# Unlocking Pre-Provision Net Revenue

## Diving into the Power of Interest Income

Mentor:
Dr. Kristina Martin

Team:
Harshita Agrawal, Meaghan Allen, Obed Domson,
Yixuan Huang, Sebastian Jaramillo

Any views expressed are those of the presenters and not of the Federal Reserve Bank of Minneapolis or the Federal Reserve System.

# Federal Reserve Bank

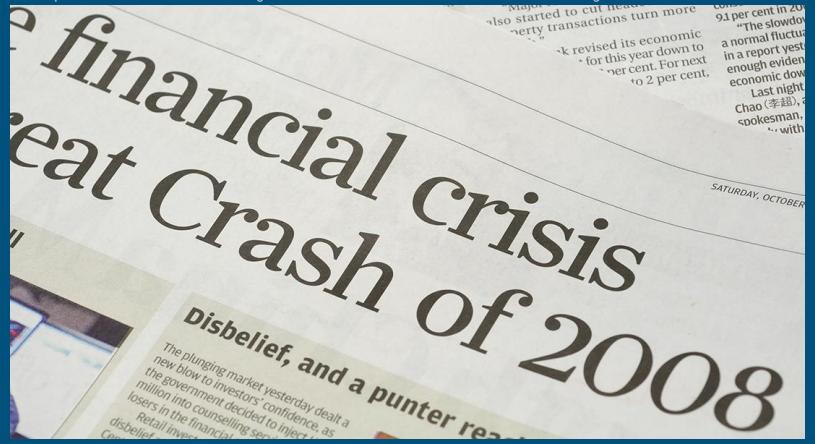
## Stress Test

evaluates resilience of large financial institutions to withstand economic shocks

## Pre-provision Net Revenue (PPNR)

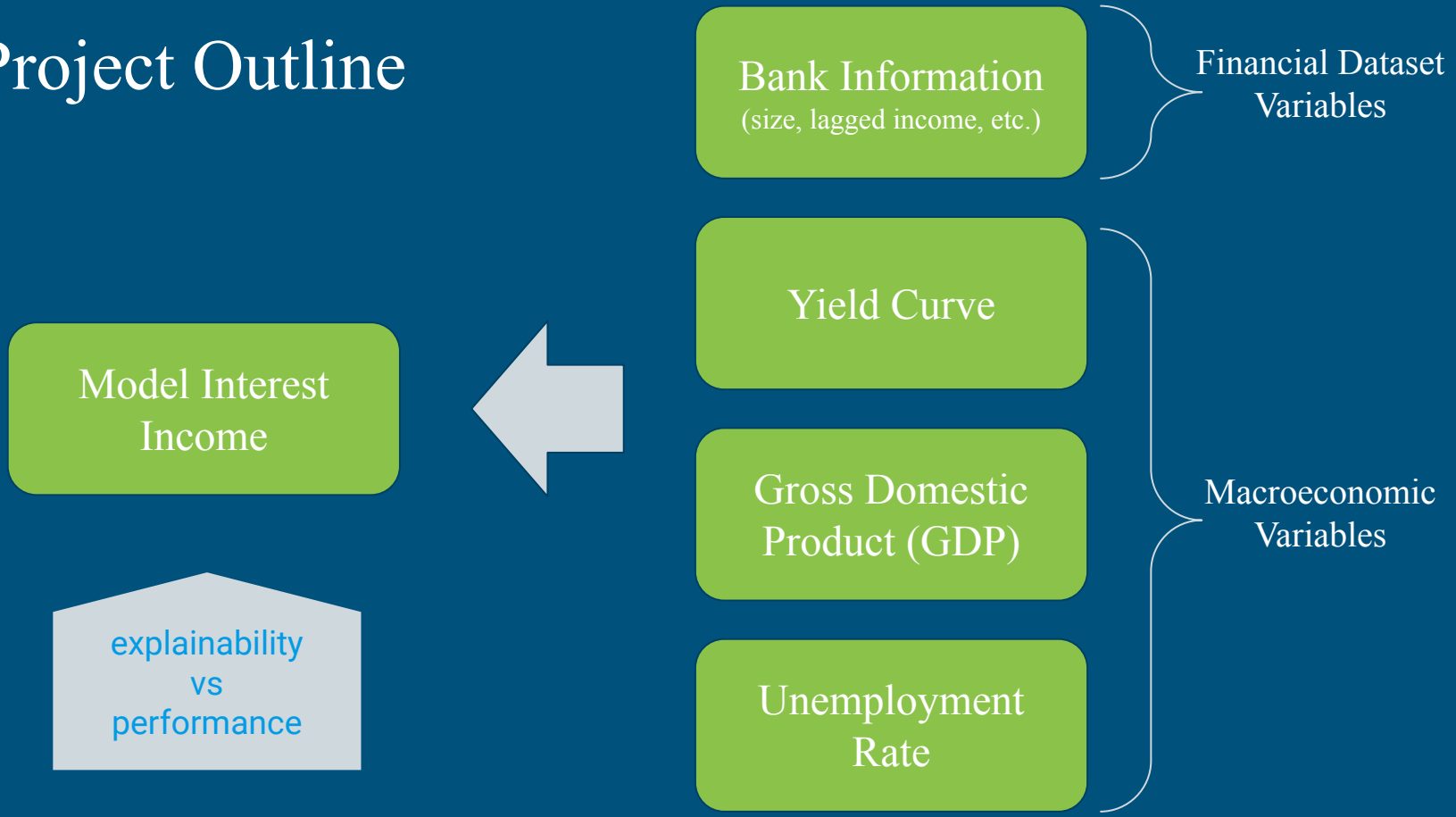
Interest Income - Interest Expense + Noninterest Income - Noninterest Expense

