True)
```



使用累積資訊 (每一期計算最佳權重的資料都從頭開始計算)

In [30]:

```
port.set_optimize()
port.Rolling_test(show=True, cul_info=True)
```

Period
From 2010-12-31 to 2011-12-31, 365 days.

Weights of Portfolio:

0050.TW	0.00%
3008.TW	19.98%
2330.TW	0.00%
1216.TW	0.00%
1301.TW	51.00%
2002.TW	0.00%
MSFT	0.00%
AAPL	29.03%

Technical Indicator:

Average Return :	-0.044
Average Standard Deviation :	0.256
Sharpe Ratio :	-0.368
Sotino Ratio :	-0.507
Maximum Drop Down :	0.297

Period
From 2011-12-31 to 2012-12-31, 366 days.

Weights of Portfolio:

0050.TW	0.00%
3008.TW	0.05%
2330.TW	7.33%
1216.TW	13.33%
1301.TW	12.13%
2002.TW	0.00%
MSFT	0.00%
AAPL	67.15%

Technical Indicator:

Average Return :	0.235
Average Standard Deviation :	0.211
Sharpe Ratio :	0.876
Sotino Ratio :	1.325
Maximum Drop Down :	0.193

Period
From 2012-12-31 to 2013-12-31, 365 days.

Weights of Portfolio:

0050.TW	0.00%
3008.TW	5.12%
2330.TW	21.49%
1216.TW	26.25%
1301.TW	0.00%
2002.TW	0.00%
MSFT	0.00%
AAPL	47.14%

Technical Indicator:

Average Return :	0.137
Average Standard Deviation :	0.181
Sharpe Ratio :	0.484
Sotino Ratio :	0.660
Maximum Drop Down :	0.136

Period
From 2013-12-31 to 2014-12-31, 365 days.

Weights of Portfolio:

0050.TW	0.00%
3008.TW	15.51%
2330.TW	16.15%
1216.TW	26.53%
1301.TW	0.00%
2002.TW	0.00%
MSFT	0.00%
AAPL	41.80%

Technical Indicator:

Average Return :	0.316
Average Standard Deviation :	0.154
Sharpe Ratio :	1.734
Sotino Ratio :	2.333
Maximum Drop Down :	0.079

Period
From 2014-12-31 to 2015-12-31, 365 days.

Weights of Portfolio:

0050.TW	0.00%
3008.TW	21.56%
2330.TW	26.26%
1216.TW	8.72%
1301.TW	0.00%
2002.TW	0.00%
MSFT	0.00%
AAPL	43.46%

Technical Indicator:

Average Return :	-0.000
Average Standard Deviation :	0.210
Sharpe Ratio :	-0.239
Sotino Ratio :	-0.327
Maximum Drop Down :	0.188

Period
From 2015-12-31 to 2016-12-31, 366 days.

```
-----------------------------------------------------------
        Weights of Portfolio:
-----------------------------------------------------------
0050.TW                      0.00%
3008.TW                     19.17%
2330.TW                     22.44%
1216.TW                     16.73%
1301.TW                      0.00%
2002.TW                      0.00%
MSFT                       1.99%
AAPL                      39.67%
-----------------------------------------------------------


        Technical Indicator:
-----------------------------------------------------------
Average Return :                                  0.223
Average Standard Deviation :                      0.171
Sharpe Ratio :                                    1.009
Sotino Ratio :                                    1.429
Maximum Drop Down :                               0.101
-----------------------------------------------------------
            Period
From 2016-12-31  to 2017-12-31, 365 days.
-----------------------------------------------------------
        Weights of Portfolio:
-----------------------------------------------------------
0050.TW                      0.00%
3008.TW                     22.10%
2330.TW                     30.39%
1216.TW                      7.33%
1301.TW                      0.00%
2002.TW                      0.00%
MSFT                       4.51%
AAPL                      35.67%
-----------------------------------------------------------


        Technical Indicator:
-----------------------------------------------------------
Average Return :                                  0.290
Average Standard Deviation :                      0.132
Sharpe Ratio :                                    1.817
Sotino Ratio :                                    2.581
Maximum Drop Down :                               0.120
-----------------------------------------------------------
            Period
From 2017-12-31  to 2018-12-31, 365 days.
-----------------------------------------------------------
        Weights of Portfolio:
-----------------------------------------------------------
0050.TW                      0.00%
3008.TW                     13.72%
2330.TW                     29.80%
1216.TW                     11.02%
1301.TW                      0.00%
2002.TW                      0.00%
MSFT                      11.47%
AAPL                      33.99%
-----------------------------------------------------------


        Technical Indicator:
-----------------------------------------------------------
Average Return :                                 -0.011
Average Standard Deviation :                      0.215
Sharpe Ratio :                                   -0.285
Sotino Ratio :                                   -0.386
Maximum Drop Down :                               0.246
-----------------------------------------------------------
            Period
From 2018-12-31  to 2019-12-31, 365 days.
-----------------------------------------------------------
        Weights of Portfolio:
-----------------------------------------------------------
0050.TW                      0.00%
3008.TW                      9.74%
2330.TW                     28.51%
1216.TW                     15.62%
1301.TW                      0.00%
2002.TW                      0.00%
MSFT                      18.28%
AAPL                      27.86%
-----------------------------------------------------------


