University of Miami - FinTech Bootcamp Summer '21

Contributors

* Angela Fuentes
* Jason Parsons
* Jesus Saenz
* Steve Stark
* Kashyap Suratia

FACT:

No Bull Market Lasts Forever.

Sooner or later, a bear market is coming.

Or even worse...


The Market Could Crash!

We decided to look at the 11 different sectors which comprise the stock market.

https://m.foolcdn.com/media/dubs/images/Stock_Market_Sectors_Chart.width-700.png

We considered all 11 sectors, with a focus on the 3 most recent down markets and crashes.

- **Jan. 3, 2006 to Dec. 30, 2010**
  Crash: Oct. 1, 2007 to Mar. 2, 2009

- **Jan. 2, 2014 to Dec. 29, 2017**
  Crash: Feb. 2, 2015 to Mar. 2, 2016

- **Jan. 3, 2017 to Dec. 30, 2019**
  Crash: Jan. 1, 2018 to Dec. 3, 2018

Our Questions:

- **Which sectors offer the best return-per-unit-of-risk? (Sharpe Ratio >= 1.0)**
- **Which sectors may diverge from a downtrending S&P 500? (low/negative correlations)**
- **Which sectors will provide the strongest return in a down market? (cumulative returns)**
- **How favorable a return can be projected for a portfolio leveraged in favor of these sectors? (ETF weighted model portfolio)**
- **Creating a weighted portfolio with select stocks from winning sectors, what kind of returns could be anticipated? (Ticker Weighted Model Portfolio)**

Our Hypotheses:

- Which sectors will outperform the S&P 500 during downturns in the market:
  - Information Technology
  - Health Care
  - Utilities
  - Consumer Staples

- A portfolio leveraged toward these sectors during a down market will perform favorably over other sectors in the market.

Results:

- Which sectors offer the best return-per-unit-of-risk?
  Crash 1: All sectors had Sharpe Ratios well below 1.0

  Crash 2: VGT - Sharpe Ratio above 1.0

  Crash 3: VGT and VHT (Health Care) both with Sharpe Ratios over 1.0

Results:

- **Which sectors may diverge from the S&P 500?**
  Overall, sectors mostly correlated to the S&P 500. VCR, VIS & VGT had the highest correlation to the S&P 500.

Results:

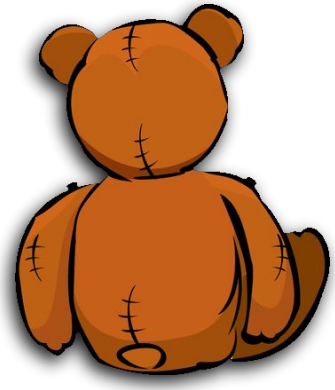
- Information Technology & Health Care consistently outperformed the S&P 500.
- From the Monte Carlo Simulations on the stock APIs, the winners were BRK.B, JNJ, PG and WMT.
- Overall, the winning sectors were:
  - Information Technology
  - Health Care
  - Consumer Staples
  - Consumer Discretionary
  - Financials

This supports our hypothesis.

Questions & Data

A great deal of data was required for this study.

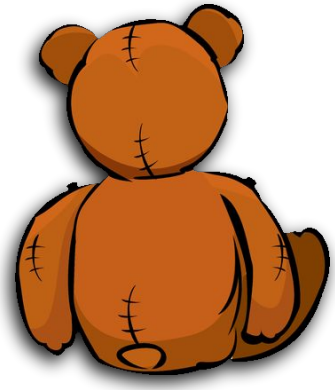
To begin with, we needed daily trading data for the time periods being investigated.



ETF (exchange traded fund):

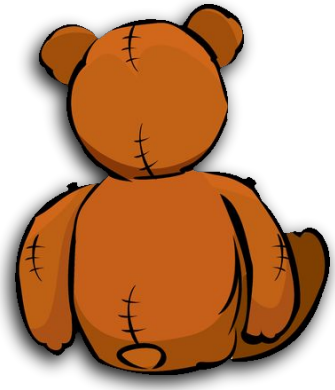
a type of security that tracks an index, sector, commodity, or other asset, but which can be purchased or sold on a stock exchange the same as a regular stock. An ETF can be structured to track anything from the price of an individual commodity to a large and diverse collection of securities. ETFs can even be structured to track specific investment strategies.

https://www.investopedia.com/terms/e/etf.asp



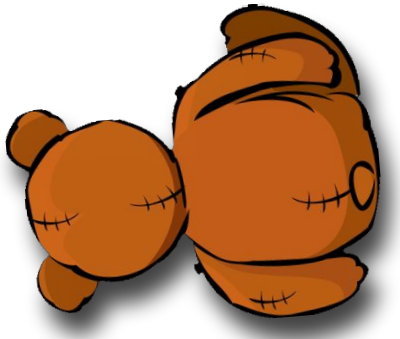
ETFs:

- Collected ETFs on all 11 market sectors, across 3 down markets
- Used GOOGLEFINANCE in Google Sheets to generate CSVs
- Read CSVs into Python
- Produced data frames and visualizations
- Analyzed outcomes



Stocks:

- Collected APIs for representative stocks in each sector.
- Created data frames and plotted histograms and density plots.
- Selected top 4 performing stocks and ran weighted 1260-day Monte Carlo Simulations for each.



Data Cleanup & Exploration

- **Calculated daily returns and cumulative returns for all data frames, and visualized results in bar and line plots.**

- **Determined that our focus would be cumulative returns since our primary interest was in seeing positive returns by the end of the selected downturns.**

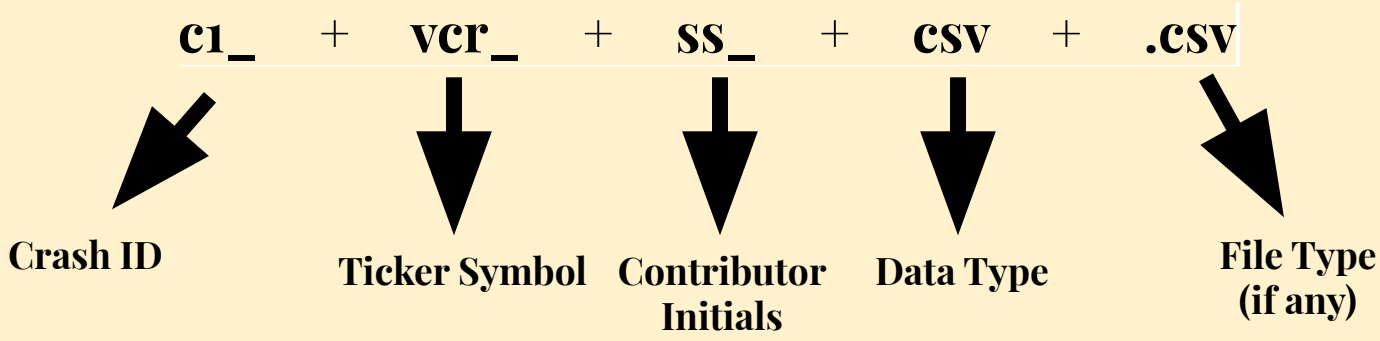
Insights

- **The only reason anyone loses money in a market crash: they sell during the crash! DON’T DO THAT!**

- **If you ride it out, you will return to the plus side.**

Problems Which Arose

- With 5 contributors, variable names were initially built on 5 different systems. The lack of a unified format made data cumbersome to work with.
  - Solution - we developed a unified format for our variables, starting with the variables we called for the CSV files:



Problems Which Arose

- We had 48+ CSVs to work with, so running code was very time consuming.
  - Solution - we developed functions to easily compute the necessary data, in particular the daily, cumulative, and model portfolio returns.

```
# Functions to calculate daily and cumulative returns

def daily_returns(x):
    ## Calculate daily returns of closing prices for
    ## ETFs, Stock Tickers, or Indices.
    daily_returns = x.pct_change().dropna()
    return daily_returns

def cumulative_daily_returns(x):
    ## Calculate the cumulative returns of the
    ## ETFs, Stock Tickers, or Indices.
    #daily_returns = x.pct_change().dropna()
    cumulative_returns = (1 + x).cumprod().dropna().reset_index()
    #return cumulative_returns
    return cumulative_returns
```

```
def investment_profits(z):
    initial_investment = 10000
    cumulative_profit = initial_investment * z
    return cumulative_profit.hvplot(
    height=600,
    width=1200
)
```

