

The background features abstract, overlapping green geometric shapes, primarily triangles and polygons, in various shades of green, creating a modern and dynamic design.

ONLY 610-90-O-2020/Spring - Project Presentation

Subhash Bharadwaj Pemmaraju

Problem Statement

- ▶ Topic modeling concerning the Federal Reserve and how does the sentiment of the news impacts stock price movements in the period of Mid Feb-March 2020

Key Inputs:

- ▶ Dataset of news articles referring to the Federal Reserve from Feb 21-Mar 21, 2020
- ▶ Stock prices of S&P 500 ETF for Jan 1, 2016 - Mar 21, 2020

Key outputs:

- ▶ Quantitative: Polarity score and ticker price plot for daily data
- ▶ Qualitative: Assuming the price volatility is going to present no clear correlation between the two datapoints, evaluate it qualitatively → (+)/(-)/(Neutral) sentiment vs directionality of stock moves (Up/Down)

Dataset for sentiment analysis/LDA/Topic Taxonomy

- ▶ Keywords: “Federal Reserve”, “The Fed”, “The NY Fed”, “Fed”, “Jerome Powell”
 - ▶ Type: news
 - ▶ Published Date: Feb 21, 2020 to Mar 21, 2020 (30 days)
 - ▶ Spam_score < 0.7

webhoseio.config(token=<>)

query_params = {

"q": "(\\"Federal Reserve\\" OR \\"The fed\\" OR \\"The ny fed\\" OR \\"Fed\\" OR \\"Jerome Powell\\") language:english published:>1577865600000 site_type:news spam_score:<0.7",

"ts": "1582309495992",

"sort": "published"

}

- ▶ Size of the dataset: 40,000
- ▶ More details
 - ▶ News articles associated with the Federal Reserve can be referenced by multiple keywords as shown above
 - ▶ High volume of chatter in the markets on the Federal Reserve in recent weeks
 - ▶ High likelihood of duplicate articles; chose a large dataset (40,000) to have a sizeable deduped sample

Dataset for stock prices

- ▶ IEXFINANCE Package

- ▶ Does not contain index data; so closest proxy of the S&P 500 index is used
- ▶ SPY: **SPDR S&P 500 ETF** is used as a proxy due to its close tracking of the index and very high traded volumes
- ▶ Date: 2016-01-01 to 2020-03-20

```
def getHistoricalPrices(stock):
```

```
    return get_historical_data(stock, start, end,  
                               output_format='pandas',  
                               token=<>)
```

```
start = datetime(2016, 1, 1)
```

```
end = datetime(2020, 3, 21)
```

```
single_stock_history = getHistoricalPrices("SPY")
```

- ▶ More details

- ▶ Financial markets have been very volatile in recent weeks
- ▶ Market data may require some sort of moving average calculation to dampen the effect of recent volatility and capture the true momentum of stocks in recent days
- ▶ Hence chose a large dataset from 2016 to present to choose an appropriate moving average measure

Analytical Steps

- ▶ Deduplication of titles - word2vec; remove any duplicates with more than 80% similarity
- ▶ Sentiment analysis using NLTK → Quantitative and Qualitative as described in prior slides
 - ▶ Using SentimentIntensityAnalyzer & also using my personal experience to manually annotate upto 50 articles and train the dataset on them
- ▶ Topic clustering with LDA using Gensim
- ▶ Topic taxonomy using a combination of LDA and personal understanding of market news

Webhose Dataset Description

- ▶ Initial dataset size: 40,000 out of 97,135 articles between Feb 22 and Mar 22'20
- ▶ Filter Parameters:
 - ▶ Keywords: Federal Reserve, The Fed, The NY Fed, Fed, Jerome Powell
 - ▶ Site Type: News
 - ▶ Spam Score: < 0.7
- ▶ 40,000 articles of the lot have the following date range:
 - ▶ Mar 12, 2020 - Mar 22, 2020
- ▶ After deduping using Word2Vec with anything having similarity score > 0.8 considered duplicate, remaining are 21,115

