Siqi's Project

November 3, 2024

1 1&2

[1]:
```
import yfinance as yf
import pandas as pd
import numpy as np
import matplotlib.pyplot as plot
import plotly.graph_objects as go
import statsmodels.api as sm
```

[2]:
```
data = yf.download("^GSPC ^IXIC GLD ^VIX", start="2007-01-01",␣
 ↪end="2020-03-31")["Close"]
data.head()
```

```
[**********************100%***********************]  4 of 4 completed
```

[2]:

Ticker	GLD	^GSPC	^IXIC	^VIX
Date				
2007-01-03 00:00:00+00:00	62.279999	1416.599976	2423.159912	12.04
2007-01-04 00:00:00+00:00	61.650002	1418.339966	2453.429932	11.51
2007-01-05 00:00:00+00:00	60.169998	1409.709961	2434.250000	12.14
2007-01-08 00:00:00+00:00	60.480000	1412.839966	2438.199951	12.00
2007-01-09 00:00:00+00:00	60.849998	1412.109985	2443.830078	11.91

[3]:
```
GLD = data[['GLD']].rename(columns={'GLD': 'Close'})
GSPC = data[['^GSPC']].rename(columns={'^GSPC': 'Close'})
IXIC = data[['^IXIC']].rename(columns={'^IXIC': 'Close'})
bear_market_start = "2007-01-01"
bear_market_end = "2009-03-31"
bull_market_start = "2009-03-31"
bull_market_end = "2020-01-31"
covid_crisis_start = "2020-01-31"
covid_crisis_end = "2020-03-31"
stocks = {'GSPC': GSPC,
          'GLD': GLD,
          'IXIC': IXIC}
stocks_bear_market = {}
stocks_bull_market = {}
stocks_covid_market = {}
```

[4]:
```
def analyze_period(period_name, stock, start_date, end_date):
    df1 = stock[start_date: end_date]
    df1_returns = df1['Return']
    df1_cum_returns = df1['Cum Return']
    return df1
```

[5]:
```
for stock in stocks.keys():
    stocks[stock]['Return'] = stocks[stock]['Close'].pct_change()
    stocks[stock]['Cum Return'] = (1 + stocks[stock]['Return']).cumprod()
    stocks_bear_market[stock] = analyze_period('bear', stocks[stock],␣
 ↪bear_market_start, bear_market_end)
    stocks_bull_market[stock] = analyze_period('bull', stocks[stock],␣
 ↪bull_market_start, bull_market_end)
    stocks_covid_market[stock] = analyze_period('covid', stocks[stock],␣
 ↪covid_crisis_start, covid_crisis_end)
```

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[6]:
```
stock_cum_return = pd.DataFrame()
for stock in stocks.keys():
    stock_cum_return[stock] = stocks[stock]['Cum Return']
stock_cum_return
```

[6]:

Date	GSPC	GLD	IXIC
2007-01-03 00:00:00+00:00	NaN	NaN	NaN
2007-01-04 00:00:00+00:00	1.001228	0.989884	1.012492
2007-01-05 00:00:00+00:00	0.995136	0.966121	1.004577
2007-01-08 00:00:00+00:00	0.997346	0.971098	1.006207
2007-01-09 00:00:00+00:00	0.996830	0.977039	1.008530
…	…	…	…
2020-03-24 00:00:00+00:00	1.727608	2.463070	3.061234
2020-03-25 00:00:00+00:00	1.747536	2.429351	3.047384
2020-03-26 00:00:00+00:00	1.856607	2.460501	3.217922
2020-03-27 00:00:00+00:00	1.794063	2.444605	3.096114
2020-03-30 00:00:00+00:00	1.854193	2.455363	3.208269

[3333 rows x 3 columns]

[7]:
```
def plot_compare(dict1):
    for key in dict1.keys():
        dict1[key]['Cum Return'].plot(figsize = (15,6))
    plot.legend(dict1.keys())
```

[8]:
```
def plot_compare2(fig, dict1, period_name):
    for key in dict1.keys():
```

```
        fig.add_trace(go.Scatter(x=dict1[key].index, y=dict1[key]['Cum␣
↪Return'], mode='lines', name=key))
    fig.update_layout(
        title={'text':'Cumulative Performance of the ' + period_name},
        title_x=0.5,
        xaxis=dict(
            title='Date',
            ),
        yaxis=dict(
            title='Return',
            ticksuffix="%"
            ),
        paper_bgcolor='rgba(0,0,0,0)',
        plot_bgcolor='rgba(0,0,0,0)'
    )
    return fig
```

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[9]:
```
fig1 = plot_compare2(go.Figure(), stocks, 'Entire Period')
fig1.show()
```

[10]:
```
fig2 = plot_compare2(go.Figure(), stocks_bear_market, 'Bear Market')
fig2.show()
```

[11]:
```
fig3 = plot_compare2(go.Figure(), stocks_bull_market, 'Bull Market')
fig3.show()
```