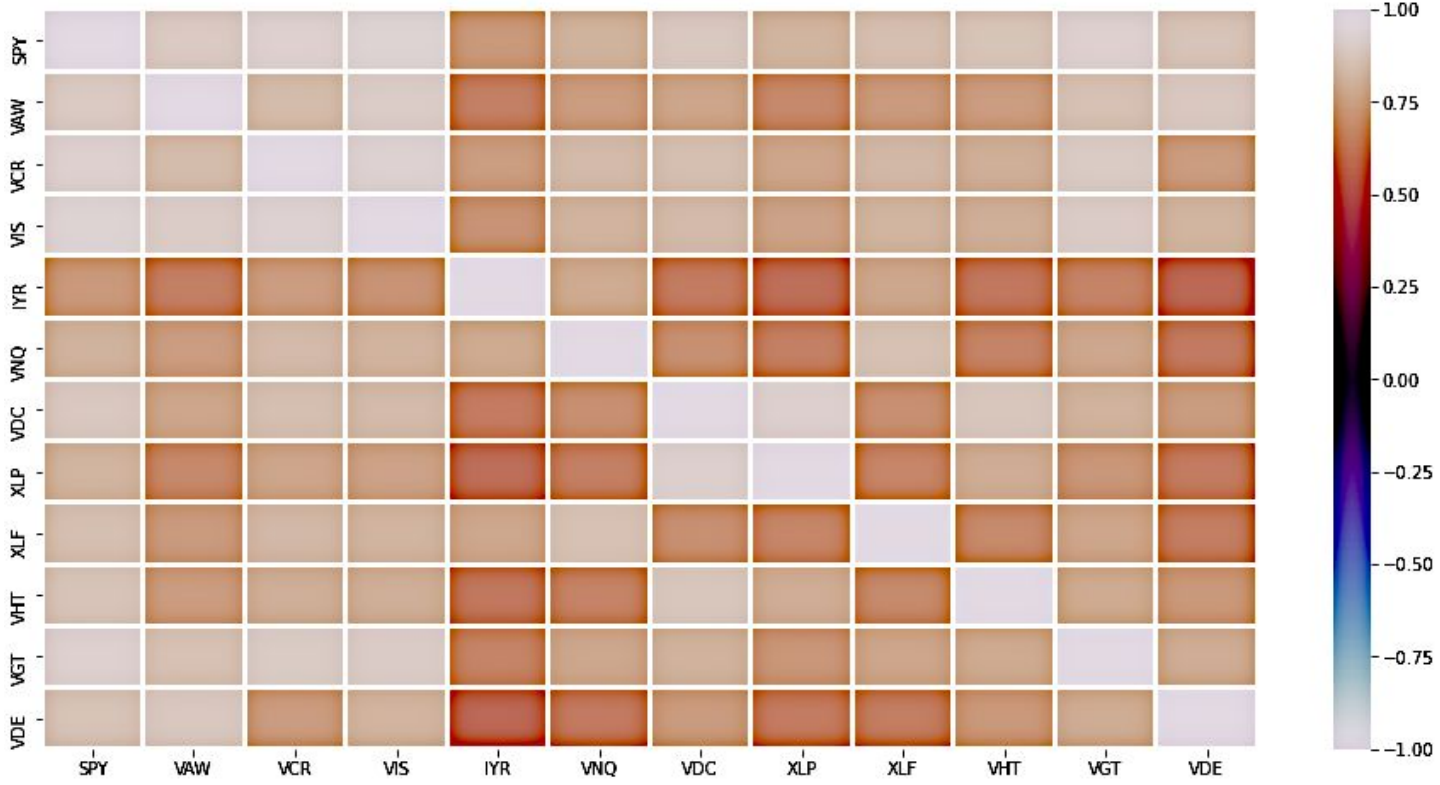

Data Analysis

FIRST CRASH

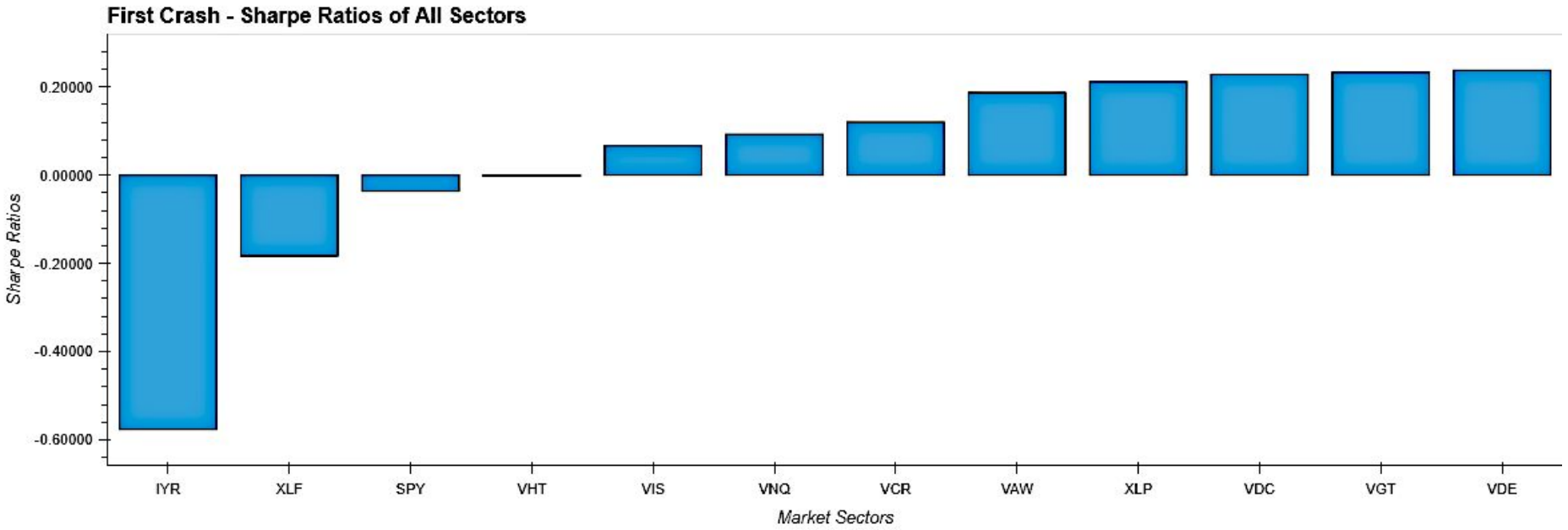
Jan. 3, 2006 to Dec. 30, 2010

Crash: Oct. 1, 2007 to Mar. 2, 2009

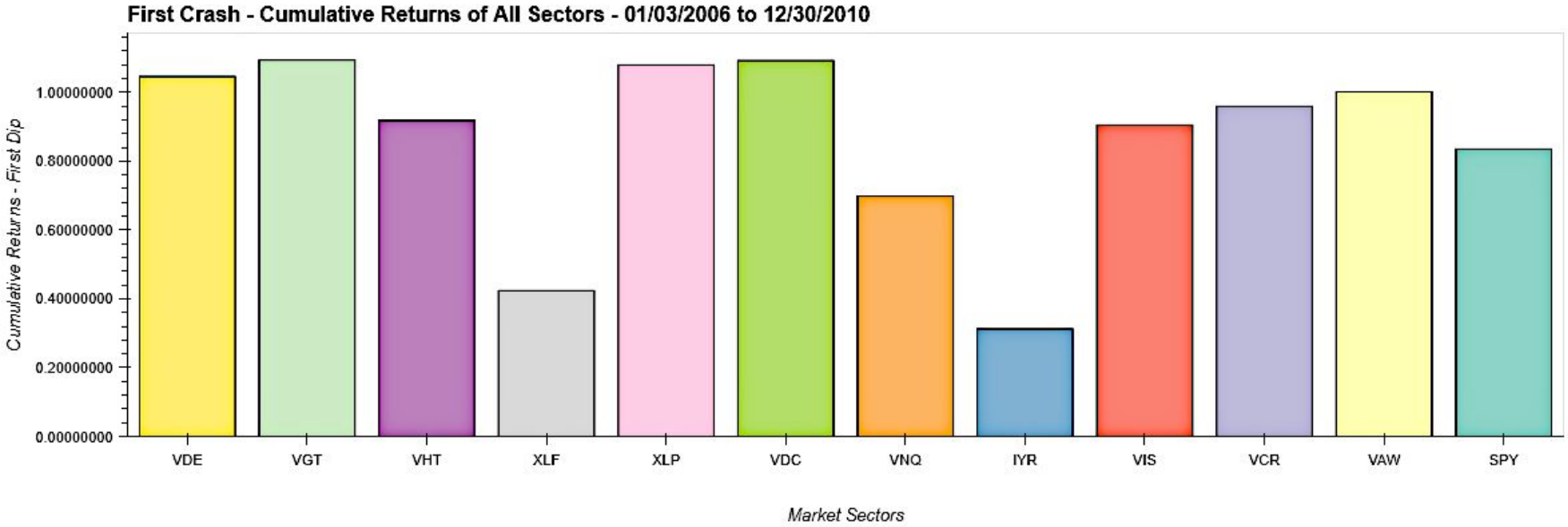
FIRST CRASH - Correlation of All Sectors



FIRST CRASH - Sharpe Ratios of All Sectors



FIRST CRASH



Date	SPY	VAW	VCR	VIS	IYR	VNQ	VDC	XLP	XLF	VHT	VGT	VDE
2010-12-29	0.834681	1.001091	0.958874	0.904576	0.3123	0.69817	1.091747	1.079044	0.423463	0.918086	1.093628	1.04534