Stock Dataset Description

- ▶ IEXFINANCE Package

- ▶ Does not contain index data; so closest proxy of the S&P 500 index is used
- ▶ SPY: **SPDR S&P 500 ETF** is used as a proxy due to its close tracking of the index and very high traded volumes
- ▶ Date: 2020-03-12 to 2020-03-22

Topic Clustering using LDA

► Key inputs for LDA

- Ignore terms that have document frequency more than 5%
- Minimum document frequency of 0.1%
- Max number of features: 200
- Number of topics = 15, number of top words/topic = 15

Topic #0: day since 1987 | worst day since 1987 | trump tangle cuomo coronavirus | coronavirus keep politics | tangle cuomo coronavirus | tangle cuomo coronavirus | cuomo coronavirus keep | keep politics | trump tangle cuomo | keep politics | keep politics | 15 trillion | 700 billion | coronavirus spread

Topic #1: news live | stock market news | market news live | stock market news live | market news live | live stock | news live stock | amid coronavirus outbreak | stock futures | live stock futures | rate cut | feed unveil emergency | unveil emergency stimulus | feed unveil emergency stimulus | slash rat

Topic #2: federal reserve slash | slash interest rat | live business | business live | reserve slash interest rat | reserve slash interest | federal reserve slash interest | business live | business live | business live business | slash interest rat zero | federal reserve slash rat | reserve slash rat | white house | federal reserve take

Topic #3: new york | coronavirus | washington post | central bank | central bank | business | new york city | coronavirus | coronavirus latest | coronavirus update | us stock market | us stock futures | live update | federal reserve take | feed inject

Topic #4: nyse | wall street | wall street | inc nyse | inc nyse | inc | inc nyse | 15 trillion | unusual disruptions | white house | nasdaq | worst day since | market | stock market | stock market

Topic #5: coronavirus outbreak | de blasio | people die | outbreak people | people die | coronavirus outbreak people | act coronavirus outbreak | act coronavirus outbreak | de blasio trump | outbreak people die | trump act coronavirus | trump act | blasio trump act | people die | blasio trump

Topic Clustering using LDA

Topic #6:

p 500 | nasdaq | interest rat zero | payroll tax cut | p | house coronavirus bill | coronavirus pandemic | worst day since | slash interest rat zero | reserve slash interest | reserve slash interest rat | federal reserve slash interest | inc | slash interest rat | federal reserve slash

Topic #7:

feed rate cut | news | bnn bloomberg | coronavirus keep | amid coronavirus crisis | test positive coronavirus | slash rat | feed slash rat | feed rate cut | federal reserve cut | coronavirus crisis | rate cut | tangle cuomo coronavirus | keep politics | keep politics

Topic #8:

coronavirus update | rate cut | feed rate | feed rate cut | new york city | fight coronavirus | stock market us | asian stock market | us futures sink | market us futures | us futures sink feed | us futures sink | futures sink feed | sink feed | futures sink feed

Topic #9:

coronavirus pandemic | employees | world news | coronavirus crisis | msa | european stock | coronavirus european stock | coronavirus european | amid coronavirus pandemic | federal government | amid coronavirus crisis | business insider | payroll tax cut | coronavirus pandemic | new york city

Topic #10:

stock market | amid coronavirus pandemic | coronavirus response | area shelterinplace | bay area | bay area shelterinplace | trump coronavirus | order due coronavirus | area shelterinplace | shelterinplace order due | order due coronavirus | san francisco bay | san francisco bay area | order due | much san francisco bay

Topic #11:

coronavirus response | rat near zero | shelterinplace | feed slash rat | feed cut rat | amid coronavirus | near zero | us futures | cut interest rat | business insider | european central bank | amid coronavirus fear | stock market | rat near zero | federal reserve cut

Topic #12:

1 trillion | video | asian stock market | feed take emergency | take emergency action | market us | rate cut | us futures | stock market | people die | us futures sink | futures sink feed | us futures sink | us futures sink feed | asian stock market

