

# Stock Market Analysis

## UCB - Project 4



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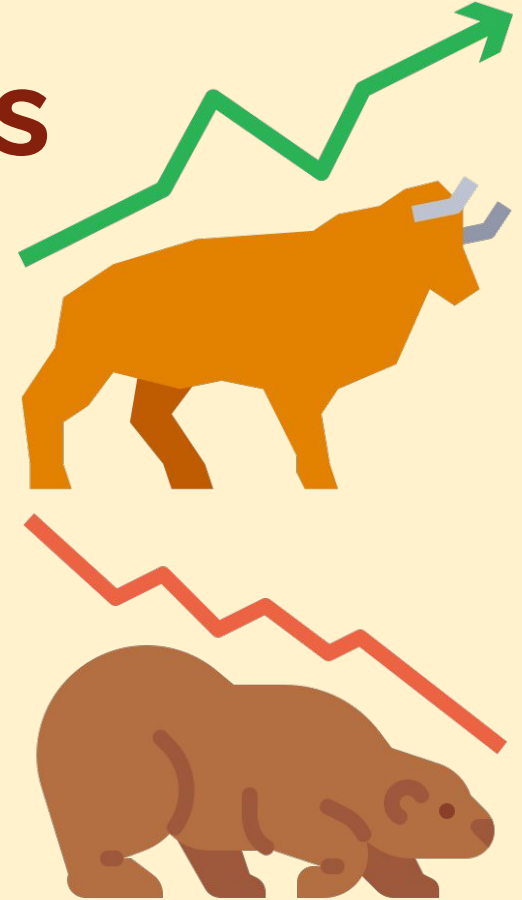
# Stock Market: Basics

- Understanding Market Participation

- **61%** of the American adult population is actively investing in the stock market
- Over the past century, the S&P 500 has shown an upward trend, being up in roughly **70%** of the years

- Why Invest?

- Higher earning potential
- Beating inflation
- Passive income
- Ownership in a company
- Diversification
- Long-term wealth building



# Objective



## Forecast..

*stock prices for specific companies using historical data and market indicators*



## Provide..

*insights into potential future trends based on predictive modeling techniques*

# Important Disclosure

- **Inherent Market Risks**

- Volatility
- Fluctuations in prices
- Potential loss for capital
- Other events (War, COVID, Election)

- **Due Diligence**

- Prior to investing, its essential to review all associated documents including prospectuses, memorandums, and any relevant terms & conditions



# Industries & Companies

Our analysis focused on..



Technology



Automotive



**HONDA**



# Database

- Extract, Transform, & Load

- The data with the high, low, close, adj close, volume, Fear Index, Spy Index, and Fed Funds were extracted as CSV files from Yahoo Finance
- The moving averages, RSI, and BB data were extracted using the finta module
- Data was transformed to a dataframe in order to be trained & fit to the regression model
- Data was transformed again to csv file to upload into database and create visualizations on Tableau

Query

Query History

-- Drop tables from database if already exist (resets database and will need to import/re-improt data)

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3 DROP TABLE IF EXISTS apple;

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6 -- Create contacts table with primary key as contact\_id

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8 CREATE TABLE apple (

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10 Date date NOT NULL PRIMARY KEY,

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12 volume VARCHAR NOT NULL,

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14 Fear\_index VARCHAR NOT NULL,

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16 SPY\_index VARCHAR NOT NULL,

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18 FEDFUNDS VARCHAR NOT NULL,

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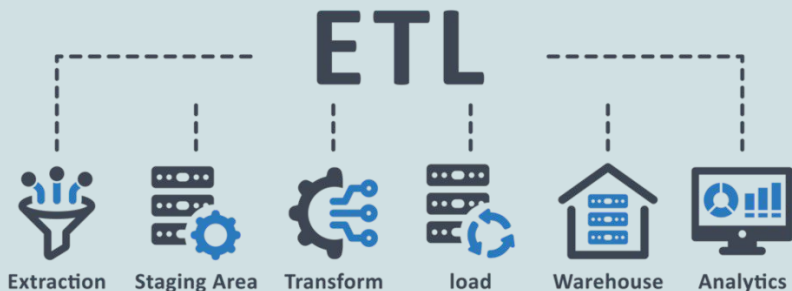
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- Importing Our Data

- After successfully training/testing our model on our companies, we imported our new prepared CSVs into pgAdmin

- Verification

- After table creation, our import was verified by querying the tables

- Data Integrity Maintenance

- o A mechanism to reset the database was implemented by dropping existing tables before creating new ones, ensuring data integrity and consistency during re-imports.