FIRST CRASH

VGT: Vanguard Information Technology Index Fund ETF

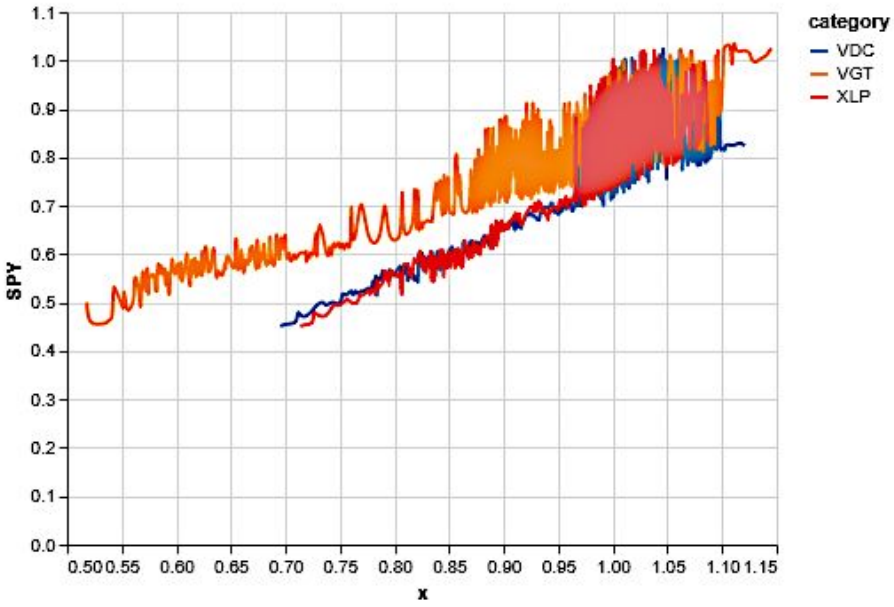
VDC: Vanguard Consumer Staples Index Fund ETF

XLP: Consumer Staples Select Sector SPDR Fund

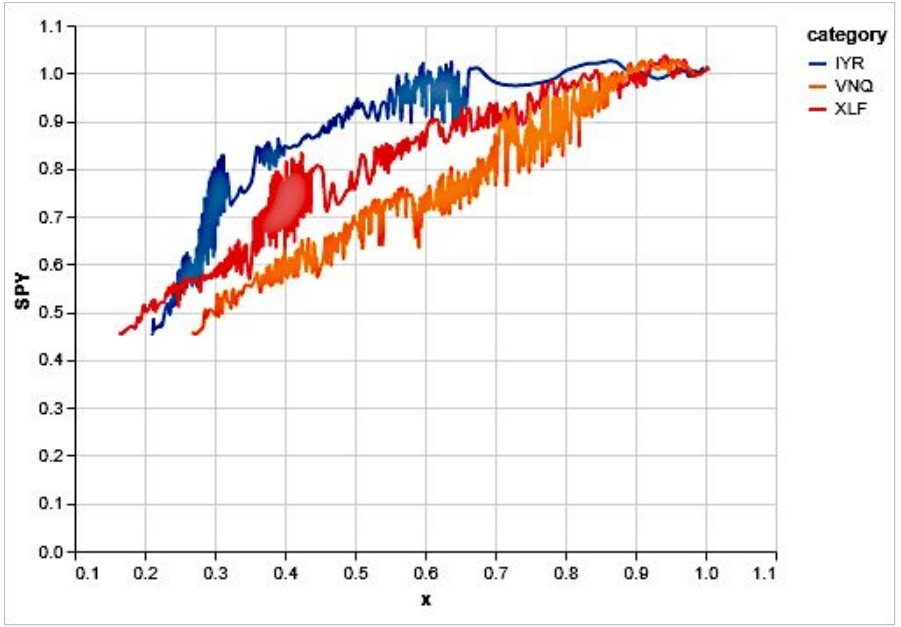
Sectors Which Outperformed S&P500 in Cumulative Returns Across Three Market Crashes