https://www.scu.edu/illuminate/thought-leaders/hersh-shefrin/what-made-the-financial-crisis-go-from-bad-to-disaster.html



https://abcnews.go.com/Business/financial-assistance-coronavirus-crisis/story?id=69689211

# Project Outline



# Data

- Financial Data
- Macroeconomic Data

# Financial Data

## Data Info

Federal FR 9-YC form

Years: 2004-2024

Quarterly

## Variables

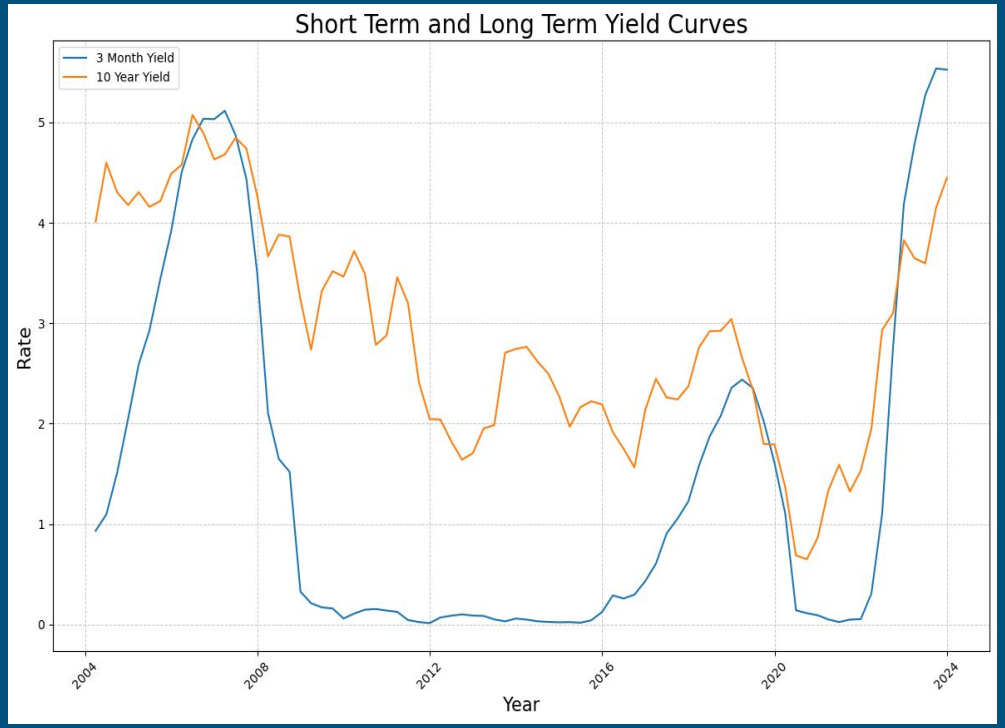
Bank Info (Name, ID)