# Data Model Optimization

- **Random Forest Regressor**

- Worked well with test data but was the model was overfitting the training data. This led to a 99% accuracy of the model.

- **Gradient Boosting Regressor**

- Similar to Random Forest, this model lead to a very high accuracy





# Data Model Implementation



- **Downloaded historical financial data**
  - Via Yahoo Finance
  - April 2014 - April 2024
- **Uploaded each dataset into Jupyter**
  - Prepared & transformed the data
- **Split data into our test and train data**
  - Trained the models

# Data Model Implementation

## Our 1st Model: Apple - 'AAPL'

```
[53]: # Filter models where both Train R-squared and Test R-squared are less than 0.96
      filtered_indices = [i for i, (train_r2, test_r2) in enumerate(zip(selected_train_r2, selected_test_r2)) if train_r2 < 0.96 and test_r2 < 0.96]

      # Calculate the absolute difference between train R-squared and test R-squared values for filtered models
      abs_diff_r2_filtered = np.abs(np.array(selected_train_r2)[filtered_indices] - np.array(selected_test_r2)[filtered_indices])

      # Find the index of the model with the smallest absolute difference among filtered models
      best_model_index = filtered_indices[np.argmin(abs_diff_r2_filtered)]

      # Retrieve the metrics for the best model
      best_train_r2 = selected_train_r2[best_model_index]
      best_test_r2 = selected_test_r2[best_model_index]
      best_train_mae = selected_train_mae[best_model_index]
      best_train_mse = selected_train_mse[best_model_index]
      best_test_mae = selected_test_mae[best_model_index]
      best_test_mse = selected_test_mse[best_model_index]

      # Print metrics for the best model
      print(f"Best Model - Train R-squared: {best_train_r2}, Test R-squared: {best_test_r2}, Train MAE: {best_train_mae}, Train MSE: {best_train_mse}, Test MAE: {best_test_mae}, Test MSE: {best_test_mse}")
```

Best Model - Train R-squared: 0.9379782750204122, Test R-squared: 0.9393265203901559, Train MAE: 8.751428891894557, Train MSE: 123.41515739309779, Test MAE: 8.900921899205576, Test MSE: 124.6952598355268



Mean Squared Error  
(MSE)

**124.69**



Root Mean Squared Error  
(RMSE)

**11.16**

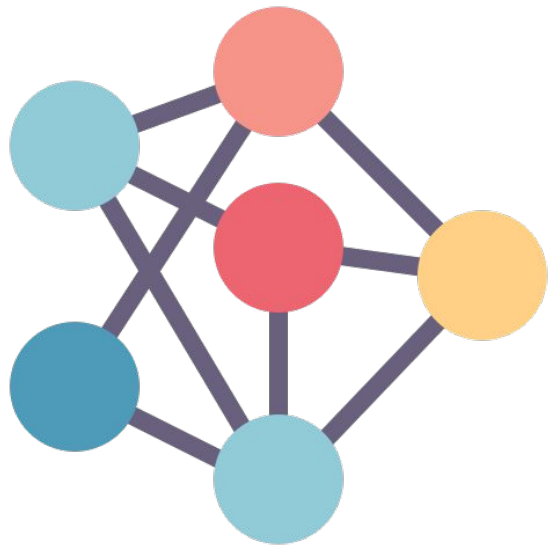


R-Squared  
(R<sup>2</sup>)

**93.9%**

The MSE of **124.69** means that on average, our model's predictions for Apple's performance are about 123.69 units off from the actual values, and the high R-squared value of **93.9%** tells us that it explains performance well, capturing most of the patterns in the data

# Data Model Optimization



- **K-Fold Cross-Validation**

- Evaluated the neural network model's performance

- **Compiling & Training the Model**

- Defined a neural network model architecture with 2 hidden layers
- Evaluation involved training the model over **50 epochs** with a smaller learning rate, assessing **R-squared scores** for both training and testing data across folds to gauge generalization ability

# Data Model Optimization

## Apple - 'AAPL'

Train

Test

Mean Squared  
Error (MSE)

93.90

97.89

Mean Absolute  
Error (MAE)