FIRST CRASH - Altair Line Charts - Winners & Losers

Winners

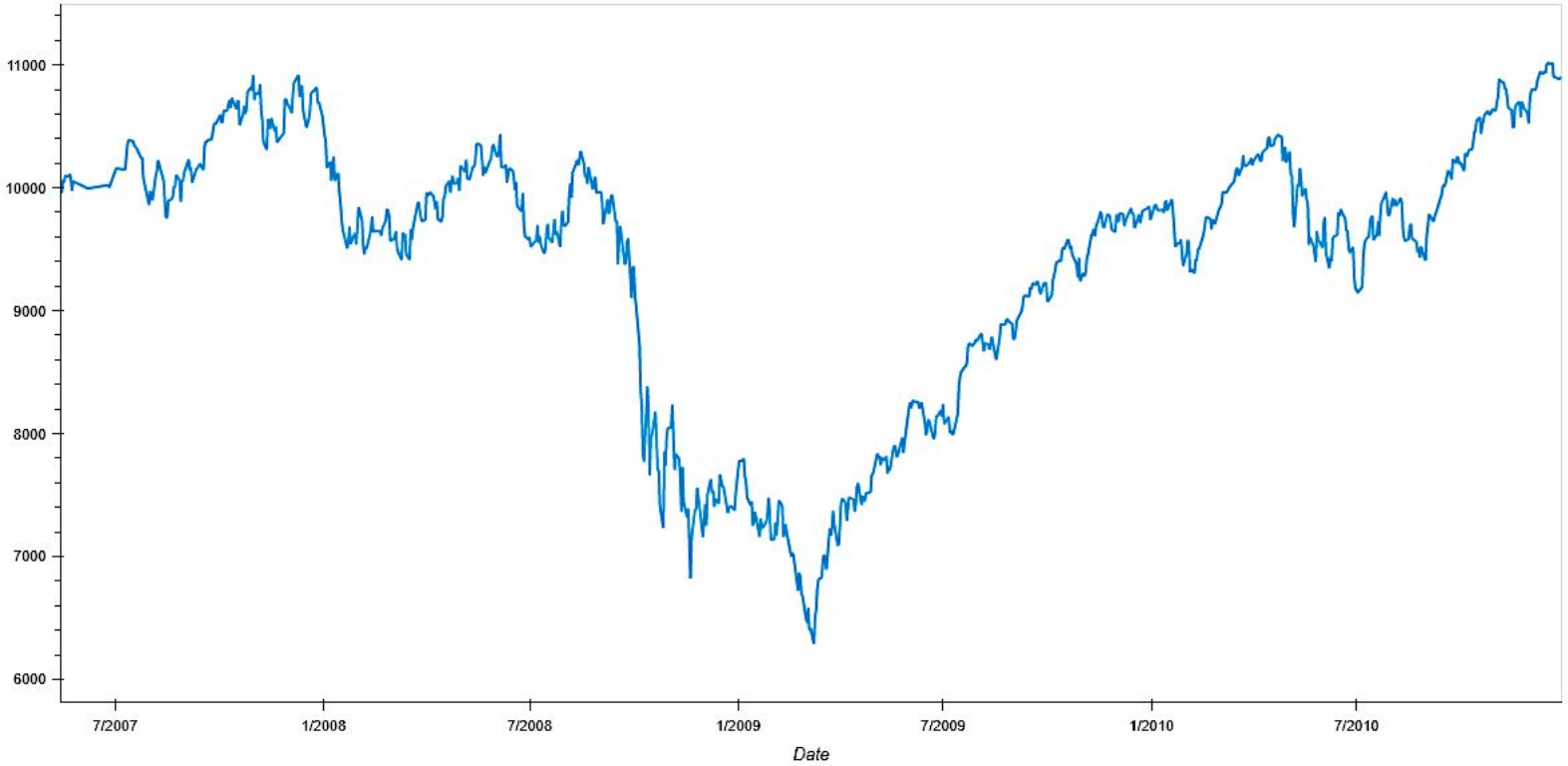


Losers



FIRST CRASH

Weighted Model Portfolio: 40% VGT, 40% VDC, 20% XLP

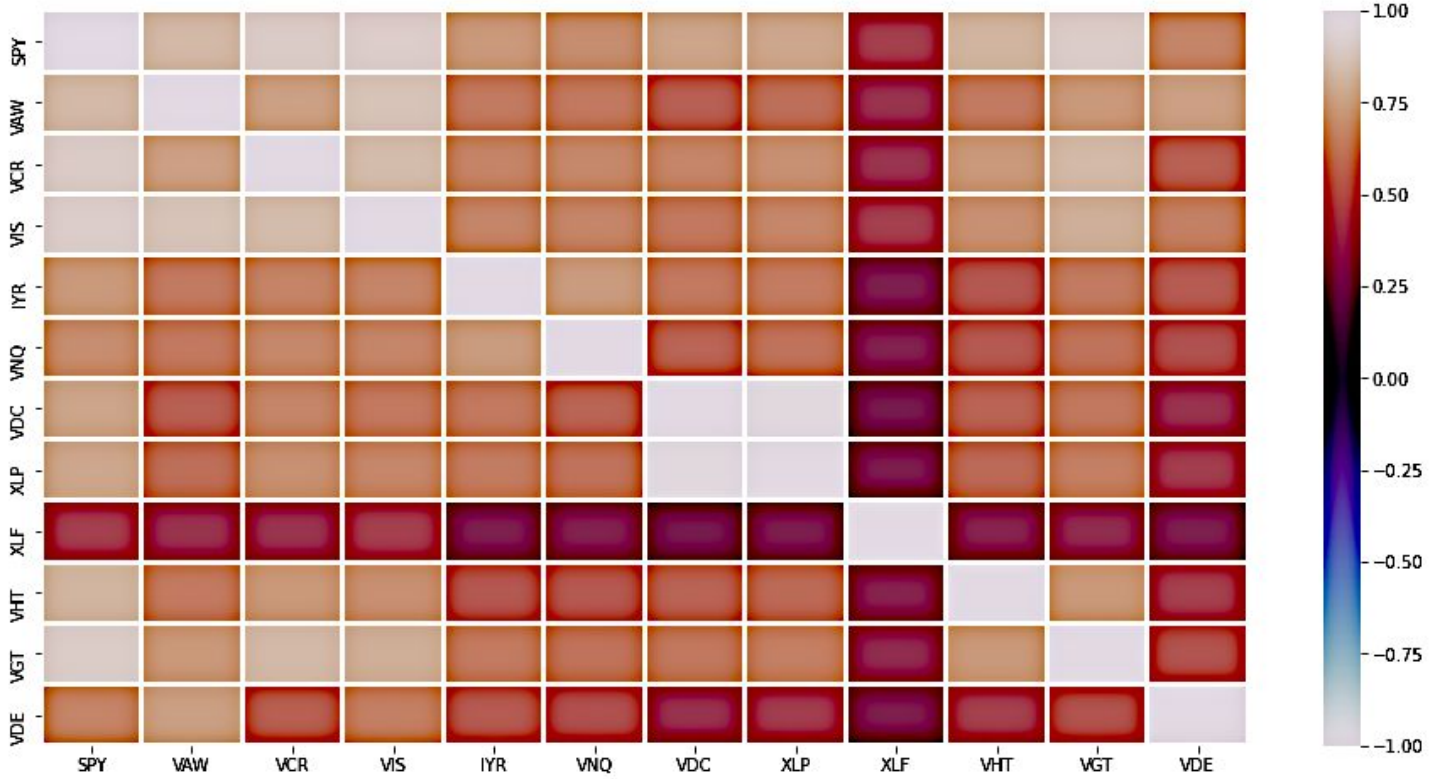


SECOND CRASH

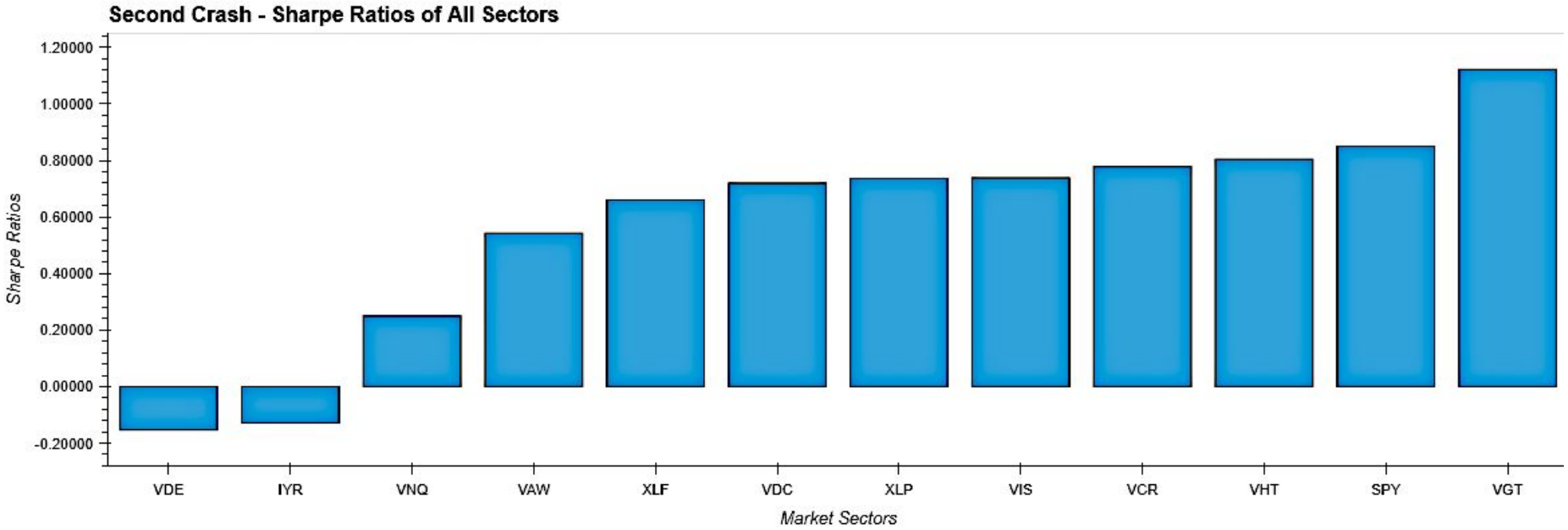
Jan. 2, 2014 to Dec. 29, 2017

Crash: Feb. 2, 2015 to Mar. 2, 2016

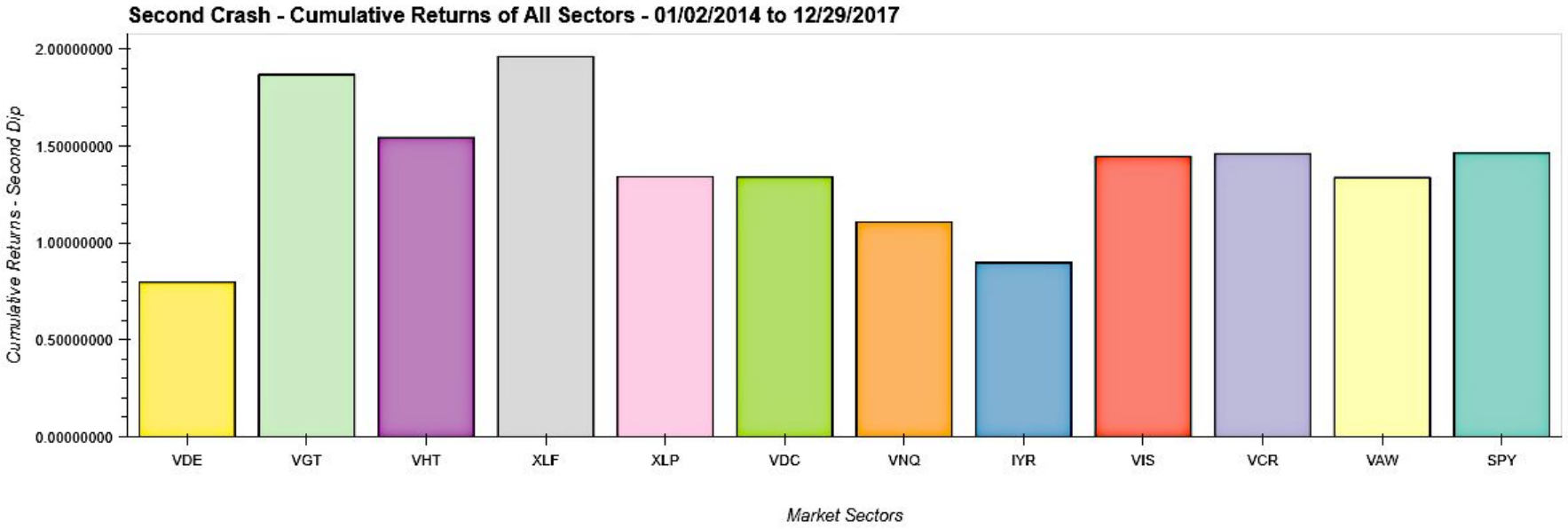
SECOND CRASH - Correlation of All Sectors



SECOND CRASH - Sharpe Ratios of All Sectors



SECOND CRASH



Date	SPY	VAW	VCR	VIS	IYR	VNQ	VDC	XLP	XLF	VHT	VGT	VDE
2017-12-28	1.464411	1.337205	1.459922	1.446031	0.898905	1.10803	1.3404	1.341905	1.961619	1.543547	1.86854	0.796903