Topic #13:

feed inject | unusual disruptions | inject 15t | feed inject 15t | disruptions market | prevent unusual disruptions | prevent unusual | unusual disruptions | unusual disruptions | unusual disruptions market | 15t prevent | 15t prevent | 15t prevent unusual | inject 15t prevent | 15t prevent

Topic #14:

| live update | coronavirus live update | coronavirus live update | | coronavirus | market | white house | slash rat | feed slash rat | news | rat near zero | world news | washington post | rate cut

Topic Taxonomy

- Leveraged the LDA analysis and manual research to identify a sensible taxonomy to cover the news being discussed at the time

```
topic_taxonomy = {
  "Markets": {
    "Equity Markets": "S&P NASDAQ NIKKEI stocks stoxx dow circuit red green bear bull wall street 1987 up down calm",
    "Credit Markets": "commerical paper bond rating grade revolving drawdown creditline junk default spreads liquid",
    "Derivative Markets": "futures swaps arbitrage"
  },
  "Federal Reserve": {
    "Monetary Policy": "Jay powell purchases scale buy rate interest treasuries asset securities quantitative inflation s
lash",
    "Emergency Measures": "liquidity facilities bid-ask TALF CPFF MBS capital disruption"
  },
  "Commentary": {
    "Fiscal Policy": "deficit spending paycheck deposit loan SBA PPP trillion tax payroll bill",
    "Economy": "growth GDP economic recession boom jobless unemployment unemploy",
    "Coronavirus": "coronavirus covid pandemic covid19 dead death die mortality ventilators PPE flatten hospital",
    "Politics": "trump president capitol secretary republican democate senate senator representative Mcconnell pelosi"
  },
  "industry": {
    "Sectors": "airlines hospitality restaurant cruises bankrupt oil fracking opec",
    "Companies": "carnival disney netflix amazon ups fedex"
  }
}
```

Top 10 articles

Politics

Former Obama official on coronavirus: 'Both the president and Congress are utterly failing'

Rep. Ron Kind touts bipartisan House response to coronavirus in La Crosse, urges Senate to pass bill | Government and Politics | lacrossetribune.com

Sen. Durbin says Senate should consider working, voting remotely

Dr. Paul Jacobs will be Republican candidate for Illinois' 115th Representative District

GOP senator warns bailout-seeking firms: Must show plan to bring 'jobs back' to America

GOP senator warns bailout-seeking firms: Must show plan to bring 'jobs back' to America

GOP senator warns bailout-seeking firms: Must show plan to bring 'jobs back' to America

White House and Pelosi come together for massive aid packages. Sen. McConnell tells Republicans to "Hold your nose and vote for the bill."

AP FACT CHECK: Trump, Dems and politics of the pandemic

AP FACT CHECK: Trump, Dems and politics of the pandemic

Monetary Policy

Fed buys more mortgage bonds as rates rise above 4%

Fed cuts main interest rate to near zero, to boost assets by \$700B

Fed cuts main interest rate to near zero, to boost assets by \$700B

Fed cuts main interest rate to near zero, to boost assets by \$700B

Fed cuts main interest rate to near zero, to boost assets by \$700B

Fed cuts main interest rate to near zero, to boost assets by \$700B

Stock market today: Coronavirus stimulus checks from White House, Fed rate cuts see stocks rise

COVID-19: US Federal Reserve cuts interest rate to zero

Fed slashes key interest rates to 0%, announces \$700 billion QE program, and dollar swap to address coronavirus panic - MarketWatch

Central banks and [large scale](#) asset purchases

Top 10 articles

Equity Markets

Stock markets formally enter bear zone; Sensex slump 2,900

Coronavirus sinks Dow into bear market territory, other major indices down 5% - the bear is back with a vengeance

Coronavirus sinks Dow into bear market territory, other major indices down 5% - the bear is back with a vengeance

Markets rise on stimulus hopes; Sensex up 1,628 pts, Nifty ends above 8,700

Stock market news live: Stock futures surge, hitting limit-up a day after sinking into a bear market