7.78

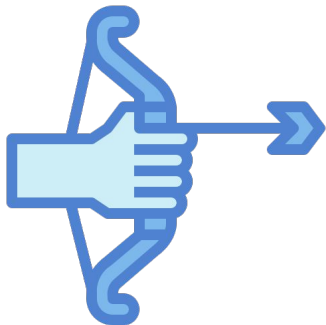
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R-Squared  
(R<sup>2</sup>)

95.26%

95.33%

Model 1 - Train R-squared: 0.9615735851349676, Test R-squared: 0.9584035991161156, Train MAE: 7.168141476354025, Train MSE: 77.36861168528293, Test MAE: 7.034944394476862, Test MSE: 76.35683145606212  
Model 2 - Train R-squared: 0.9290994571329977, Test R-squared: 0.9304370888796382, Train MAE: 8.593844473626822, Train MSE: 140.43590446651078, Test MAE: 8.665637809605363, Test MSE: 148.6798051905982  
Model 3 - Train R-squared: 0.9478119102053203, Test R-squared: 0.9441378359672211, Train MAE: 8.438092976548905, Train MSE: 104.46920547531651, Test MAE: 8.537702166008373, Test MSE: 108.87611939553148  
Model 4 - Train R-squared: 0.9669647385281387, Test R-squared: 0.9690153884685491, Train MAE: 6.495349016917169, Train MSE: 66.05083324667056, Test MAE: 6.13505515018395, Test MSE: 60.9825660603803  
Model 5 - Train R-squared: 0.960908852964437, Test R-squared: 0.9567461948482872, Train MAE: 7.095985701694946, Train MSE: 78.36589854008088, Test MAE: 7.409456570652123, Test MSE: 83.17442528135216  
Model 6 - Train R-squared: 0.9527591113022505, Test R-squared: 0.9440345383666274, Train MAE: 7.875742783656346, Train MSE: 96.54393459714595, Test MAE: 7.408290410362923, Test MSE: 86.66745906184688  
Model 7 - Train R-squared: 0.9526919028849193, Test R-squared: 0.953345877220076, Train MAE: 7.789271046483702, Train MSE: 93.90235823436248, Test MAE: 8.240341993653557, Test MSE: 97.8975559699576  
Model 8 - Train R-squared: 0.9612718345353637, Test R-squared: 0.9648374069476484, Train MAE: 7.24067594802959, Train MSE: 76.6238012962962, Test MAE: 7.323799278727215, Test MSE: 75.78361041609146  
Model 9 - Train R-squared: 0.9566785435583931, Test R-squared: 0.9584170521378743, Train MAE: 7.393871557687941, Train MSE: 86.11699166316636, Test MAE: 7.31254794467482, Test MSE: 86.23928420925877  
Model 10 - Train R-squared: 0.9510959832772197, Test R-squared: 0.9504376608285463, Train MAE: 7.967502162618909, Train MSE: 96.3200318823462, Test MAE: 8.617059868572177, Test MSE: 110.48203207471585

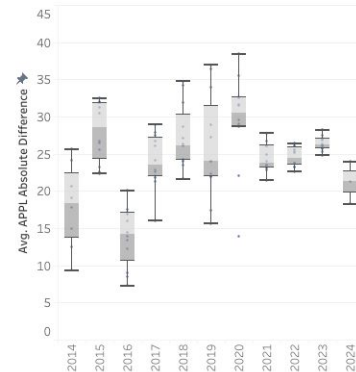


These metrics collectively provide insights into the accuracy, precision, and explanatory power of the model in predicting stock prices