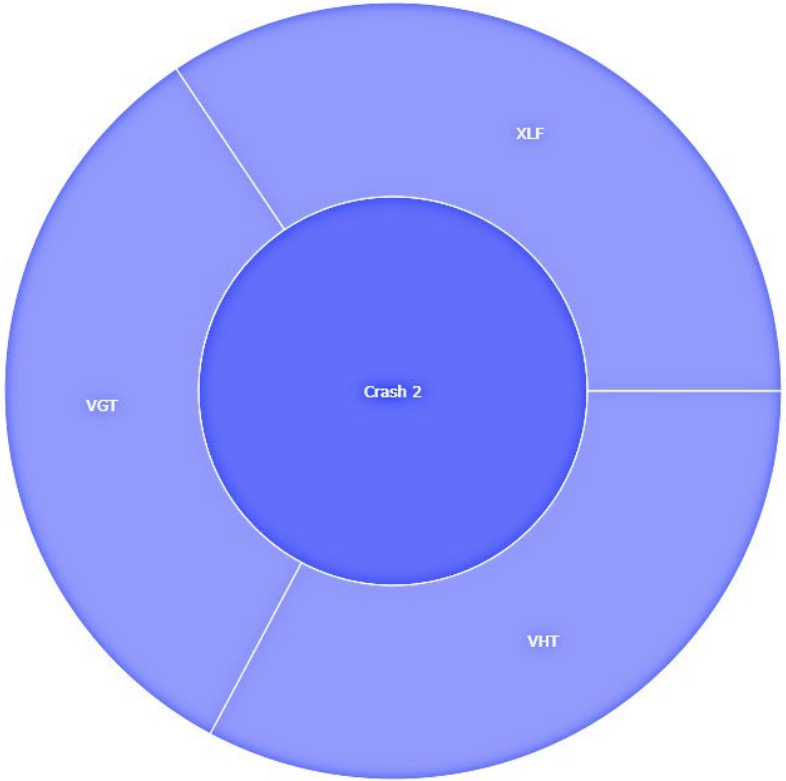
SECOND CRASH

VGT: Vanguard Information Technology Index Fund ETF

VHT: Vanguard Health Care Index Fund ETF

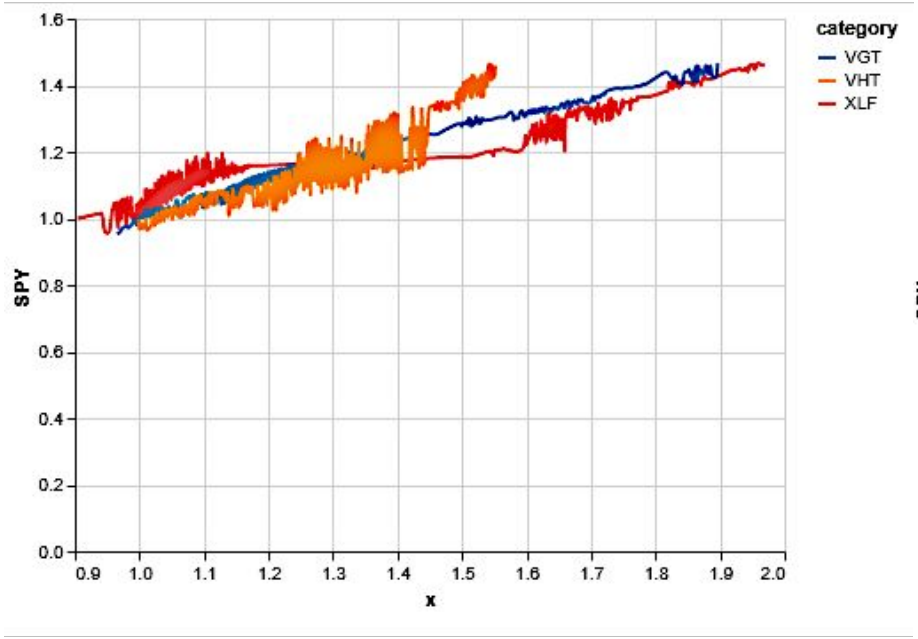
XLF: Financial Select Sector SPDR Fund

Sectors Which Outperformed S&P500 in Cumulative Returns Across Three Market Crashes