[12]:
```
fig4 = plot_compare2(go.Figure(), stocks_covid_market, 'Covid Period')
fig4.show()
```

[13]:
```
stock_return = pd.DataFrame()
stock_return['GSPC'] = data['^GSPC'].pct_change()
stock_return['IXIC'] = data['^IXIC'].pct_change()
stock_return['GLD'] = data['GLD'].pct_change()
stock_return['VIX'] = data['^VIX'].pct_change()
stock_return
```

[13]:

Date	GSPC	IXIC	GLD	VIX
2007-01-03 00:00:00+00:00	NaN	NaN	NaN	NaN
2007-01-04 00:00:00+00:00	0.001228	0.012492	-0.010116	-0.044020
2007-01-05 00:00:00+00:00	-0.006085	-0.007818	-0.024007	0.054735
2007-01-08 00:00:00+00:00	0.002220	0.001623	0.005152	-0.011532
2007-01-09 00:00:00+00:00	-0.000517	0.002309	0.006118	-0.007500
…	…	…	…	…
2020-03-24 00:00:00+00:00	0.093828	0.081215	0.048530	0.001299

```
2020-03-25 00:00:00+00:00  0.011535 -0.004524 -0.013690  0.036971
2020-03-26 00:00:00+00:00  0.062414  0.055962  0.012822 -0.046130
2020-03-27 00:00:00+00:00 -0.033687 -0.037853 -0.006460  0.074426
2020-03-30 00:00:00+00:00  0.033516  0.036225  0.004401 -0.129081

[3333 rows x 4 columns]
```

[14]:
```
#5
def df_subset(df, start, point1, point2, end):
    df1 = df[start : point1]
    df2 = df[point1 : point2]
    df3 = df[point2 : end]
    return pd.DataFrame(df1), pd.DataFrame(df2), pd.DataFrame(df3)
```

[15]:
```
GSPC_bear, GSPC_bull, GSPC_covid = df_subset(stock_return['GSPC'],␣
 ↪"2007-01-01", "2009-03-31", "2020-01-31", "2020-03-31")
GLD_bear, GLD_bull, GLD_covid = df_subset(stock_return['GLD'], "2007-01-01",␣
 ↪"2009-03-31", "2020-01-31", "2020-03-31")
IXIC_bear, IXIC_bull, IXIC_covid = df_subset(stock_return['IXIC'],␣
 ↪"2007-01-01", "2009-03-31", "2020-01-31", "2020-03-31")
VIX_bear, VIX_bull, VIX_covid = df_subset(stock_return['VIX'], "2007-01-01",␣
 ↪"2009-03-31", "2020-01-31", "2020-03-31")
```

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4.1 Correlation

[16]:
```
bear_correlation = pd.concat([GSPC_bear, GLD_bear, IXIC_bear, VIX_bear], axis =␣
 ↪1).corr()
print(bear_correlation)
```

```
          GSPC       GLD      IXIC       VIX
GSPC  1.000000  0.026650  0.966570 -0.750564
GLD   0.026650  1.000000  0.001684 -0.069637
IXIC  0.966570  0.001684  1.000000 -0.736483
VIX  -0.750564 -0.069637 -0.736483  1.000000
```

[17]:
```
bull_correlation = pd.concat([GSPC_bull, GLD_bull, IXIC_bull, VIX_bull], axis =␣
 ↪1).corr()
print(bull_correlation)
```

```
          GSPC       GLD      IXIC       VIX
GSPC  1.000000  0.010457  0.952222 -0.775549
GLD   0.010457  1.000000 -0.005408  0.010601
IXIC  0.952222 -0.005408  1.000000 -0.752368
VIX  -0.775549  0.010601 -0.752368  1.000000
```

[18]:
```
covid_correlation = pd.concat([GSPC_covid, GLD_covid, IXIC_covid, VIX_covid],␣
↪axis = 1).corr()
print(covid_correlation)
```

```
          GSPC       GLD      IXIC       VIX
GSPC  1.000000  0.176480  0.987217 -0.751337
GLD   0.176480  1.000000  0.174675 -0.040569
IXIC  0.987217  0.174675  1.000000 -0.795287
VIX  -0.751337 -0.040569 -0.795287  1.000000
```

4.2 Beta

[19]:
```
def beta_cal(Y_list, X):
    beta_list = []
    for Y in Y_list:
        model = sm.OLS(Y,X,missing="drop").fit()
        beta_list.append(model.params['GSPC'])
    return beta_list

beta_bear = beta_cal([GLD_bear, VIX_bear], GSPC_bear)
beta_bull = beta_cal([GLD_bull, VIX_bull], GSPC_bull)
beta_covid = beta_cal([GLD_covid, VIX_covid], GSPC_covid)
beta_list = [beta_bear, beta_bear, beta_bear]
print(beta_list)
```

```
[[0.02018356097772447, -3.0374940228167615], [0.02018356097772447,
-3.0374940228167615], [0.02018356097772447, -3.0374940228167615]]
```