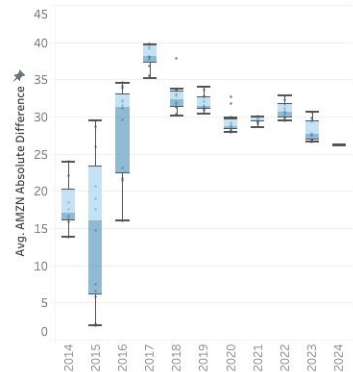


# Results- Yearly IQR of Absolute Value Percentage Difference (AVPD) by Month

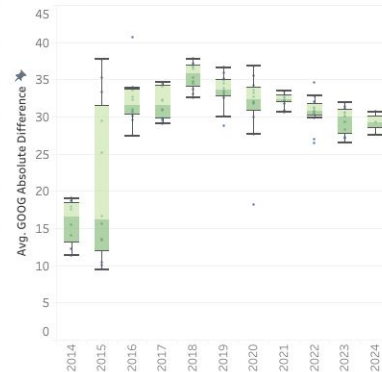
Apple



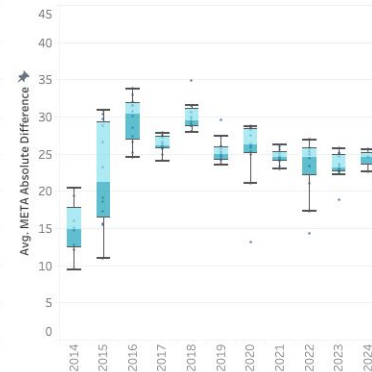
Amazon



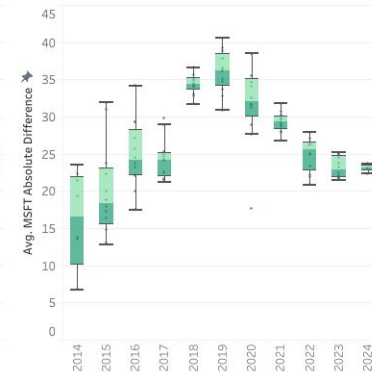
Google (Alphabet)



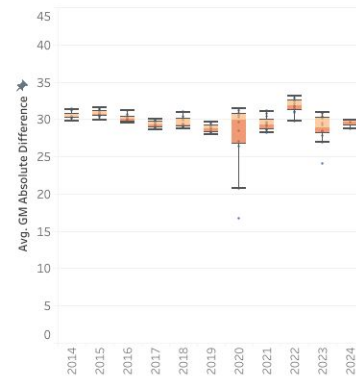
Facebook (META)