Year and Quarter

Normalized Interest Income

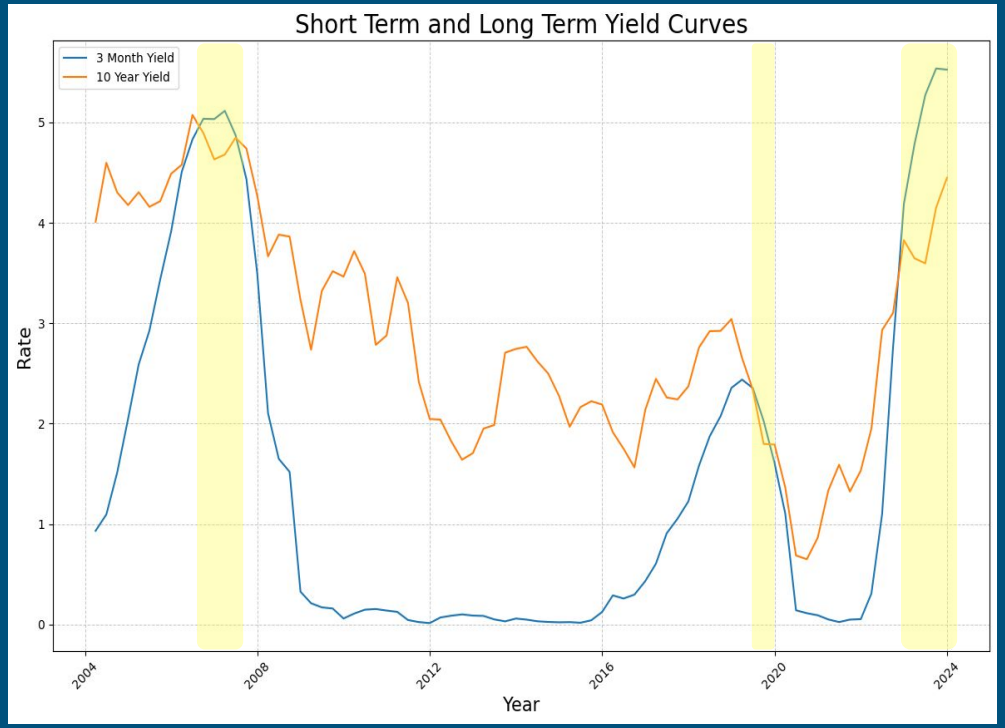
**Lagged Income** (normalized interest income from previous quarter)

# Macroeconomic Data




**Yield Curves**

# Macroeconomic Data

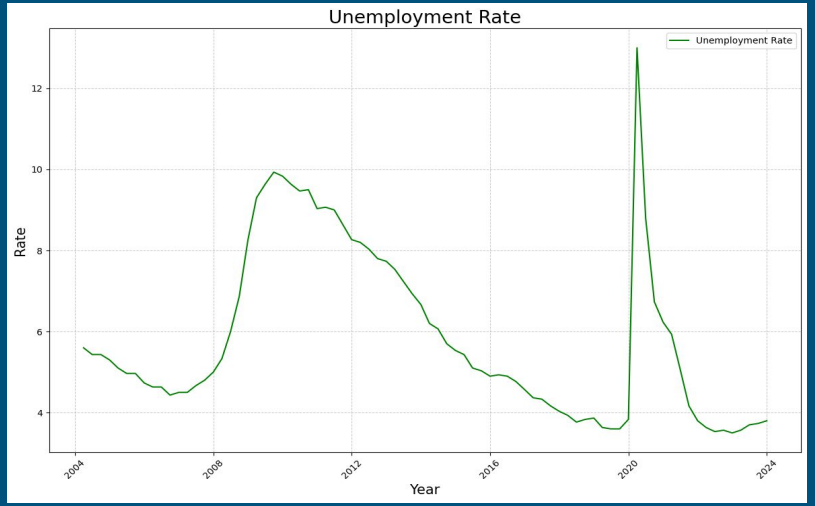



## Yield Curves

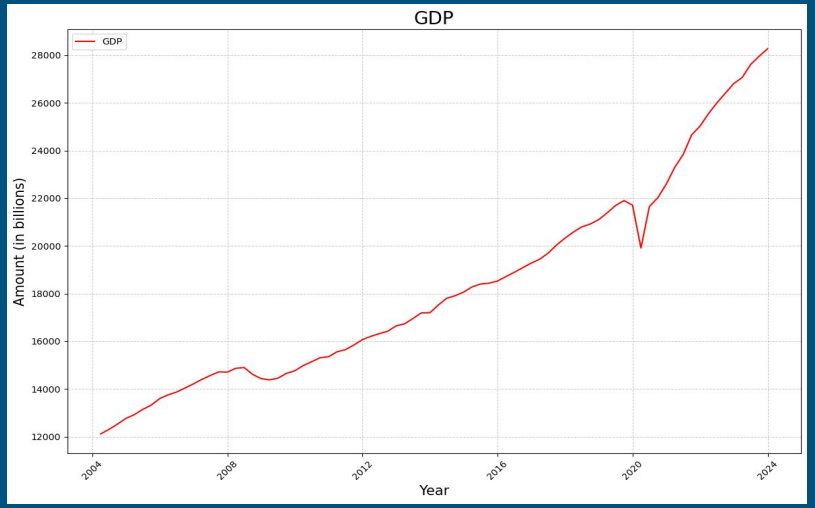
- Periods where short term yields were higher than long term
- Bad sign for economy