        Technical Indicator:
-----------------------------------------------------------
Average Return :                                  0.484
Average Standard Deviation :                      0.151
Sharpe Ratio :                                    2.878
Sotino Ratio :                                    3.912
Maximum Drop Down :                               0.100
-----------------------------------------------------------
            Period
From 2019-12-31  to 2019-12-31, 0 days.
-----------------------------------------------------------
        Weights of Portfolio:
-----------------------------------------------------------
0050.TW                      0.00%
3008.TW                      8.29%
2330.TW                     31.02%
1216.TW                      9.49%
1301.TW                      0.00%
2002.TW                      0.00%
MSFT                      20.57%
AAPL                      30.62%
-----------------------------------------------------------


        Technical Indicator:
-----------------------------------------------------------
Average Return :                                 -0.206
Average Standard Deviation :                        nan
Sharpe Ratio :                                      nan
Sotino Ratio :                                     -inf
Maximum Drop Down :                               0.000
-----------------------------------------------------------

D:\ipython\TMBA\PortfolioOptimizer.py:198: RuntimeWarning: divide by zero encountered in double_scalars
  252 / (DownRisk * np.sqrt(252))
```

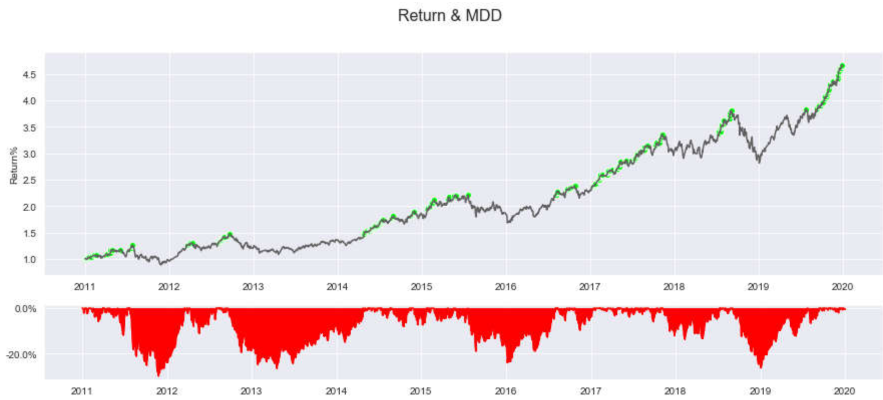
Out[30]:
```
2010-12-31    0.000283
2011-01-03    0.006083
2011-01-04    0.002903
2011-01-05   -0.005094
2011-01-06   -0.001285
                ...
2019-12-24   -0.002109
2019-12-26    0.009212
2019-12-27    0.005555
2019-12-30   -0.003488
2019-12-31   -0.000999
Length: 2134, dtype: float64
```

In [31]:
```
port.Backtest_Summary()
```

```
                Period
From 2010-12-31  to 2019-12-31, 3287 days.
------------------------------------------------------------
          Latest Weights of Portfolio:
------------------------------------------------------------
0050.TW                          0.00%
3008.TW                          8.29%
2330.TW                         31.02%
1216.TW                          9.49%
1301.TW                          0.00%
2002.TW                          0.00%
MSFT                            20.57%
AAPL                            30.62%
------------------------------------------------------------


             Technical Indicator:
------------------------------------------------------------
Average Return :                           0.182
Average Standard Deviation :               0.191
Sharpe Ratio :                             0.690
Sotino Ratio :                             0.951
Maximum Drop Down :                        0.297
------------------------------------------------------------
```

In [32]:
```
port.Return_Plot(backtest=True)
```



Neutral

In [33]:
```
port.set_optimize()
port.Rolling_test(hedge=True)
```

Out[33]:
```
2010-12-31   -0.007353
2011-01-03    0.002531
2011-01-04    0.003884
2011-01-05    0.005590
2011-01-06   -0.010450
                ...
2019-12-24   -0.004186
2019-12-26   -0.004218
2019-12-27    0.002078
2019-12-30   -0.007562
2019-12-31    0.000268
Length: 2134, dtype: float64
```

In [34]:
```
port.Backtest_Summary()
```

```
                Period
From 2010-12-31  to 2019-12-31, 3287 days.
------------------------------------------------------------
          Latest Weights of Portfolio:
------------------------------------------------------------
0050.TW                         32.56%
3008.TW                          2.72%
2330.TW                         21.33%
1216.TW                          0.00%
1301.TW                        -22.39%
2002.TW                        -77.61%
MSFT                            20.89%
AAPL                            22.49%
------------------------------------------------------------


             Technical Indicator:
------------------------------------------------------------
Average Return :                           0.057
Average Standard Deviation :               0.163
Sharpe Ratio :                             0.041
Sotino Ratio :                             0.058
Maximum Drop Down :                        0.332
------------------------------------------------------------
```

In [35]:
```
port.Return_Plot(backtest=True)
```

Return & MDD

累積資料

In [36]:
```
port.set_optimize()
port.Rolling_test(hedge=True, cul_info=True)
port.Backtest_Summary()
```

```
             Period
From 2010-12-31  to 2019-12-31, 3287 days.
------------------------------------------------------------
        Latest Weights of Portfolio:
------------------------------------------------------------
0050.TW                   -62.12%
3008.TW                    13.07%
2330.TW                    47.11%
1216.TW                    12.60%
1301.TW                     0.00%
2002.TW                   -37.88%
MSFT                        7.04%
AAPL                       20.19%
------------------------------------------------------------


          Technical Indicator:
------------------------------------------------------------
Average Return :                             0.096
Average Standard Deviation :                 0.122
Sharpe Ratio :                               0.377
Sotino Ratio :                               0.529
Maximum Drop Down :                          0.146
------------------------------------------------------------
```

In [37]:
```
port.Return_Plot(backtest=True)
```

Return & MDD

改變換倉頻率

3個月

In [38]:

```
port.set_optimize()
port.Rolling_test(show=True, freq='3m')
```

```
        Period
From 2010-01-31  to 2010-04-30, 89 days.
-----------------------------------------------------------
        Weights of Portfolio:
-----------------------------------------------------------
0050.TW                    0.00%
3008.TW                  100.00%
2330.TW                    0.00%
1216.TW                    0.00%
1301.TW                    0.00%
2002.TW                    0.00%
MSFT                      0.00%
AAPL                      0.00%
-----------------------------------------------------------


        Technical Indicator:
-----------------------------------------------------------
Average Return :                               0.993
Average Standard Deviation :                   0.287
Sharpe Ratio :                                 3.286
Sotino Ratio :                                 4.863
Maximum Drop Down :                            0.060
-----------------------------------------------------------
        Period
From 2010-04-30  to 2010-07-31, 92 days.
-----------------------------------------------------------
        Weights of Portfolio:
-----------------------------------------------------------
0050.TW                    0.00%
3008.TW                   29.72%
2330.TW                    0.00%
1216.TW                    0.00%
1301.TW                    5.83%
2002.TW                    0.00%
MSFT                     14.91%
AAPL                     49.55%
-----------------------------------------------------------


        Technical Indicator:
-----------------------------------------------------------
Average Return :                               0.012
Average Standard Deviation :                   0.256
Sharpe Ratio :                                -0.150
Sotino Ratio :                                -0.223
Maximum Drop Down :                            0.100
-----------------------------------------------------------
        Period
From 2010-07-31  to 2010-10-31, 92 days.
-----------------------------------------------------------
        Weights of Portfolio:
-----------------------------------------------------------
0050.TW                    0.00%
3008.TW                   39.26%
2330.TW                    0.00%
1216.TW                   60.75%
1301.TW                    0.00%
2002.TW                    0.00%
MSFT                      0.00%
AAPL                      0.00%
-----------------------------------------------------------


        Technical Indicator:
-----------------------------------------------------------
Average Return :                               0.421
Average Standard Deviation :                   0.247
Sharpe Ratio :                                 1.503
Sotino Ratio :                                 2.343
Maximum Drop Down :                            0.064
-----------------------------------------------------------
        Period
From 2010-10-31  to 2011-01-31, 92 days.
-----------------------------------------------------------
        Weights of Portfolio:
-----------------------------------------------------------
0050.TW                    0.00%
3008.TW                    0.00%
2330.TW                    0.00%
1216.TW                   14.46%
1301.TW                   56.00%
2002.TW                    0.00%
MSFT                      0.00%
AAPL                     29.55%
-----------------------------------------------------------


        Technical Indicator:
-----------------------------------------------------------
Average Return :                               0.414
Average Standard Deviation :                   0.143
Sharpe Ratio :                                 2.543
Sotino Ratio :                                 3.373
Maximum Drop Down :                            0.054
-----------------------------------------------------------
        Period
From 2011-01-31  to 2011-04-30, 89 days.
-----------------------------------------------------------
        Weights of Portfolio:
-----------------------------------------------------------
0050.TW                   16.04%
3008.TW                   10.84%
2330.TW                   27.10%
1216.TW                    0.00%
1301.TW                    8.21%
2002.TW                   22.10%
MSFT                      0.00%
AAPL                     15.71%
-----------------------------------------------------------