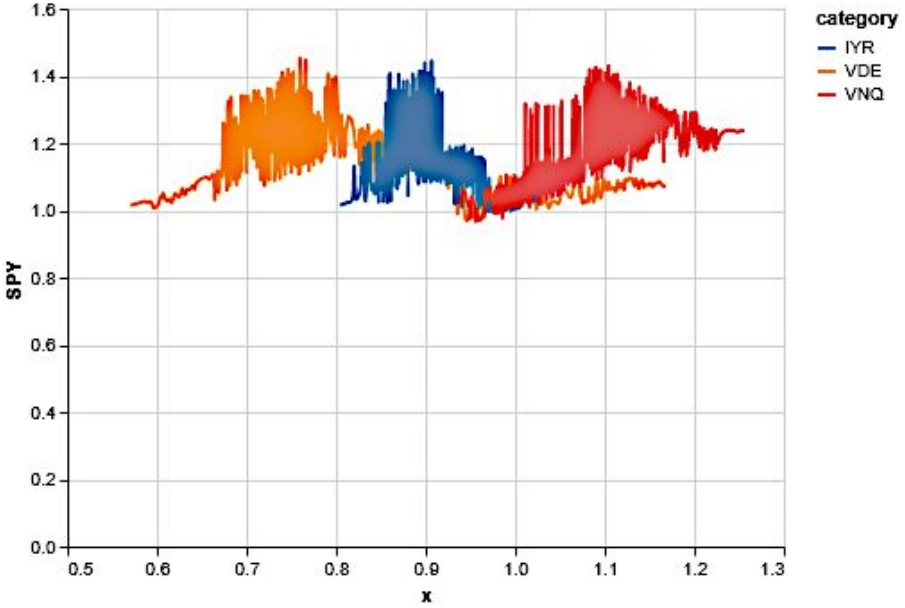


SECOND CRASH - Altair Line Charts - Winners & Losers

Winners

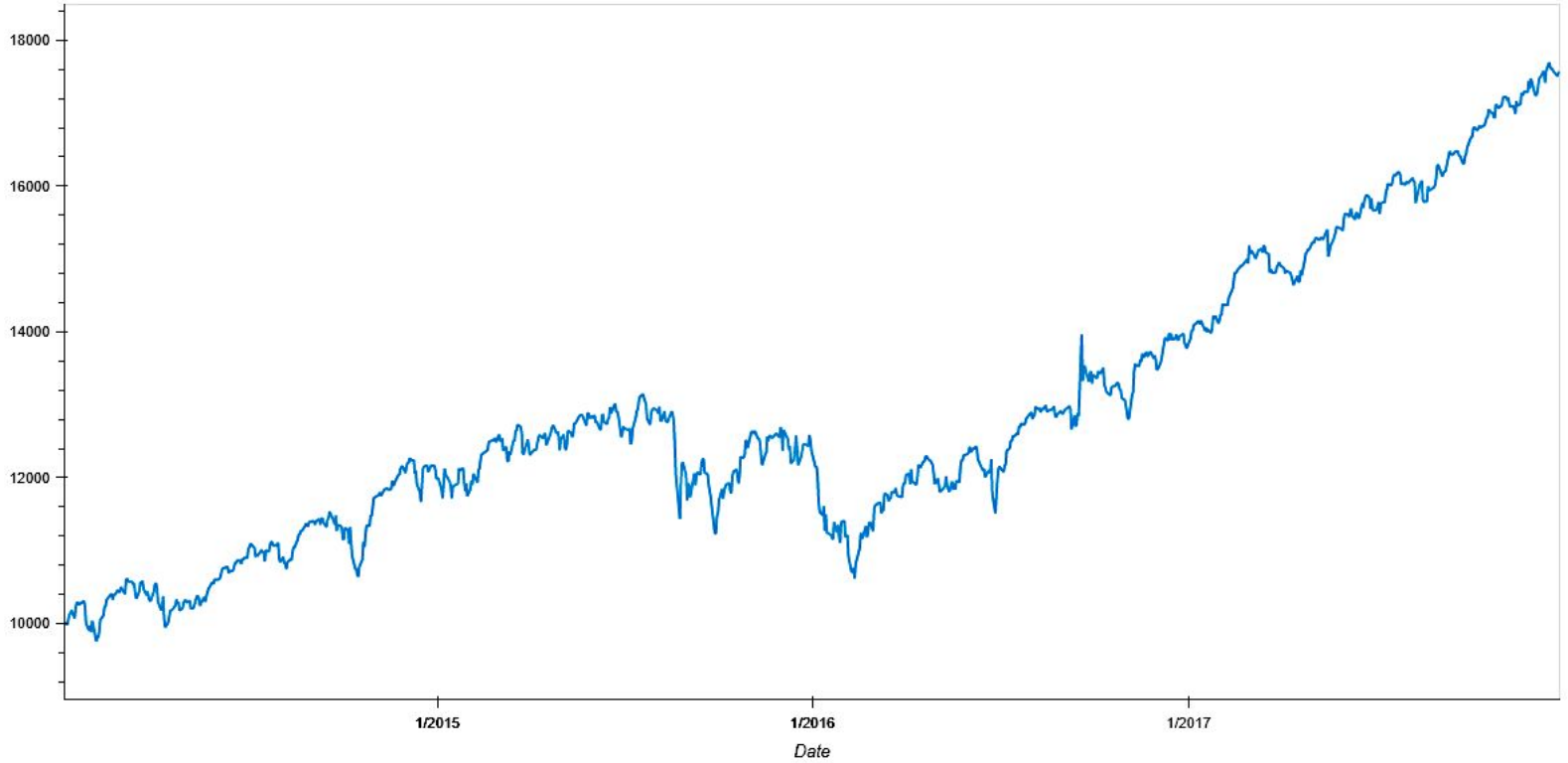


Losers



SECOND CRASH

Weighted Model Portfolio: 40% VGT, 40% VHT, 20% XLF

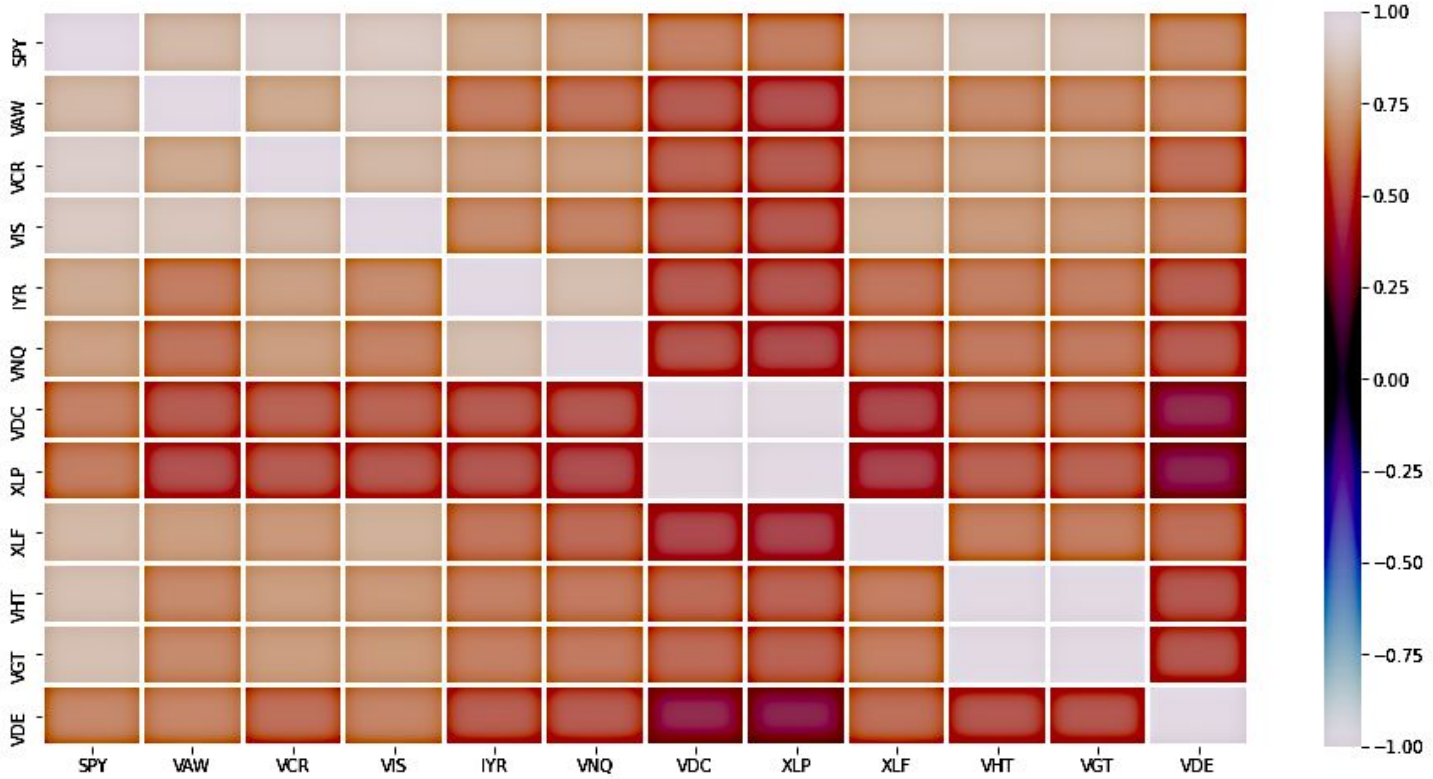


THIRD CRASH

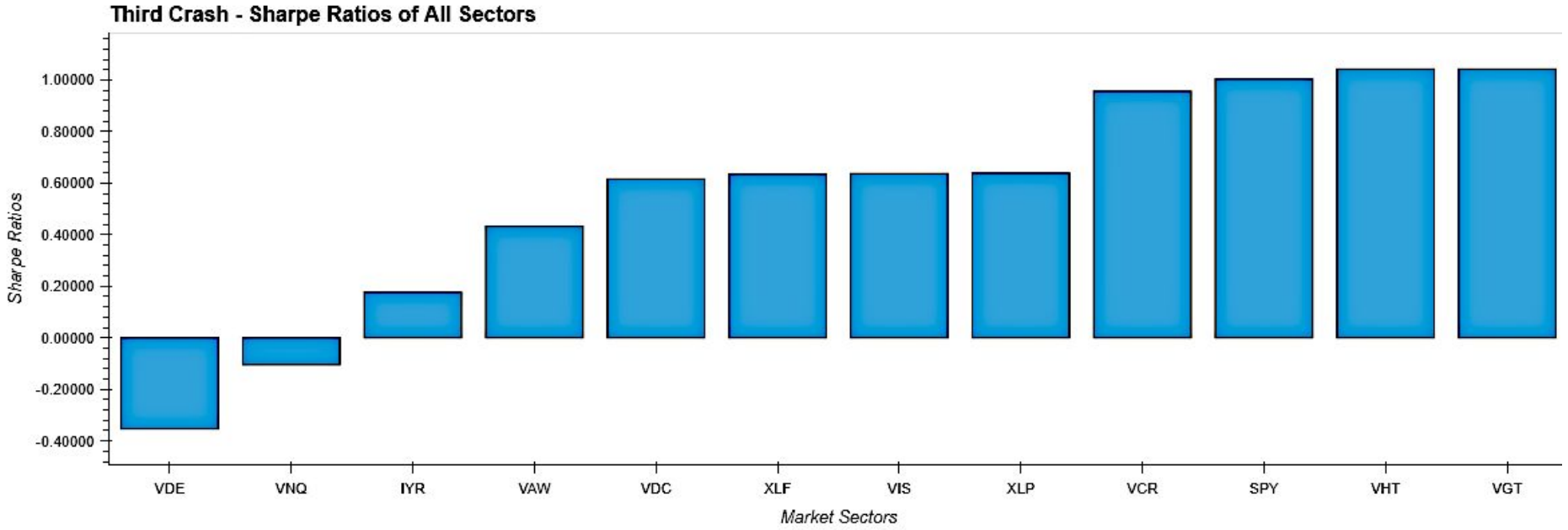
Jan. 3, 2017 to Dec. 30, 2019

Crash: Jan. 1, 2018 to Dec. 3, 2018

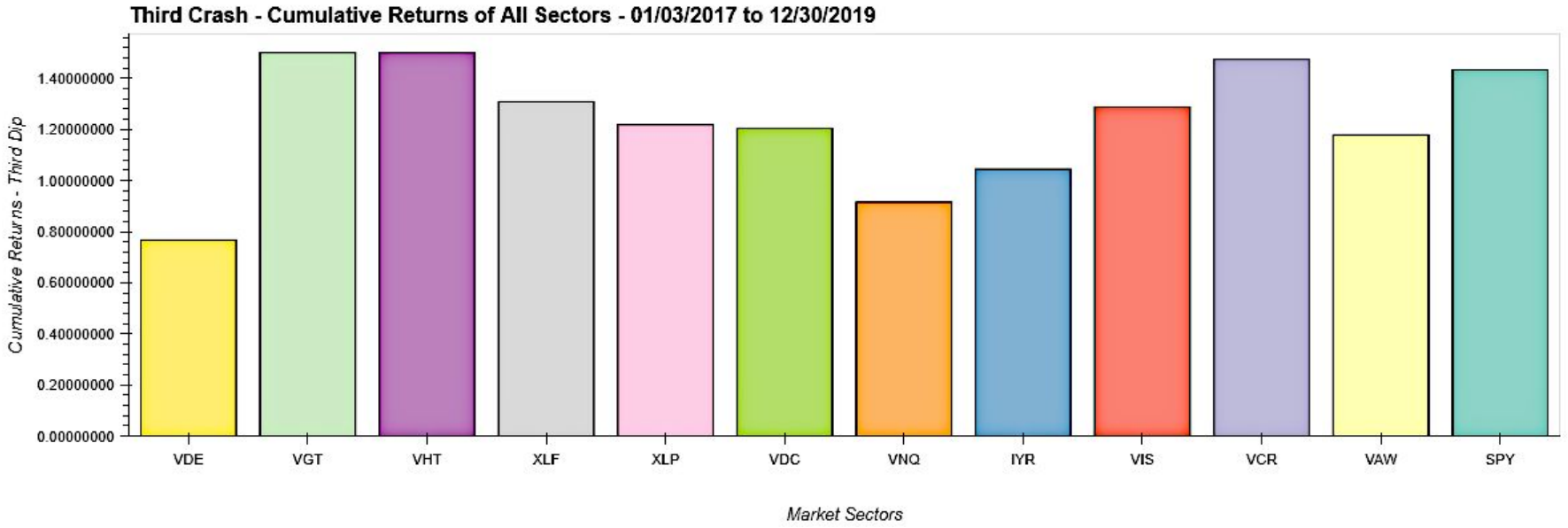
THIRD CRASH - Correlation of All Sectors



THIRD CRASH - Sharpe Ratios of All Sectors



THIRD CRASH



Date	SPY	VAW	VCR	VIS	IYR	VNQ	VDC	XLP	XLF	VHT	VGT	VDE
2019-12-27	1.433404	1.178562	1.474662	1.287821	1.044313	0.915587	1.204493	1.21869	1.308805	1.500701	1.500701	0.766783