# Macroeconomic Data

## Unemployment Rate



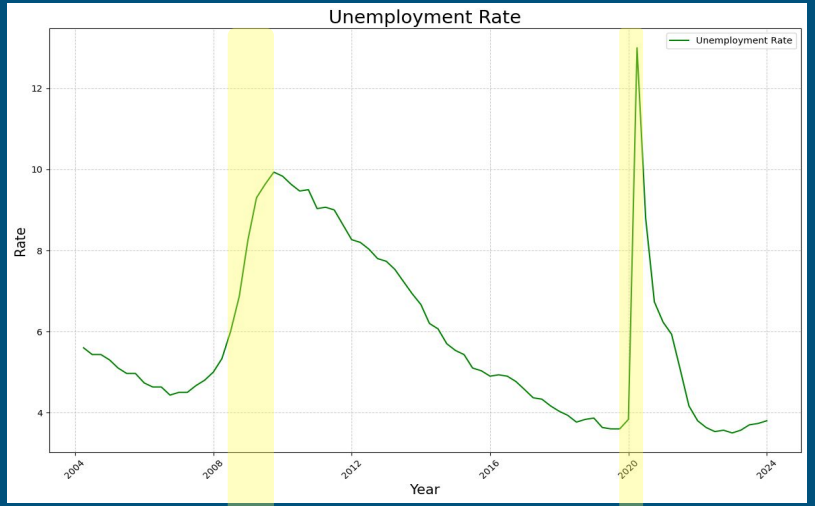

## Gross Domestic Product (GDP)



# Macroeconomic Data

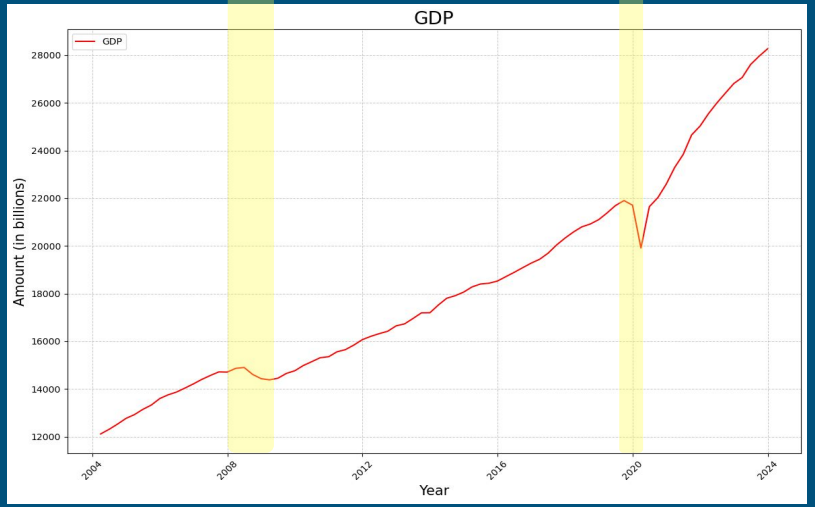
## Unemployment Rate

- Unemployment Rate spiking




## Gross Domestic Product (GDP)

- GDP decreasing

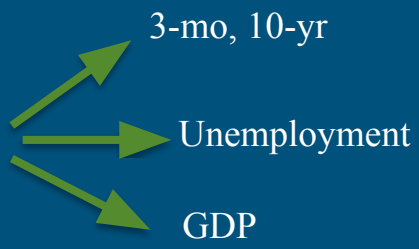


# Models

- Linear Regression
- Regression Trees
- Random Forest

# Linear Regression

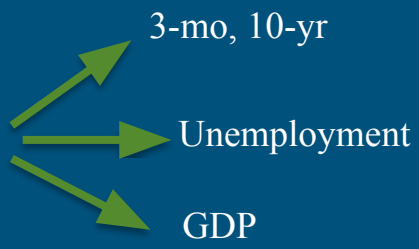
- Normalized Interest Income vs
  - Macroeconomic indicators




$R^2 = 0.44$

# Linear Regression

- Normalized Interest Income vs
  - Macroeconomic indicators

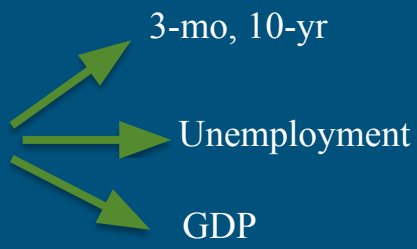



$R^2 = 0.44$

  - Macroeconomic + Lagged Income

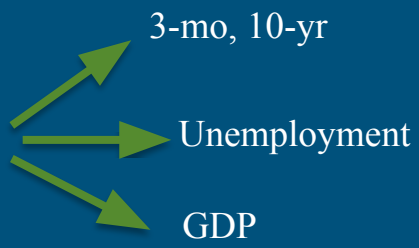
$R^2 = 0.81$

# Linear Regression

- Normalized Interest Income vs
  - Macroeconomic indicators 

    R^2 = 0.44
  - Macroeconomic + Lagged Income R^2 = 0.81
  - **Lagged Income ONLY** R^2 = 0.79

# Linear Regression

- Normalized Interest Income vs
  - Macroeconomic indicators 

    R^2 = 0.44
  - Macroeconomic + Lagged Income R^2 = 0.81
  - **Lagged Income ONLY** R^2 = 0.79

