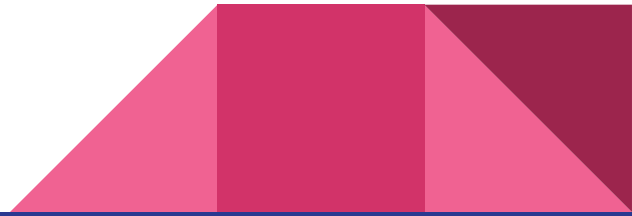
Exploring the Relationship Between the Economy and USA Federal Interest rates

By: Jacob Curry and Gabriel Rodriguez

Overview

- Context of Federal Interest Rates and Data
- Explanation of EFFR
- Questions
  - Question 1:
    - Strategy
    - Analysis
    - Answer
  - Question 2:
    - Strategy
    - Analysis
    - Answer
- Summary and Next Steps



Context of Federal Interest Rates

- Set and determined by the Federal Reserve (US Central Bank)
- Meant to help the dual mandate of the Federal Reserve
  - Maximize Employment
  - Healthy ~3-4% Yearly Inflation
- Gathered data on Effective Federal Funds Rate (EFFR) and four economic features
  - Real GDP
  - Unemployment Rate
  - Inflation Rate
  - Core PCE

Explanation of EFFR

- The Effective Federal Funds Rate is the rate that banks lend excess reserves to each other overnight
- Federal Reserve sets these rates by having a range for EFFR
  - E.g. Current target rate 375 - 400 bps (3.75% - 4%)
  - Federal Reserve through the Repo Market will offer to borrow from banks at the upper range (4%) and lend to banks at 3.75%; this sets the range in stone and influences the EFFR

Questions

- **Question 1**
  - ***Can our models predict future Federal Reserve interest rate decisions just based on economic and market data? How dependent is the Federal Reserve on economic data really?***
- Question 2
  - *Do different time periods (e.g., the "stagflation" era, 2008 recession, and post-Covid) have different relationships between the features and federal interest rates?*

Question 1 Strategy

- Make federal interest rates categorical
  - Used the five-number summary to create ranges of federal interest rates

Interest Rate Range (measured in %**)**	**Frequency in Dataset**
[0.05, 1.225)	150
[1.225, 4.99)	150
[4.99, 7.1125)	150
[7.1125, 19.1]	148

- Trained classification models
  - Pair of Decision Trees
  - Pair of Neural Networks

Question 1 Analysis

KDD Method	Accuracy (measured in %)
Decision Tree (Scikit-Learn)	84.56%
Decision Tree (Lab)	59.73%
Neural Network (Scikit-Learn)	85.91%
Neural Network (Lab)	24.44%

- Generally strong performance (random guess = 25% accurate)
- No clear winner between decision tree and neural network
- Labs are inferior to Scikit-Learn
  - Lack of tuning and hyperparameter options

Question 1 Answer

- *Can our models predict future Federal Reserve interest rate decisions just based on economic and market data? How dependent is the Federal Reserve on economic data really?*
  - Yes!
  - Strong performance with Scikit-Learn classification
  - Permutation Test-Based Feature importance:

Feature	**Importance** (Accuracy, %)
Core PCE	45.10%
Inflation Rate	30.07%
Unemployment Rate	29.13%
Real GDP	7.85%

Questions

- Question 1
  - *Can our models predict future Federal Reserve interest rate decisions just based on economic and market data? How dependent is the Federal Reserve on economic data really?*
- **Question 2**
  - ***Do different time periods (e.g., the "stagflation" era, 2008 recession, and post-Covid) have different relationships between the features and federal interest rates?***

Question 2 Strategy

- We decided to implement permutation-based feature on seven different economic/Federal Reserve regimes since January 1973 to October 2022:
  - The Stagflation Era (1973 - 1982)
  - The Reagan/Bush Era (1983 - 1992)
  - The Clinton Era (1993 - 2000)
  - The War on Terror Era (2001 - 2007)
  - Global Financial Crisis Era (2008 - 2015)
  - Trump Era (2016 - 2019)
  - Covid/Post-Covid Era (2020 - Present)
- Trained Decision Trees and used sklearn and lab feature importance on testing data set and compared

Question 2 Analysis

Stagflation Era	Feature Importance (Lab)	Feature Importance (sklearn)
RealGDP	0.0727	0.0729
Unemployment Rate	0.3368	0.3386
Inflation Rate (CPI)	0.2378	0.2380
Core PCE	-0.0102	-0.0093

Reagan/Bush Era	Feature Importance (Lab)	Feature Importance (sklearn)
RealGDP	-0.0074	-0.0065
Unemployment Rate	0.1664	0.1723
Inflation Rate (CPI)	0.0584	0.0574
Core PCE	0.2509	0.2501

Question 2 Analysis Continued

Clinton Era	Feature Importance (Lab)	Feature Importance (sklearn)
RealGDP	0.0147	0.0162
Unemployment Rate	0.3049	0.3017
Inflation Rate (CPI)	0.0274	0.0272
Core PCE	-0.0013	-0.0029

War-on-Terror Era	Feature Importance (Lab)	Feature Importance (sklearn)
RealGDP	0.0243	0.2467
Unemployment Rate	0.4009	0.4002
Inflation Rate (CPI)	0.1606	0.1574
Core PCE	0.0329	0.0337

Question 2 Analysis Continued

Recession Era	Feature Importance (Lab)	Feature Importance (sklearn)
RealGDP	0.1340	0.1351
Unemployment Rate	0.0860	0.0886
Inflation Rate (CPI)	0.2950	0.2934
Core PCE	0.0677	0.0636

Trump Era	Feature Importance (Lab)	Feature Importance (sklearn)
RealGDP	0.0009	0.0011
Unemployment Rate	0.4447	0.4468
Inflation Rate (CPI)	-0.0741	-0.0731
Core PCE	0.0643	0.0593

Question 2 Analysis Continued

Covid/Post-Covid Era	Feature Importance (Lab)	Feature Importance (sklearn)
RealGDP	0.0	0.0
Unemployment Rate	0.2659	0.2611
Inflation Rate (CPI)	0.1523	0.1549
Core PCE	0.1593	0.1635

Question 2 Answer

- Question: Do different time periods (e.g., the "stagflation" era, 2008 recession, and post-Covid) have different relationships between the features and federal interest rates?
  - Yes! There is a stark contrast between the economic variables that are/were important in determining the Effective Federal Funds Rate in different Fed Chair/Presidency regimes
  - This makes sense, for example we had extremely high interest rates in the late 70s. So that being the most important feature for determining Federal Reserve decisions is intuitive

Summary and Next Steps

- Federal Reserve has always stated that they are data-driven in their determination of Interest rate hikes
    - We found this to be mostly true and their most looked-at economic indicator, Core PCE, was significantly more important based on Permutation-based feature importance calculations.
- We found that in different Federal Reserve Chair/Presidential regimes there were significant differences in which economic variable was most important in determining EFFR increases by the Federal Reserve
- We would like to look further at how we can use these models to predict futures *sizes* of EFFR increases and see if we can predict movements in Treasury, FX, and Equity markets based on our model's predictions.