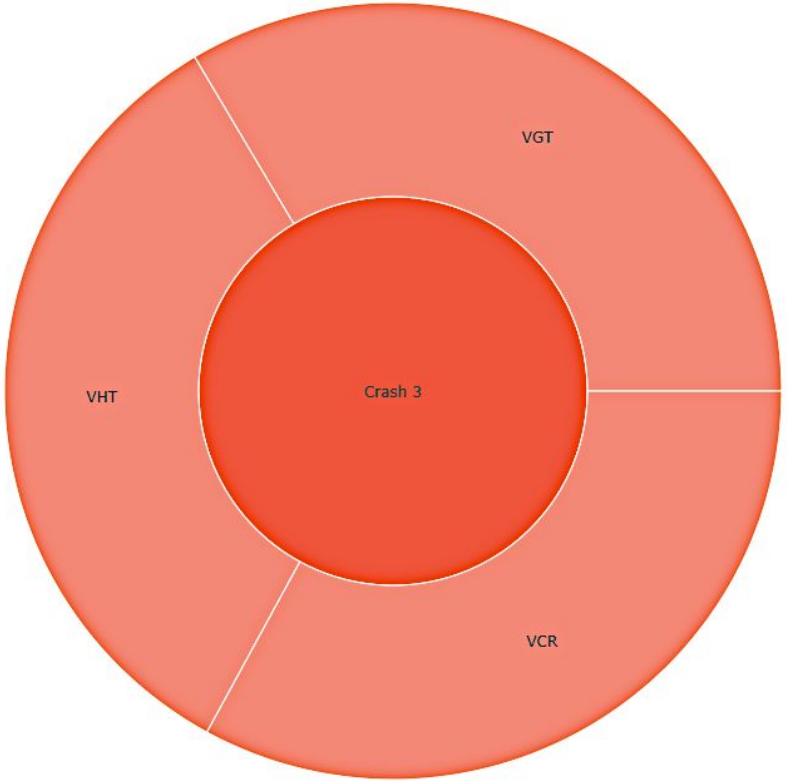
THIRD CRASH

VGT: Vanguard Information Technology Index Fund ETF

VHT: Vanguard Health Care Index Fund ETF

VCR: Vanguard Consumer Discretionary Index Fund ETF

Sectors Which Outperformed S&P500 in Cumulative Returns Across Three Market Crashes



THIRD CRASH - Altair Line Charts - Winners & Losers

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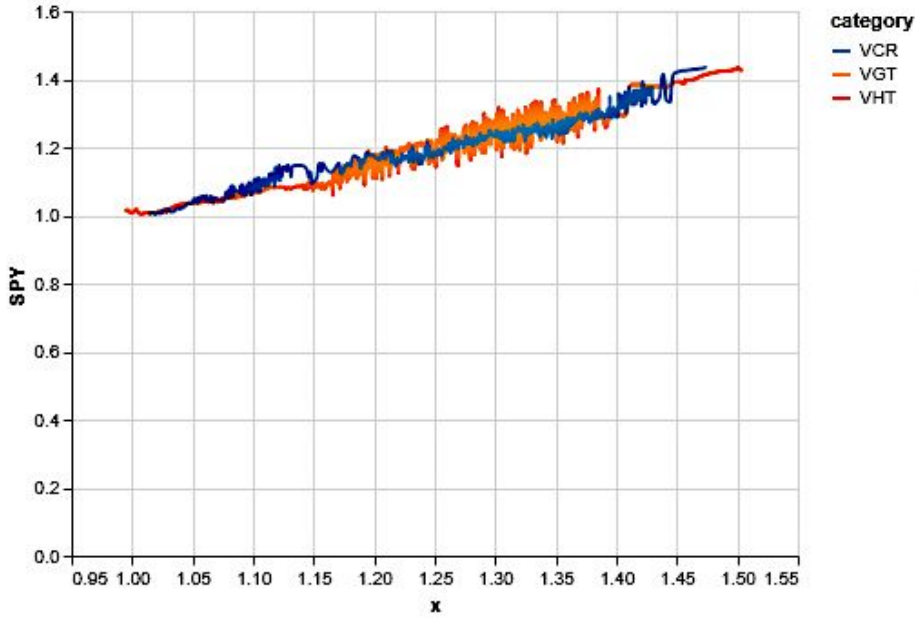
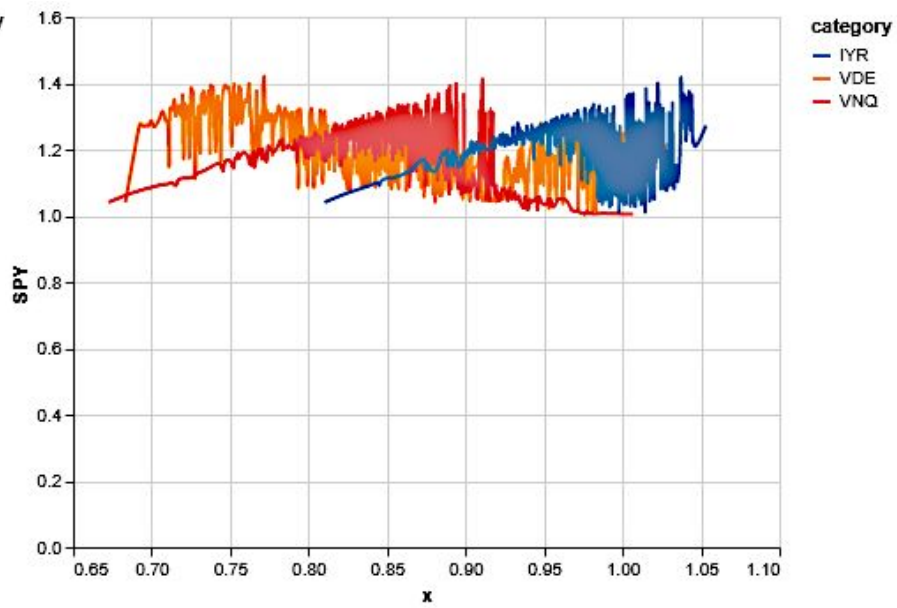
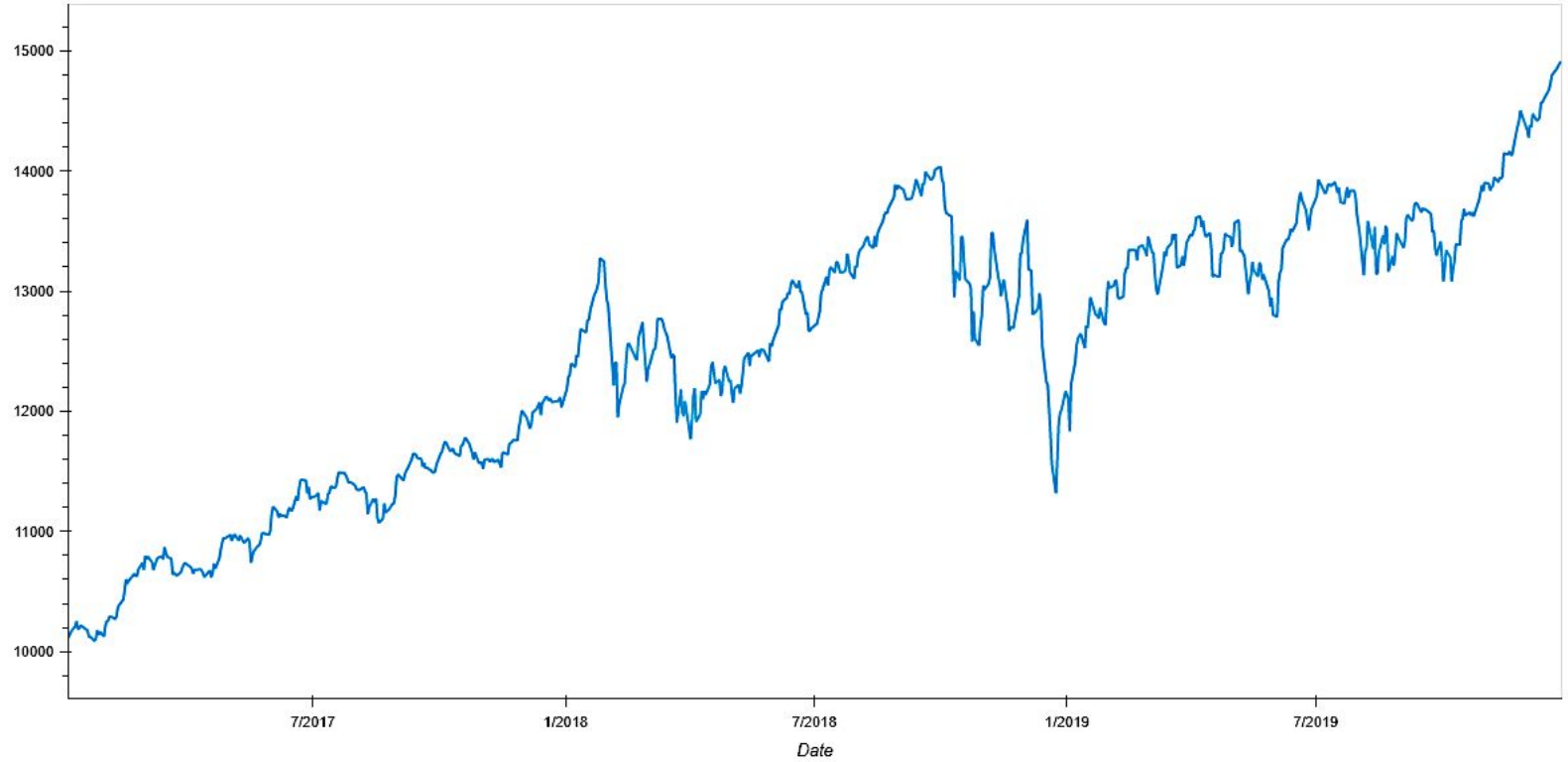