        Technical Indicator:
-----------------------------------------------------------
Average Return :                               0.143
Average Standard Deviation :                   0.149
Sharpe Ratio :                                 0.626
Sotino Ratio :                                 0.884
Maximum Drop Down :                            0.060
-----------------------------------------------------------
        Period
From 2011-04-30  to 2011-07-31, 92 days.
```

Weights of Portfolio:

0050.TW	0.00%
3008.TW	27.40%
2330.TW	0.00%
1216.TW	0.00%
1301.TW	60.95%
2002.TW	4.50%
MSFT	0.00%
AAPL	7.15%

Technical Indicator:

Average Return :	0.073
Average Standard Deviation :	0.230
Sharpe Ratio :	0.102
Sotino Ratio :	0.153
Maximum Drop Down :	0.134

Period

From 2011-07-31 to 2011-10-31, 92 days.

Weights of Portfolio:

0050.TW	0.00%
3008.TW	6.15%
2330.TW	0.00%
1216.TW	49.02%
1301.TW	0.00%
2002.TW	0.00%
MSFT	18.11%
AAPL	26.72%

Technical Indicator:

Average Return :	-0.108
Average Standard Deviation :	0.309
Sharpe Ratio :	-0.511
Sotino Ratio :	-0.749
Maximum Drop Down :	0.124

Period

From 2011-10-31 to 2012-01-31, 92 days.

Weights of Portfolio:

0050.TW	0.00%
3008.TW	0.00%
2330.TW	30.52%
1216.TW	0.00%
1301.TW	0.00%
2002.TW	0.00%
MSFT	0.00%
AAPL	69.48%

Technical Indicator:

Average Return :	0.472
Average Standard Deviation :	0.212
Sharpe Ratio :	1.992
Sotino Ratio :	3.147
Maximum Drop Down :	0.085

Period

From 2012-01-31 to 2012-04-30, 90 days.

Weights of Portfolio:

0050.TW	0.00%
3008.TW	0.00%
2330.TW	16.66%
1216.TW	0.00%
1301.TW	0.00%
2002.TW	0.00%
MSFT	20.07%
AAPL	63.27%

Technical Indicator:

Average Return :	0.815
Average Standard Deviation :	0.225
Sharpe Ratio :	3.407
Sotino Ratio :	5.466
Maximum Drop Down :	0.072

Period

From 2012-04-30 to 2012-07-31, 92 days.

Weights of Portfolio:

0050.TW	0.00%
3008.TW	0.00%
2330.TW	34.51%
1216.TW	0.00%
1301.TW	0.00%
2002.TW	0.00%
MSFT	33.50%
AAPL	32.00%

Technical Indicator:

Average Return :	-0.115
Average Standard Deviation :	0.202
Sharpe Ratio :	-0.816
Sotino Ratio :	-1.123
Maximum Drop Down :	0.091

Period

From 2012-07-31 to 2012-10-31, 92 days.

Weights of Portfolio:

0050.TW	0.00%
3008.TW	39.25%
2330.TW	0.00%
1216.TW	60.75%
1301.TW	0.00%
2002.TW	0.00%
MSFT	0.00%
AAPL	0.00%

Technical Indicator:

Average Return :	0.359
Average Standard Deviation :	0.169
Sharpe Ratio :	1.828
Sotino Ratio :	2.645
Maximum Drop Down :	0.037

Period

From 2012-10-31 to 2013-01-31, 92 days.

Weights of Portfolio:

0050.TW	0.00%
3008.TW	0.05%
2330.TW	57.28%
1216.TW	42.67%
1301.TW	0.00%
2002.TW	0.00%
MSFT	0.00%
AAPL	0.00%

Technical Indicator:

Average Return :	0.399
Average Standard Deviation :	0.149
Sharpe Ratio :	2.342
Sotino Ratio :	3.431
Maximum Drop Down :	0.040

Period

From 2013-01-31 to 2013-04-30, 89 days.

Weights of Portfolio:

0050.TW	0.00%
3008.TW	12.79%
2330.TW	62.04%
1216.TW	0.00%
1301.TW	0.00%
2002.TW	25.17%
MSFT	0.00%
AAPL	0.00%

Technical Indicator:

Average Return :	0.174
Average Standard Deviation :	0.181
Sharpe Ratio :	0.684
Sotino Ratio :	1.032
Maximum Drop Down :	0.093

Period

From 2013-04-30 to 2013-07-31, 92 days.

Weights of Portfolio:

0050.TW	0.00%
3008.TW	0.00%
2330.TW	0.00%
1216.TW	38.57%
1301.TW	0.00%
2002.TW	0.00%
MSFT	61.43%
AAPL	0.00%

Technical Indicator:

Average Return :	0.041
Average Standard Deviation :	0.218
Sharpe Ratio :	-0.040
Sotino Ratio :	-0.048
Maximum Drop Down :	0.100

Period

From 2013-07-31 to 2013-10-31, 92 days.

Weights of Portfolio:

0050.TW	0.00%
3008.TW	25.67%
2330.TW	0.00%
1216.TW	13.94%
1301.TW	36.21%
2002.TW	0.00%
MSFT	0.00%
AAPL	24.18%

Technical Indicator:

Average Return :	0.140
Average Standard Deviation :	0.181
Sharpe Ratio :	0.494
Sotino Ratio :	0.654
Maximum Drop Down :	0.044

Period

From 2013-10-31 to 2014-01-31, 92 days.

Weights of Portfolio:

0050.TW	17.78%
3008.TW	0.00%
2330.TW	12.91%

1216.TW	0.00%
1301.TW	0.00%
2002.TW	0.00%
MSFT	30.84%
AAPL	38.47%

Technical Indicator:

Average Return :	0.086
Average Standard Deviation :	0.122
Sharpe Ratio :	0.296
Sotino Ratio :	0.446
Maximum Drop Down :	0.053

Period

From 2014-01-31 to 2014-04-30, 89 days.

Weights of Portfolio:

0050.TW	0.00%
3008.TW	48.38%
2330.TW	0.00%
1216.TW	0.00%
1301.TW	0.00%
2002.TW	0.00%
MSFT	4.44%
AAPL	47.18%

Technical Indicator:

Average Return :	1.210
Average Standard Deviation :	0.270
Sharpe Ratio :	4.299
Sotino Ratio :	6.574
Maximum Drop Down :	0.037

Period

From 2014-04-30 to 2014-07-31, 92 days.

Weights of Portfolio:

0050.TW	0.00%
3008.TW	36.38%
2330.TW	29.89%
1216.TW	0.00%
1301.TW	0.00%
2002.TW	0.00%
MSFT	33.73%
AAPL	0.00%

Technical Indicator:

Average Return :	0.393
Average Standard Deviation :	0.174
Sharpe Ratio :	1.973
Sotino Ratio :	2.624
Maximum Drop Down :	0.076

Period

From 2014-07-31 to 2014-10-31, 92 days.

Weights of Portfolio:

0050.TW	29.43%
3008.TW	3.90%
2330.TW	0.00%
1216.TW	20.28%
1301.TW	0.00%
2002.TW	4.61%
MSFT	25.53%
AAPL	16.26%

Technical Indicator:

Average Return :	0.103
Average Standard Deviation :	0.148
Sharpe Ratio :	0.361
Sotino Ratio :	0.486
Maximum Drop Down :	0.074

Period

From 2014-10-31 to 2015-01-31, 92 days.

Weights of Portfolio:

0050.TW	0.00%
3008.TW	0.00%
2330.TW	6.15%
1216.TW	0.00%
1301.TW	0.00%
2002.TW	31.13%
MSFT	22.88%
AAPL	39.85%

Technical Indicator:

Average Return :	0.094
Average Standard Deviation :	0.168
Sharpe Ratio :	0.264
Sotino Ratio :	0.360
Maximum Drop Down :	0.061

Period

From 2015-01-31 to 2015-04-30, 89 days.

Weights of Portfolio:

0050.TW	0.00%
3008.TW	48.96%
2330.TW	1.50%
1216.TW	0.00%
1301.TW	28.28%
2002.TW	0.00%