Stock market news live: Stock futures surge, hitting limit-up a day after sinking into a bear market

Stock market news live: Stock futures surge, hitting limit-up a day after sinking into a bear market

Stock market news live: Stock futures surge, hitting limit-up a day after sinking into a bear market

EUR/JPY: Market has turned indecisive amid wild swings in stocks

American stocks engaged in a bear market? [2](#) Today's stock market advice

Emergency Measures

Federal Reserve provides liquidity for money market funds

US Fed opens liquidity facility for Brazil, Mexico, others

Fed to establish temporary dollar liquidity arrangements with other CBs

Fed must elastically supply liquidity to ensure functioning of markets, [sufficient](#) cash for businesses

Bond investors remain thirsty, despite Fed liquidity efforts

U.S. Fed moves to ensure liquidity in money market mutual funds | News | WIN 98.5

Federal Reserve Board broadens program of support for the flow of credit to households and businesses by establishing a Money Market Mutual Fund Liquidity Facility (MMLF)

Fed starts bond purchases under ramped up liquidity program

Fed starts bond purchases under ramped up liquidity program | WIBQ

Fed expands lending facility to support municipal bond market

Top 10 articles

Economy

Fed's Rosengren: US economy to suffer a 'significant shock' with higher unemployment
Economic stimulus can't save US from deflation and recession
Mnuchin sees 20% unemployment without Covid-19 stimulus | Gray's Economy
Global economy headed for recession
Economic downturn temporary
Coronavirus recession layoffs require reforms to the Unemployment Insurance program now to fully protect all U.S.

workers

Markets slide despite government stimulus pledges to fight Covid-19 recession - business live | Business
Markets slide despite government stimulus pledges to fight Covid-19 recession - business live | Business
Markets slide despite government stimulus pledges to fight Covid-19 recession - business live | Business
Economists say recession a reality locally, statewide

Derivative Markets

Global markets and US stock futures rally as central banks go all-in - rockdalenewtoncitizen.com
US equity index futures trading on Globex have hit limit down
Stock market futures plummet despite Fed intervention
12h - US futures indikují další propad zřejmě opětovně až o 9%
Gasoline futures log lowest settlement in 11 years - Global Rubber Markets
Stock market news live: Stocks futures drop after Fed slashes rates, launches quantitative easing
Stock market news live: Stocks futures drop after Fed slashes rates, launches quantitative easing

Credit Markets

What zero rates, sub-1% bond yields mean for your mortgages, student loans and credit cards
What zero rates, sub-1% bond yields mean for your mortgages, student loans and credit cards
What zero rates, sub-1% bond yields mean for your mortgages, student loans and credit cards
What zero rates, sub-1% bond yields mean for your mortgages, student loans and credit cards
What zero rates, sub-1% bond yields mean for your mortgages, student loans and credit cards
Saudi banks placed on Fitch rating watch as oil prices drop
Investors 'caught in the headlights' as ABS and CLO spreads widen rapidly
Dash for cash: investors dump shares, bonds in wild week for markets
Dash for cash: investors dump shares, bonds in wild week for markets
Euro zone bond yields tumble as risk sentiment picks up

Coronavirus

HHS official ducks whether there'll be enough ICU beds and ventilators available for coronavirus patients
Tesla's Musk offers to make ventilators to help coronavirus fight | Coronavirus pandemic News
Italy reports one-third of deaths in global coronavirus pandemic
Italy reports one-third of deaths in global coronavirus pandemic
Italy reports one-third of deaths in global coronavirus pandemic
Italy reports one-third of deaths in global coronavirus pandemic
Italy reports one-third of deaths in global coronavirus pandemic

