

Siqi's Project

November 3, 2024

```
[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
```

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[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
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[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
```

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[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
```

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[6]:
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	GSPC	GLD	IXIC
Date			
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())
```

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[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(
```

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        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

```

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

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[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
```

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[13]:
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	GSPC	IXIC	GLD	VIX
Date				
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

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```
[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)
```

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[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")
```

```
[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

```
[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]]
```