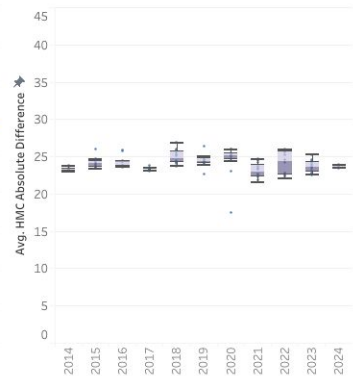
Microsoft



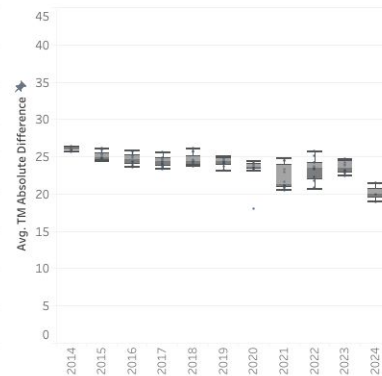
General Motors



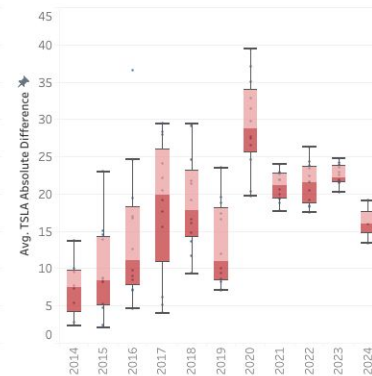
Honda



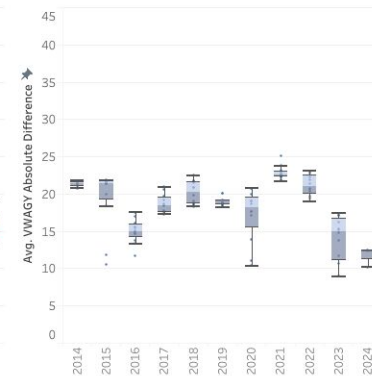
Toyota



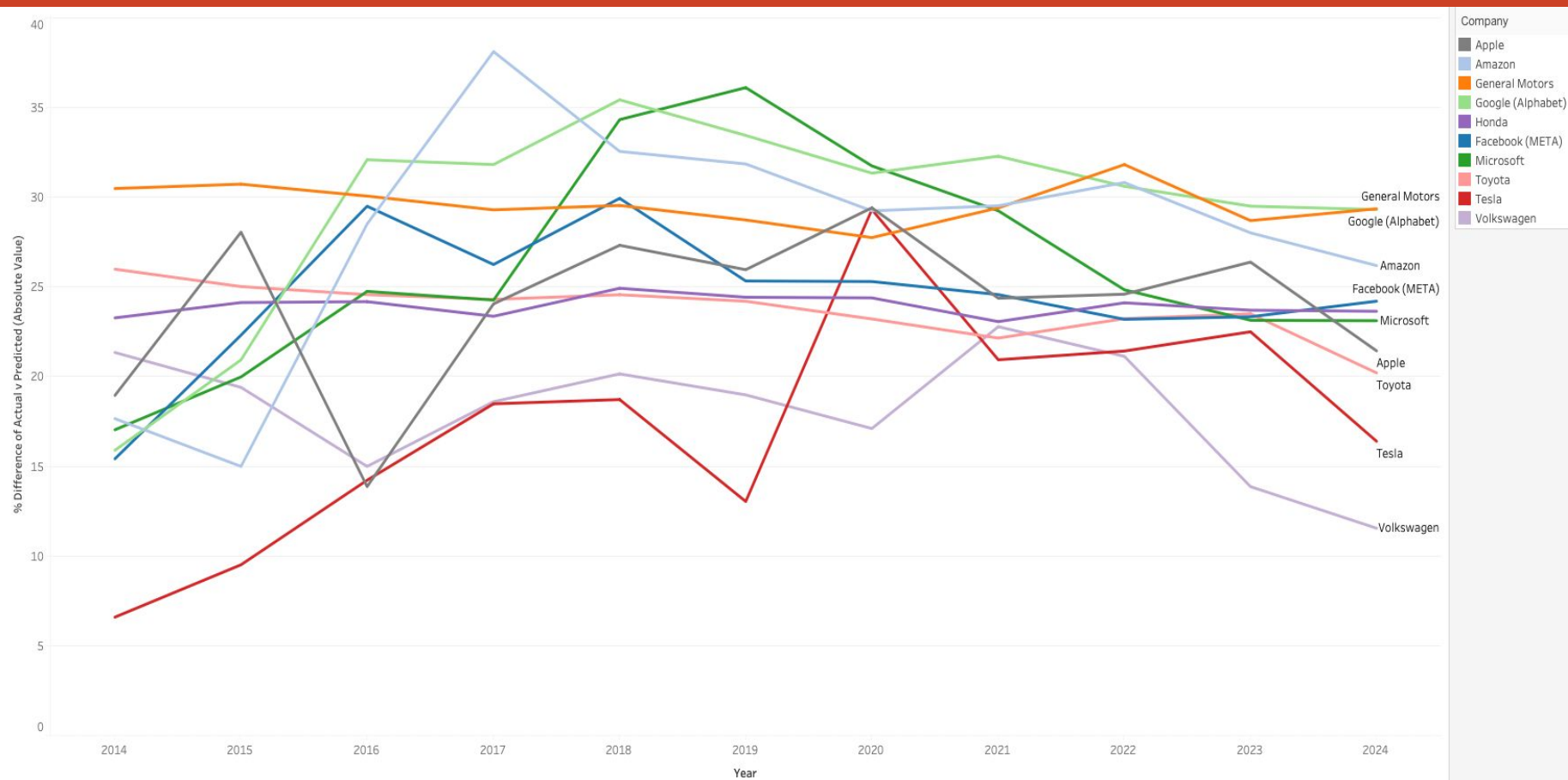
Tesla



Volkswagen



# Results- Yearly Average AVPD by Company



# Final Thoughts

- **Challenges**

- Time-Splitting Data
- Data Overfitting- decided to drop the original features (open, high, low, close, adj. close)
- Data Volatility- stock splits, company reports, geopolitical events

- **What's Next?**

- Adding extra features- more sentiment analysis
- Experimenting with new models- LSTM (possibly combined with NLP), different regressors
- Paper Trading to test- Alpaca
- Creating an interactive dashboard for users to experiment with



# Links

- **GitHub: Stock Price Prediction**
  - Take a deeper dive into our stock market analysis, the datasets we used, and more!
- **Connect with us on LinkedIn:**
  - [Amy Larsen](#)
  - [Anthony Abushacra](#)
  - [Karan Dogra](#)
  - [Paolo Arciaga](#)
  - [Thotadamoole Shreenidhi](#)







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*Thank  
you!*