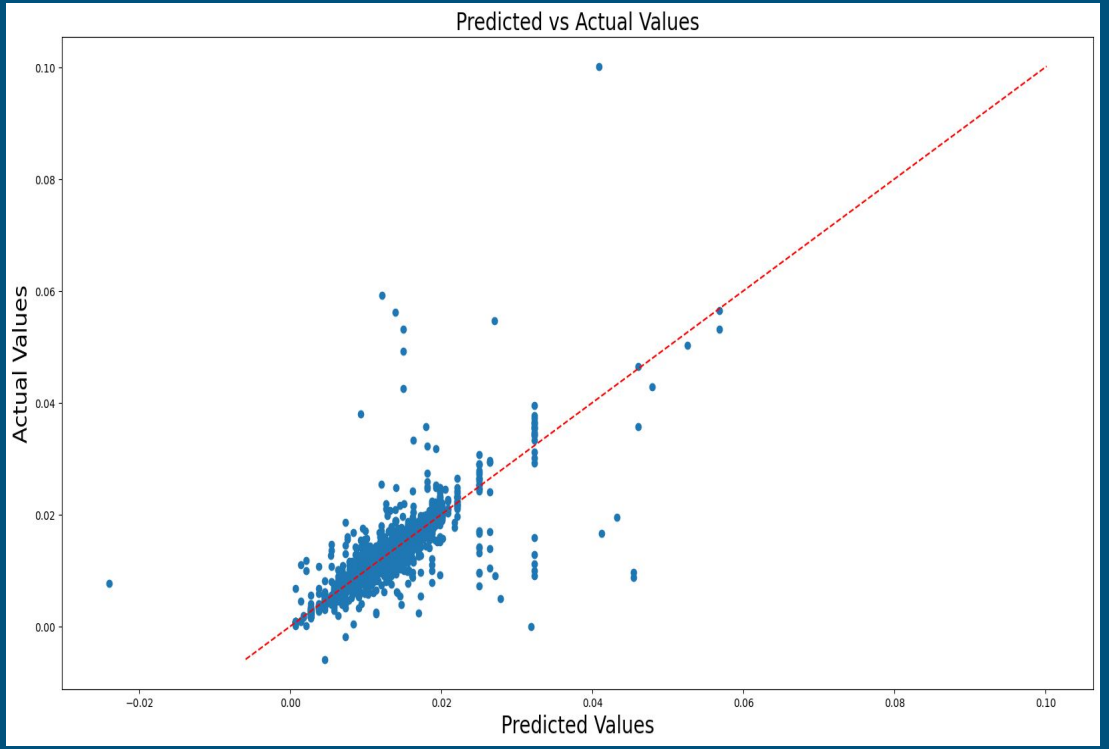
**Lagged Income is the feature with most importance!**

# Regression Trees

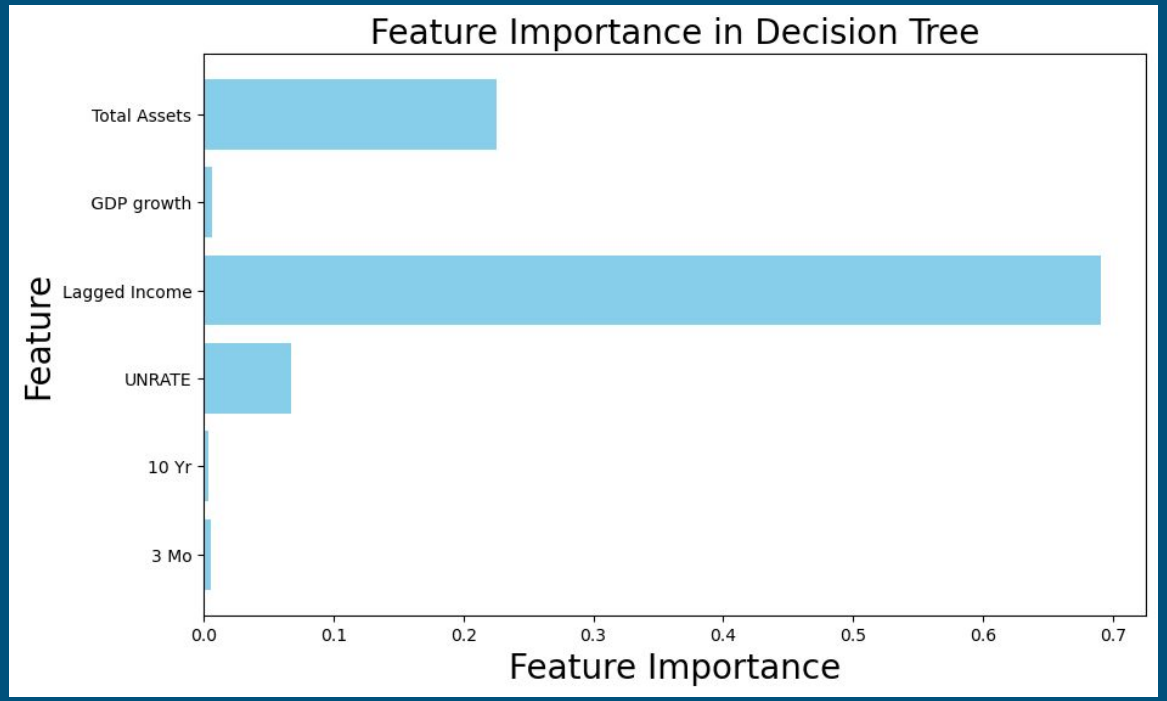
- Variables:
  - Macroeconomic indicators
  - Lagged Income + Total Assets