```
MSFT                    0.00%
AAPL                   21.26%
------------------------------------------------------------


          Technical Indicator:
------------------------------------------------------------
Average Return :                                  0.457
Average Standard Deviation :                      0.198
Sharpe Ratio :                                    2.052
Sotino Ratio :                                    2.878
Maximum Drop Down :                               0.053
------------------------------------------------------------
               Period
From 2015-04-30  to 2015-07-31, 92 days.
------------------------------------------------------------
          Weights of Portfolio:
------------------------------------------------------------
0050.TW                  14.31%
3008.TW                  30.53%
2330.TW                   0.00%
1216.TW                   0.00%
1301.TW                   0.00%
2002.TW                   0.00%
MSFT                     55.15%
AAPL                      0.00%
------------------------------------------------------------


          Technical Indicator:
------------------------------------------------------------
Average Return :                                 -0.109
Average Standard Deviation :                      0.190
Sharpe Ratio :                                   -0.834
Sotino Ratio :                                   -1.127
Maximum Drop Down :                               0.074
------------------------------------------------------------
               Period
From 2015-07-31  to 2015-10-31, 92 days.
------------------------------------------------------------
          Weights of Portfolio:
------------------------------------------------------------
0050.TW                   0.00%
3008.TW                   0.76%
2330.TW                   0.00%
1216.TW                  99.24%
1301.TW                   0.00%
2002.TW                   0.00%
MSFT                      0.00%
AAPL                      0.00%
------------------------------------------------------------


          Technical Indicator:
------------------------------------------------------------
Average Return :                                  0.209
Average Standard Deviation :                      0.277
Sharpe Ratio :                                    0.572
Sotino Ratio :                                    0.818
Maximum Drop Down :                               0.080
------------------------------------------------------------
               Period
From 2015-10-31  to 2016-01-31, 92 days.
------------------------------------------------------------
          Weights of Portfolio:
------------------------------------------------------------
0050.TW                   0.00%
3008.TW                   0.00%
2330.TW                   0.00%
1216.TW                   0.00%
1301.TW                  39.57%
2002.TW                   0.00%
MSFT                     60.43%
AAPL                      0.00%
------------------------------------------------------------


          Technical Indicator:
------------------------------------------------------------
Average Return :                                  0.163
Average Standard Deviation :                      0.194
Sharpe Ratio :                                    0.579
Sotino Ratio :                                    0.834
Maximum Drop Down :                               0.071
------------------------------------------------------------
               Period
From 2016-01-31  to 2016-04-30, 90 days.
------------------------------------------------------------
          Weights of Portfolio:
------------------------------------------------------------
0050.TW                   0.00%
3008.TW                   0.00%
2330.TW                  48.19%
1216.TW                   0.00%
1301.TW                   0.00%
2002.TW                   0.00%
MSFT                     51.81%
AAPL                      0.00%
------------------------------------------------------------