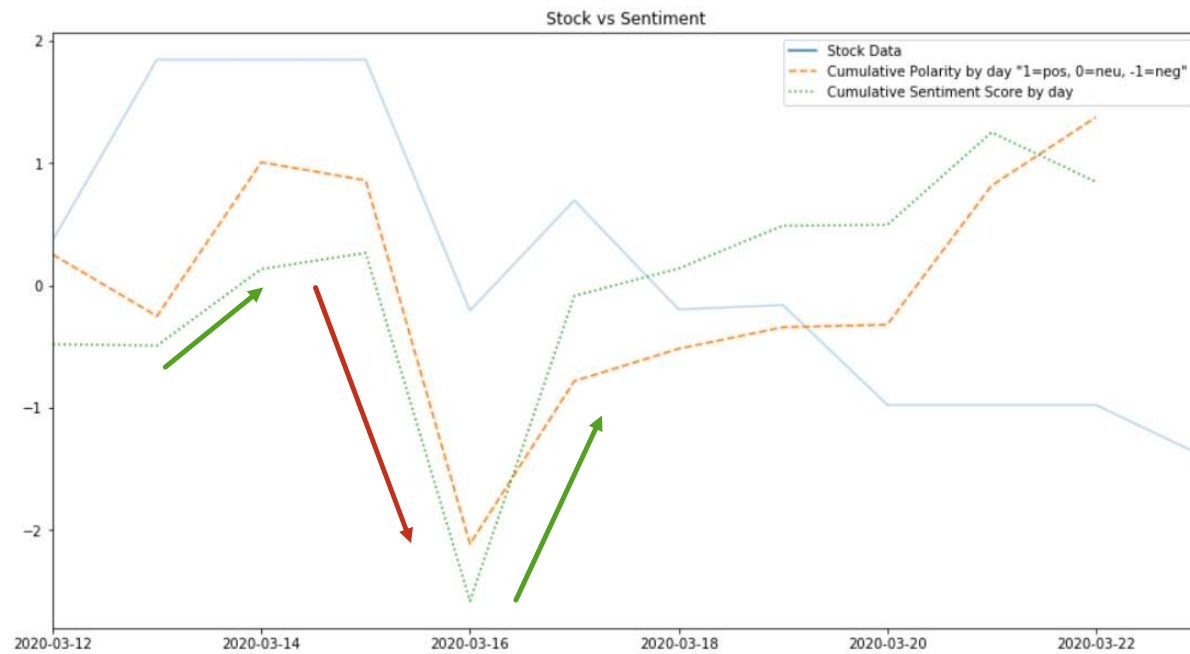
Sentiment Analysis

- ▶ Sentiment scores and polarity calculated for the full deduped dataset
- ▶ Cumulative compound scores for daily data is calculated
- ▶ Similarly, for sentiment polarity assign +1 (positive), -1 (negative), 0 (neutral) and calculate cumulative score
- ▶ Using Sentiment Intensity Analyzer
- ▶ Using Naïve-Bayes on a manually trained model

```
Counter({'2020-03-22': -78.36400000000052,  
        '2020-03-21': 45.26999999999958,  
        '2020-03-20': -185.78839999999929,  
        '2020-03-19': -187.85449999999915,  
        '2020-03-18': -294.7051999999999,  
        '2020-03-17': -363.2842999999982,  
        '2020-03-16': -1125.0193000000113,  
        '2020-03-15': -255.60309999999947,  
        '2020-03-14': -296.14830000000075,  
        '2020-03-13': -487.3104999999998,  
        '2020-03-12': -483.8795999999976})
```

```
Counter({'2020-03-22': -593,  
        '2020-03-21': -1073,  
        '2020-03-20': -2049,  
        '2020-03-19': -2067,  
        '2020-03-18': -2218,  
        '2020-03-17': -2445,  
        '2020-03-16': -3589,  
        '2020-03-15': -1036,  
        '2020-03-14': -909,  
        '2020-03-13': -1989,  
        '2020-03-12': -1556})
```

Plot of Sentiment vs closing price of S&P 500 ETF



Conclusions

- ▶ Market was very volatile during the time and there is some evidence of positive correlation between the sentiment of the news concerning the Fed
- ▶ Topics around this time were largely focused on the economy, coronavirus, market fluctuations and fed actions