- R^2 score = 0.81

- Red line: perfect prediction



# Regression Trees



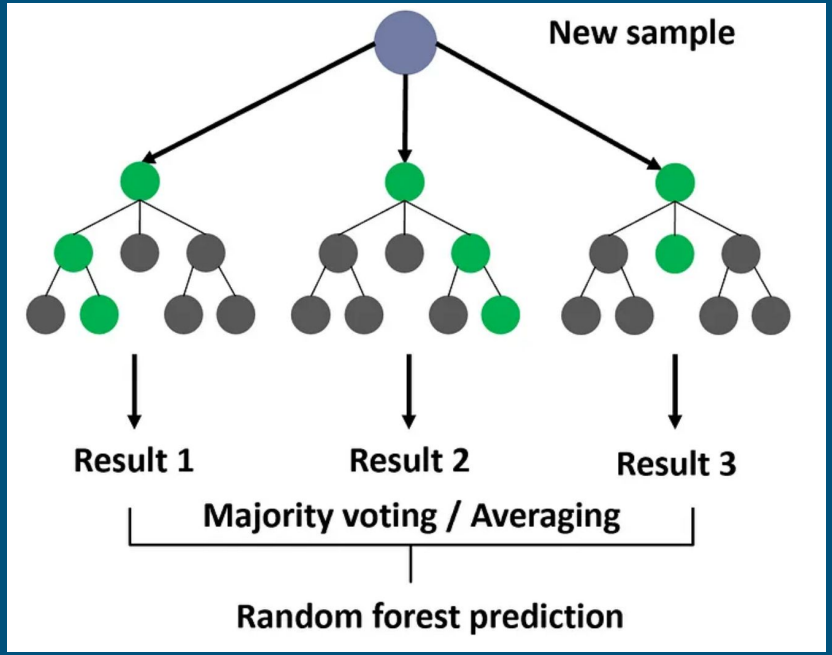

Top Important Features:

- Lagged Income
- Total Assets
- Unemployment Rate

# Random Forest

HOW?

- Multiple Subsets of Data
- Train Decision Trees for Each Subset
- Aggregate Predictions




PROS:

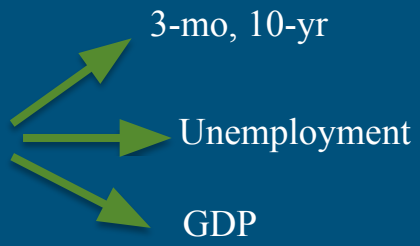
- High accuracy
- Robustness

CONS:

- High complexity
- Hard to interpret

# Random Forest

- Macroeconomic indicators




R^2 = 0.45

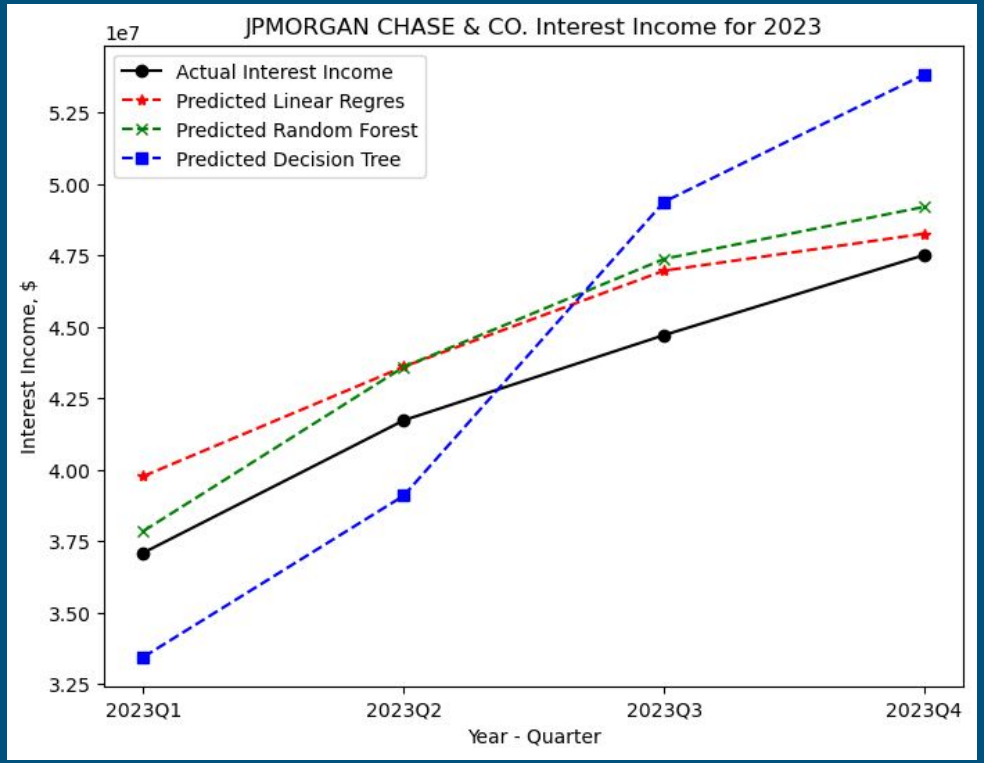
- Macroeconomic + Lagged Income

R^2 = 0.81

# Results

- 2023 Predictions
- 2008 Crisis
- 2020 Pandemic
- Conclusion
- Future Work

# 2023 Prediction Accuracy for JP Morgan Chase




Linear Regression:

- Oversimplify complex relationships.
- Do not capture non-linear effects.

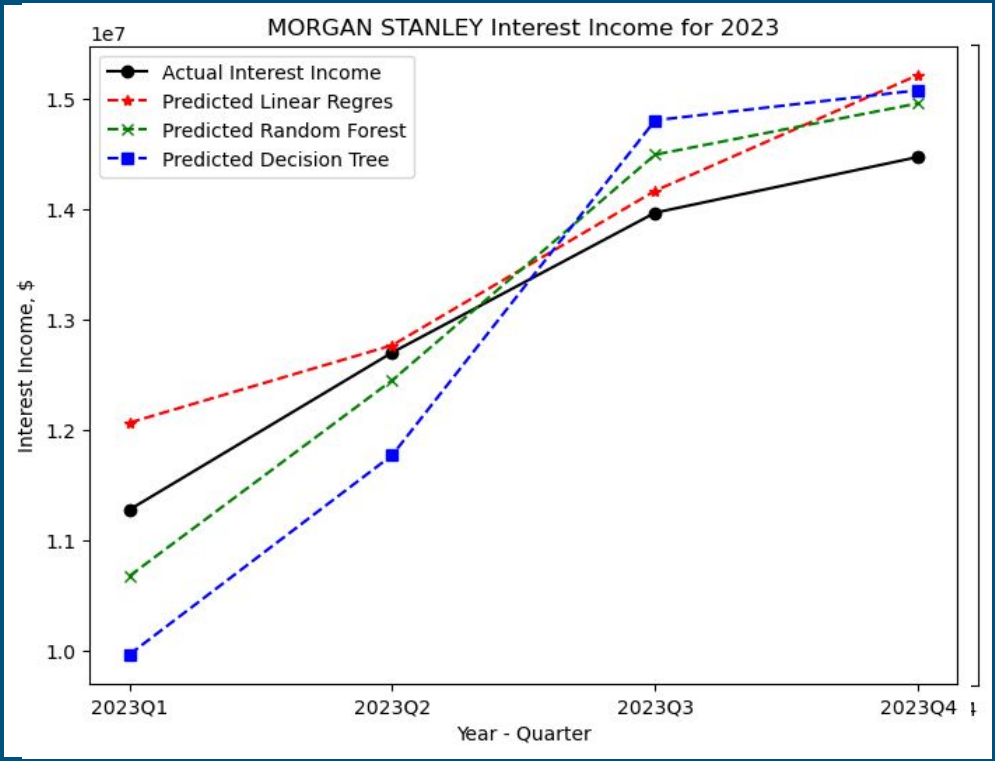
Decision Tree:

- Sensitive to fluctuations.
- Might overfit the data

Random Forest:

- Robust
- Strong prediction for 1st Quarter
- Follows the trend.