          Technical Indicator:
------------------------------------------------------------
Average Return :                                 -0.118
Average Standard Deviation :                      0.185
Sharpe Ratio :                                   -0.911
Sotino Ratio :                                   -1.188
Maximum Drop Down :                               0.086
------------------------------------------------------------
               Period
From 2016-04-30  to 2016-07-31, 92 days.
------------------------------------------------------------
          Weights of Portfolio:
------------------------------------------------------------
0050.TW                   0.00%
3008.TW                   0.00%
2330.TW                   0.00%
1216.TW                   0.00%
1301.TW                   0.00%
2002.TW                 100.00%
MSFT                      0.00%
AAPL                      0.00%
------------------------------------------------------------
```

Technical Indicator:

Average Return :	-0.020
Average Standard Deviation :	0.274
Sharpe Ratio :	-0.256
Sotino Ratio :	-0.353
Maximum Drop Down :	0.125

Period
From 2016-07-31 to 2016-10-31, 92 days.

Weights of Portfolio:

0050.TW	0.00%
3008.TW	27.18%
2330.TW	36.10%
1216.TW	3.32%
1301.TW	0.00%
2002.TW	0.00%
MSFT	26.03%
AAPL	7.37%

Technical Indicator:

Average Return :	0.334
Average Standard Deviation :	0.158
Sharpe Ratio :	1.805
Sotino Ratio :	2.702
Maximum Drop Down :	0.052

Period
From 2016-10-31 to 2017-01-31, 92 days.

Weights of Portfolio:

0050.TW	0.00%
3008.TW	7.84%
2330.TW	0.00%
1216.TW	0.00%
1301.TW	38.91%
2002.TW	0.00%
MSFT	26.07%
AAPL	27.18%

Technical Indicator:

Average Return :	0.292
Average Standard Deviation :	0.105
Sharpe Ratio :	2.316
Sotino Ratio :	3.187
Maximum Drop Down :	0.037

Period
From 2017-01-31 to 2017-04-30, 89 days.

Weights of Portfolio:

0050.TW	0.00%
3008.TW	13.49%
2330.TW	0.00%
1216.TW	0.00%
1301.TW	0.29%
2002.TW	37.63%
MSFT	26.49%
AAPL	22.10%

Technical Indicator:

Average Return :	0.277
Average Standard Deviation :	0.102
Sharpe Ratio :	2.236
Sotino Ratio :	3.216
Maximum Drop Down :	0.036

Period
From 2017-04-30 to 2017-07-31, 92 days.

Weights of Portfolio:

0050.TW	32.78%
3008.TW	2.06%
2330.TW	0.00%
1216.TW	0.00%
1301.TW	0.00%
2002.TW	0.00%
MSFT	37.62%
AAPL	27.53%

Technical Indicator:

Average Return :	0.268
Average Standard Deviation :	0.114
Sharpe Ratio :	1.911
Sotino Ratio :	2.474
Maximum Drop Down :	0.038

Period
From 2017-07-31 to 2017-10-31, 92 days.

Weights of Portfolio:

0050.TW	29.77%
3008.TW	0.40%
2330.TW	29.03%
1216.TW	0.00%
1301.TW	0.00%
2002.TW	22.47%
MSFT	18.32%
AAPL	0.00%

Technical Indicator:

Average Return :	0.295
Average Standard Deviation :	0.090
Sharpe Ratio :	2.714
Sotino Ratio :	4.279
Maximum Drop Down :	0.030

Period
From 2017-10-31 to 2018-01-31, 92 days.

Weights of Portfolio:

0050.TW	0.00%
3008.TW	0.00%
2330.TW	37.52%
1216.TW	24.67%
1301.TW	0.00%
2002.TW	0.00%
MSFT	27.69%
AAPL	10.11%

Technical Indicator:

Average Return :	0.320
Average Standard Deviation :	0.112
Sharpe Ratio :	2.418
Sotino Ratio :	3.317
Maximum Drop Down :	0.031

Period
From 2018-01-31 to 2018-04-30, 89 days.

Weights of Portfolio:

0050.TW	0.00%
3008.TW	0.00%
2330.TW	0.00%
1216.TW	28.72%
1301.TW	36.36%
2002.TW	0.00%
MSFT	34.92%
AAPL	0.00%

Technical Indicator:

Average Return :	0.089
Average Standard Deviation :	0.193
Sharpe Ratio :	0.204
Sotino Ratio :	0.306
Maximum Drop Down :	0.064

Period
From 2018-04-30 to 2018-07-31, 92 days.

Weights of Portfolio:

0050.TW	0.00%
3008.TW	0.00%
2330.TW	0.00%
1216.TW	96.92%
1301.TW	0.00%
2002.TW	0.00%
MSFT	3.08%
AAPL	0.00%

Technical Indicator:

Average Return :	0.553
Average Standard Deviation :	0.209
Sharpe Ratio :	2.402
Sotino Ratio :	3.427
Maximum Drop Down :	0.044

Period
From 2018-07-31 to 2018-10-31, 92 days.

Weights of Portfolio:

0050.TW	0.00%
3008.TW	14.60%
2330.TW	4.32%
1216.TW	17.39%
1301.TW	6.82%
2002.TW	17.13%
MSFT	24.30%
AAPL	15.45%

Technical Indicator:

Average Return :	-0.183
Average Standard Deviation :	0.213
Sharpe Ratio :	-1.096
Sotino Ratio :	-1.397
Maximum Drop Down :	0.110

Period
From 2018-10-31 to 2019-01-31, 92 days.

Weights of Portfolio:

0050.TW	0.00%
3008.TW	0.00%
2330.TW	0.00%
1216.TW	0.00%
1301.TW	0.00%
2002.TW	0.00%
MSFT	0.00%
AAPL	100.00%

Technical Indicator:

Average Return :	-1.057
Average Standard Deviation :	0.476

```
Sharpe Ratio :                          -2.329
Sotino Ratio :                          -3.177
Maximum Drop Down :                     0.358
----------------------------------------------------------
          Period
From 2019-01-31  to 2019-04-30, 89 days.
----------------------------------------------------------
       Weights of Portfolio:
----------------------------------------------------------
0050.TW              0.00%
3008.TW              11.56%
2330.TW              0.00%
1216.TW              0.00%
1301.TW              0.00%
2002.TW              86.33%
MSFT                 2.10%
AAPL                 0.00%
----------------------------------------------------------


        Technical Indicator:
----------------------------------------------------------
Average Return :                        0.055
Average Standard Deviation :            0.095
Sharpe Ratio :                          0.058
Sotino Ratio :                          0.084
Maximum Drop Down :                     0.024
----------------------------------------------------------
          Period
From 2019-04-30  to 2019-07-31, 92 days.
----------------------------------------------------------
       Weights of Portfolio:
----------------------------------------------------------
0050.TW              18.22%
3008.TW              5.17%
2330.TW              0.00%
1216.TW              0.00%
1301.TW              21.99%
2002.TW              0.00%
MSFT                 37.47%
AAPL                 17.15%
----------------------------------------------------------


        Technical Indicator:
----------------------------------------------------------
Average Return :                        0.046
Average Standard Deviation :            0.144
Sharpe Ratio :                          -0.029
Sotino Ratio :                          -0.040
Maximum Drop Down :                     0.083
----------------------------------------------------------
          Period
From 2019-07-31  to 2019-10-31, 92 days.
----------------------------------------------------------
       Weights of Portfolio:
----------------------------------------------------------
0050.TW              0.00%
3008.TW              0.00%
2330.TW              8.32%
1216.TW              68.08%
1301.TW              0.00%
2002.TW              0.00%
MSFT                 18.03%
AAPL                 5.57%
----------------------------------------------------------