Losers



THIRD CRASH

Weighted Model Portfolio: 40% VGT, 40% VHT, 20% VCR



MODEL WEIGHTED STOCK PORTFOLIO

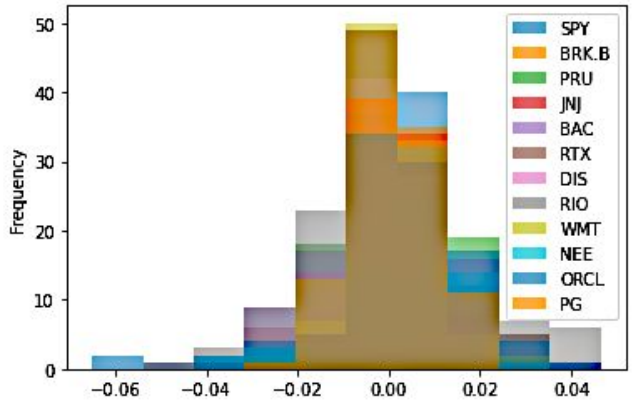
Winners:

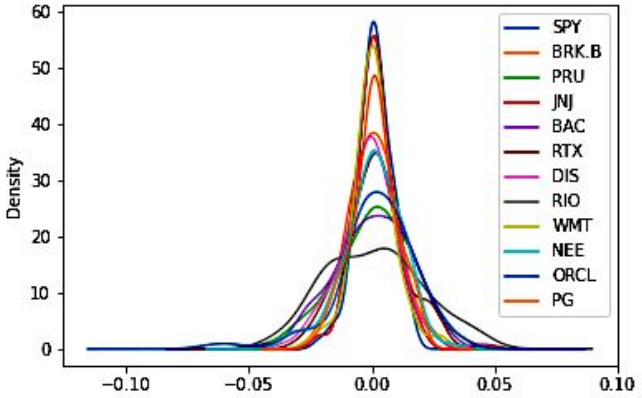
BRK.B - Berkshire Hathaway
JNJ - Johnson & Johnson
PG - Procter & Gamble
WMT - Walmart

MODEL WEIGHTED STOCK PORTFOLIO

	SPY	BRK.B	PRU	JNJ	BAC	RTX	DIS	RIO	WMT	NEE	ORCL	PG
2021-03-11	0.010218	-0.010914	-0.004418	0.000377	-0.003212	0.006270	0.008716	0.028678	-0.000378	0.005238	-0.065040	-0.003612
2021-03-12	0.001499	-0.003717	0.016127	0.003016	0.018797	0.019343	0.001576	-0.015030	0.014910	0.010955	-0.003560	0.009930
2021-03-15	0.006039	-0.021268	-0.000852	0.004698	-0.005271	0.013372	-0.001675	-0.020674	-0.004996	-0.002511	0.008038	0.003121
2021-03-16	-0.001337	-0.011749	-0.025693	0.005799	-0.002650	-0.016841	-0.012759	-0.009927	-0.000300	-0.001325	-0.012995	0.002800
2021-03-17	0.003233	0.002147	0.019586	-0.002542	0.008236	0.017257	0.005252	-0.001015	-0.008172	-0.031706	-0.009425	-0.003879
...	...	...	...	...	...	...	...	...	...	...	...	...
2021-07-26	0.002478	0.000898	0.012563	0.000553	0.011671	0.001166	0.014761	0.039502	0.001334	-0.004144	0.001939	0.003649
2021-07-27	-0.004513	0.007498	-0.002084	0.004422	-0.004195	0.026892	0.004364	-0.038117	0.000140	0.012484	-0.000455	0.004063
2021-07-28	-0.000364	-0.009756	0.000398	-0.002607	0.003949	-0.011450	-0.002507	0.046394	-0.004136	-0.000257	-0.007288	-0.014766
2021-07-29	0.004170	0.006149	0.008451	-0.000116	0.014424	0.005275	-0.004132	0.023900	0.001337	0.004111	0.005047	0.004468
2021-07-30	-0.004947	-0.005146	-0.011338	0.000465	-0.008402	-0.008099	-0.012897	-0.026725	0.002109	-0.003199	-0.005478	0.019799

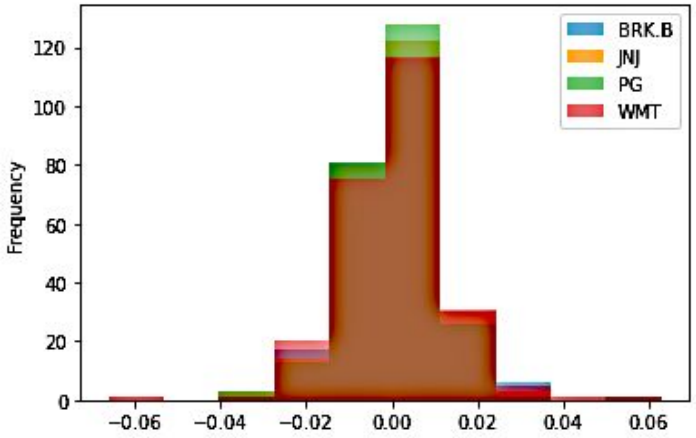
99 rows × 12 columns



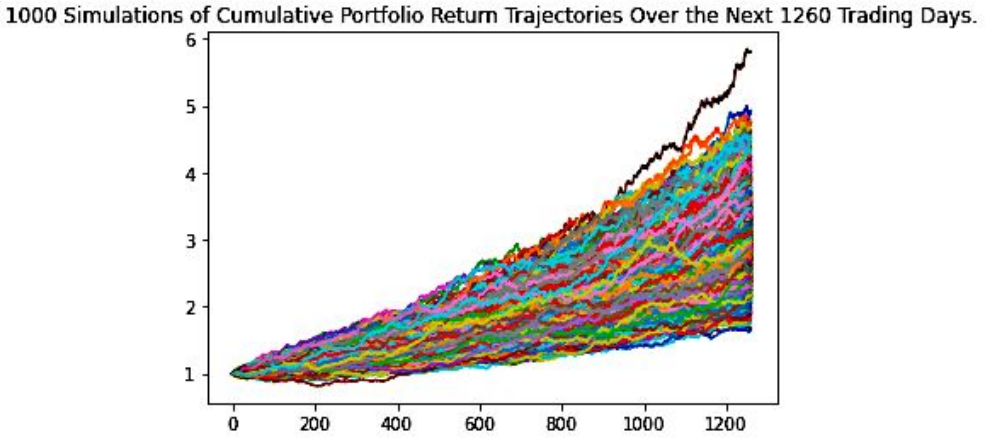


Winners:

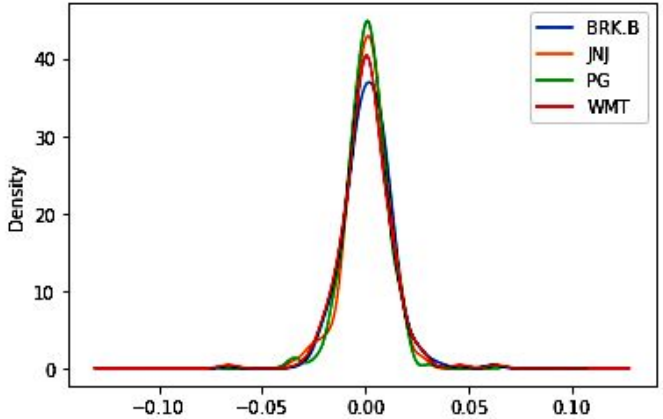
- BRK.B
- JNJ
- PG
- WMT



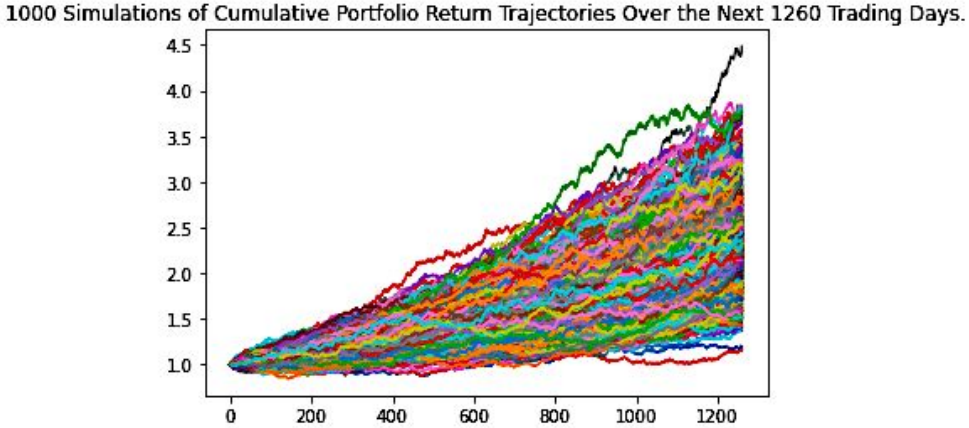
Winner Stock Daily Returns - Histogram



Berkshire Hathaway-Weighted Monte Carlo



Winner Stock Daily Returns - Density Plot



Procter & Gamble-Weighted Monte Carlo

DISCUSSION

So what's this all about, anyway?

- The Information Technology and Health Care sectors have routinely outperformed the S&P 500 during down markets.
- The Financial, Consumer Staples and Consumer Discretionary sectors have often performed well against the S&P 500 in down markets, as well.
- A portfolio weighted in favor of IT and Health Care stocks would appear to be well-protected in a typical downturn.

POSTMORTEM

If we had one more day for this study, we would remedy one error which was caught too late to repair.

If we had two more weeks for additional research and analysis, we would:

- Study Crypto Markets
- Study Commodities Markets

Thank You