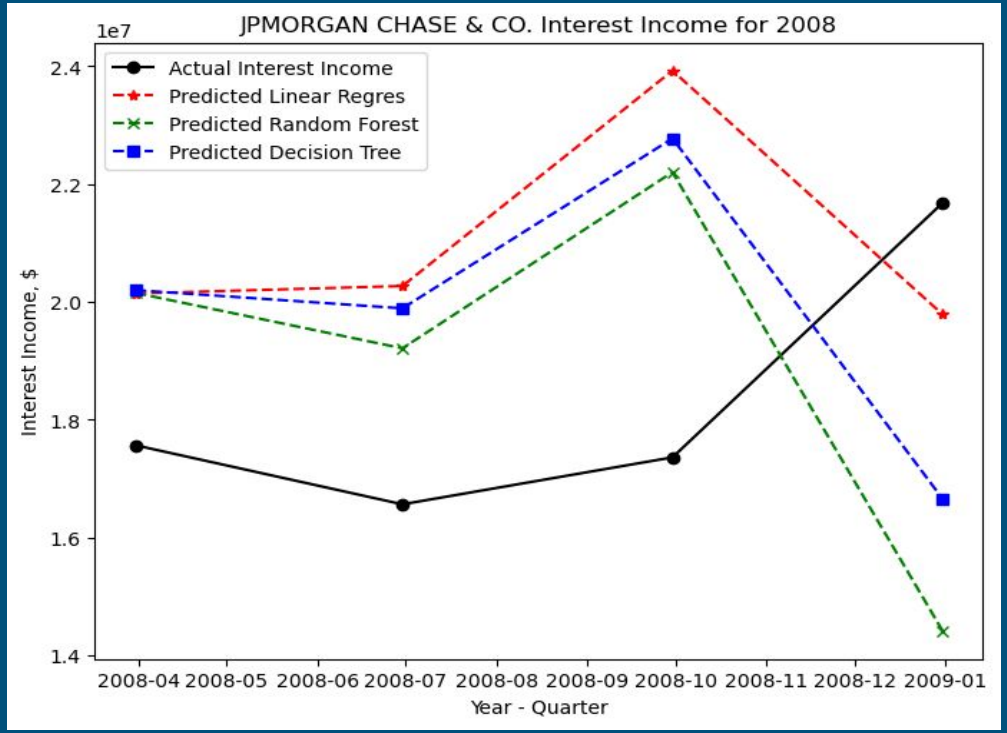
# 2023 Prediction Accuracy for Morgan Stanley




Similar patterns

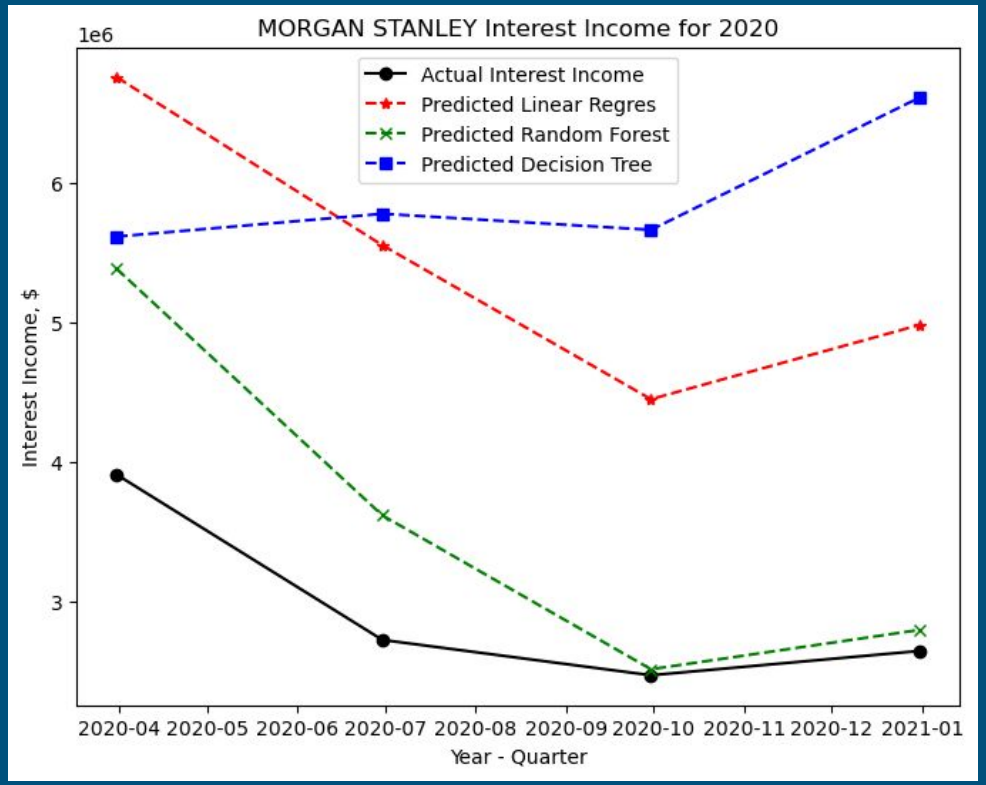
- Robustness shown by Random Forest
- Follows the trend
- Good 1st and 4th Quarter Prediction

# 2008 Crisis Predictions for JP Morgan Chase




- Good predictions for first 3 quarters.
- Deviates in the fourth quarter.
- Models do not undergo overfitting.

# 2020 Pandemic Predictions for Morgan Stanley




- Robustness shown by Random Forest
- Follows the trend
- Good 3rd and 4th Quarter Prediction

# Conclusions

- Exploration of multiple modeling approaches
- Importance of features in the prediction for interest income
- Accurate prediction, not overfitting

# Future Work

- Feature Engineering and Selection
- Real-Time Data Integration
- Hybrid Models

# Thank you! Questions?