        Technical Indicator:
----------------------------------------------------------
Average Return :                        0.024
Average Standard Deviation :            0.127
Sharpe Ratio :                          -0.202
Sotino Ratio :                          -0.312
Maximum Drop Down :                     0.047
----------------------------------------------------------
          Period
From 2019-10-31  to 2019-12-31, 61 days.
----------------------------------------------------------
       Weights of Portfolio:
----------------------------------------------------------
0050.TW              0.00%
3008.TW              0.11%
2330.TW              67.81%
1216.TW              0.00%
1301.TW              0.00%
2002.TW              0.00%
MSFT                 0.00%
AAPL                 32.08%
----------------------------------------------------------


        Technical Indicator:
----------------------------------------------------------
Average Return :                        0.806
Average Standard Deviation :            0.158
Sharpe Ratio :                          4.769
Sotino Ratio :                          7.259
Maximum Drop Down :                     0.028
----------------------------------------------------------
```

Out[38]:

```
2010-02-01   -0.023045
2010-02-02    0.013407
2010-02-03    0.030992
2010-02-04    0.009346
2010-02-05   -0.040338
                ...
2019-12-24   -0.003768
2019-12-26    0.008358
2019-12-27    0.009996
2019-12-30   -0.005166
2019-12-31   -0.004789
Length: 2357, dtype: float64
```

In [39]:
```
port.Backtest_Summary()
```

```
             Period
From 2010-02-01  to 2019-12-31, 3620 days.
-----------------------------------------------------------
       Latest Weights of Portfolio:
-----------------------------------------------------------
0050.TW                          0.00%
3008.TW                          0.11%
2330.TW                         67.81%
1216.TW                          0.00%
1301.TW                          0.00%
2002.TW                          0.00%
MSFT                           0.00%
AAPL                          32.08%
-----------------------------------------------------------


          Technical Indicator:
-----------------------------------------------------------
Average Return :                              0.212
Average Standard Deviation :                  0.205
Sharpe Ratio :                                0.792
Sotino Ratio :                                1.106
Maximum Drop Down :                           0.405
-----------------------------------------------------------
```

In [40]:
```
port.Return_Plot(backtest=True)
```

3個月加上累積資料

In [41]:
```
port.set_optimize()
port.Rolling_test(freq='3m', cul_info=True)
port.Backtest_Summary()
```

```
             Period
From 2010-02-01  to 2019-12-31, 3620 days.
-----------------------------------------------------------
       Latest Weights of Portfolio:
-----------------------------------------------------------
0050.TW                          0.00%
3008.TW                          8.50%
2330.TW                         29.81%
1216.TW                         12.22%
1301.TW                          0.00%
2002.TW                          0.00%
MSFT                          20.51%
AAPL                          28.97%
-----------------------------------------------------------


          Technical Indicator:
-----------------------------------------------------------
Average Return :                              0.212
Average Standard Deviation :                  0.202
Sharpe Ratio :                                0.803
Sotino Ratio :                                1.115
Maximum Drop Down :                           0.271
-----------------------------------------------------------
```

In [42]:
```
port.Return_Plot(backtest=True)
```

半年

In [43]:
```
port.set_optimize()
port.Rolling_test(freq='6m')
port.Backtest_Summary()
```

```
              Period
From 2010-02-01  to 2019-12-31, 3620 days.
------------------------------------------------------------
       Latest Weights of Portfolio:
------------------------------------------------------------
0050.TW                    0.00%
3008.TW                    0.00%
2330.TW                   16.10%
1216.TW                   31.02%
1301.TW                    0.00%
2002.TW                    0.00%
MSFT                      35.84%
AAPL                      17.04%
------------------------------------------------------------


          Technical Indicator:
------------------------------------------------------------
Average Return :                        0.184
Average Standard Deviation :            0.203
Sharpe Ratio :                          0.661
Sotino Ratio :                          0.933
Maximum Drop Down :                     0.274
------------------------------------------------------------
```

In [44]:
```
port.Return_Plot(backtest=True)
```

半年加上累積資訊

In [45]:
```
port.set_optimize()
port.Rolling_test(freq='6m', cul_info=True)
port.Backtest_Summary()
```

```
              Period
From 2010-02-01  to 2019-12-31, 3620 days.
------------------------------------------------------------
       Latest Weights of Portfolio:
------------------------------------------------------------
0050.TW                    0.00%
3008.TW                    9.10%
2330.TW                   25.51%
1216.TW                   16.12%
1301.TW                    0.00%
2002.TW                    0.00%
MSFT                      22.48%
AAPL                      26.78%
------------------------------------------------------------


          Technical Indicator:
------------------------------------------------------------
Average Return :                        0.222
Average Standard Deviation :            0.212
Sharpe Ratio :                          0.813
Sotino Ratio :                          1.136
Maximum Drop Down :                     0.296
------------------------------------------------------------
```

In [46]:
```
port.Return_Plot(backtest=True)
```

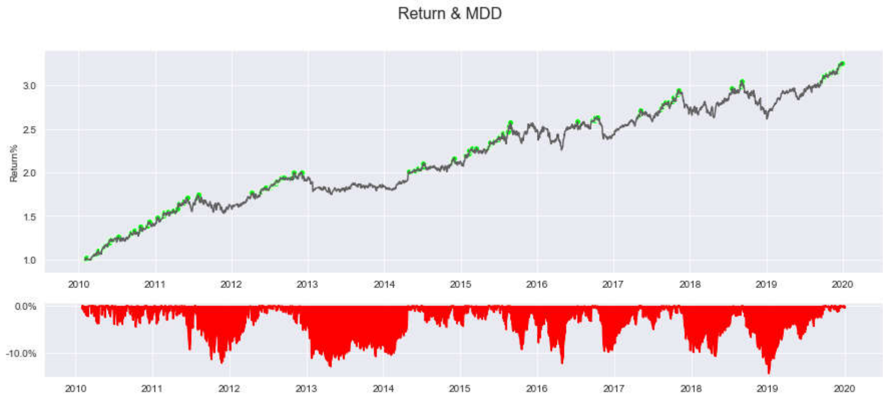
Hedge加上累積資料

In [47]:
```
port.set_optimize()
port.Rolling_test(freq='6m', cul_info=True, hedge=True)
port.Backtest_Summary()
```

```
            Period
From 2010-02-01  to 2019-12-31, 3620 days.
-----------------------------------------------------------
        Latest Weights of Portfolio:
-----------------------------------------------------------
0050.TW                    -69.89%
3008.TW                     13.55%
2330.TW                     43.46%
1216.TW                     18.19%
1301.TW                      0.34%
2002.TW                    -30.11%
MSFT                       8.38%
AAPL                      16.09%
-----------------------------------------------------------


           Technical Indicator:
-----------------------------------------------------------
Average Return :                            0.126
Average Standard Deviation :                0.126
Sharpe Ratio :                              0.604
Sotino Ratio :                              0.847
Maximum Drop Down :                         0.143
-----------------------------------------------------------
```

In [48]:
```
port.Return_Plot(backtest=True)
```



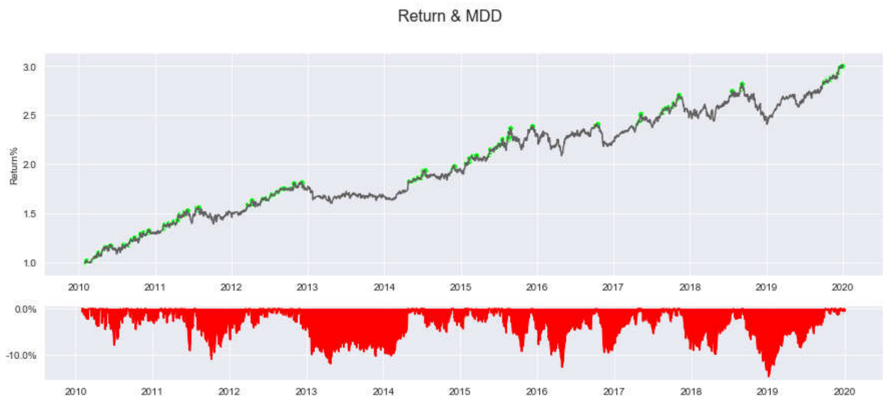
3個月Hedge加上累積資料

In [49]:
```
port.set_optimize()
port.Rolling_test(freq='3m', cul_info=True, hedge=True)
port.Backtest_Summary()
```

```
            Period
From 2010-02-01  to 2019-12-31, 3620 days.
-----------------------------------------------------------
        Latest Weights of Portfolio:
-----------------------------------------------------------
0050.TW                    -64.51%
3008.TW                     12.99%
2330.TW                     46.30%
1216.TW                     15.26%
1301.TW                      0.00%
2002.TW                    -35.49%
MSFT                       6.95%
AAPL                      18.50%
-----------------------------------------------------------


           Technical Indicator:
-----------------------------------------------------------
Average Return :                            0.118
Average Standard Deviation :                0.126
Sharpe Ratio :                              0.535
Sotino Ratio :                              0.756
Maximum Drop Down :                         0.147
-----------------------------------------------------------
```

In [50]:
```
port.Return_Plot(backtest=True)
```



如果權重全開 (正反各自總和超過1)

In [53]:
```
port.set_optimize()
port.Rolling_test(freq='3m', cul_info=True, hedge=True, hedge_con=False)
port.Backtest_Summary()
```

```
            Period
From 2010-02-01  to 2019-12-31, 3620 days.
------------------------------------------------------------
       Latest Weights of Portfolio:
------------------------------------------------------------
0050.TW                    -100.00%
3008.TW                      22.68%
2330.TW                      86.15%
1216.TW                      33.85%
1301.TW                       6.60%
2002.TW                    -100.00%
MSFT                         16.48%
AAPL                         34.24%
------------------------------------------------------------


          Technical Indicator:
------------------------------------------------------------
Average Return :                          0.266
Average Standard Deviation :              0.261
Sharpe Ratio :                            0.828
Sotino Ratio :                            1.163
Maximum Drop Down :                       0.293
------------------------------------------------------------
```

In [54]:
```
port.Return_Plot(backtest=True)
```

發現與心得

1. 真實使用上，Markowitz模型需要比較長的資料來做基礎，所以累積資料的穩健度跟獲利性基本上屌打滾動資料
2. 從半年與三個月的Hedge來看，其實到後來做多與放空的比例都差不多，所以時間一長的話，模型權重趨於固定，因此對於市場突然的大波動反應不夠
3. 即使三個月換一次的Hedge還是太長了，實務上運用會有很多的衍生成本

檢討與改進

個人認為未來還可以朝以下方向改進:

1. 此模型只有透過純粹的價格資料，可以引入交易量、財報等資料做更宏觀的判斷
2. 由於Markowitz模型本身的限制，權重變動劇烈，實作困難，如果有適合的主觀矩陣生成方法，未來也可以考慮使用Black-Litterman Model來做改進
3. 在前期的選擇Stock Pool也很重要，未來也可以朝著這個地方的改良下手