Erdos Institute Winter 2024

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Predicting Stock Prices after Earnings Calls

Team: Yearning for Earnings

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Overview

- Earnings calls often lead to **volatility in stock prices.**
- We want to create **machine learning models** that **predict percentage changes** in stock prices surrounding earnings calls based on
    - **sentiment analysis** of earnings call transcripts
    - earnings and revenue data
    - stock prices and volume before the earnings
- Detect factors which influence stock price the most

NVDA earnings call working in favor of its stock price

META earnings call negatively impacts tech sector

Datasets

We selected **98 companies** from S&P 500 with a **6-year** earning period. In total we have **over 2000** data points. Sample companies include:

Data were gathered using Seeking Alpha API from [rapidapi.com]() and Yahoo Finance.

Earnings Call Transcripts

Web Scraping using Seeking Alpha API obtained from Rapid API

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Earnings and Revenue Data

Web Scraping using Rapid API

1. Earnings per share (EPS)
2. Earning and revenue surprises

+

Stock Prices and Volume

Yahoo finance python package

1. Stock prices several time points before and after earnings
2. Average volume 50 days before each earning

Data Processing

- Instead of looking at **absolute changes**, we look at **percentage changes**.
- Key features include: **average_volume_50_days, % Change Revenue, % Change EPS Normalized** and several sentiment scores:
  - **Financial_performance_score**
  - **Market_position_score**
  - **Strategic_direction_score**
  - **Operational_aspects_score**
  - **Financial_indicators_score**
  - **Risks_challenges_score**
  - **Economic_factors_score**
- Target Feature: **perc_change_next_prev** (percentage of stock price changes next day to previous day of earnings call)

We label the data using
Symbol + Year + Quarter

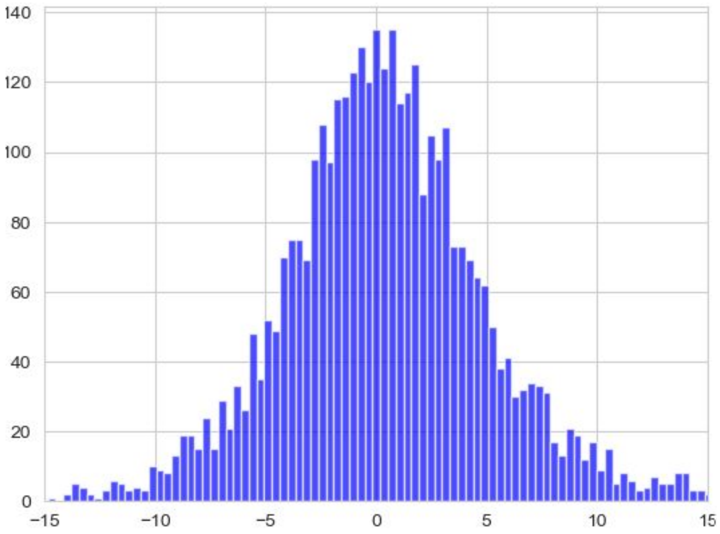
AAPL2019Q1
AAPL2020Q1
AAPL2021Q1
AAPL2022Q1
AAPL2023Q1
...
XOM2019Q3
XOM2020Q3
XOM2021Q3
XOM2022Q3
XOM2023Q3

Exploratory Data Analysis (EDA)

Scatter plot of percent change in **Revenue** vs **Stock Price** on earnings

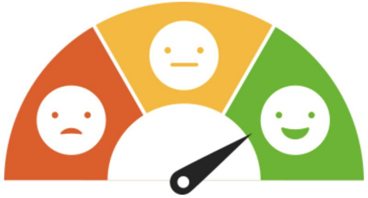
x = Stock Price Change

Histogram of **percentage change in stock price** after earnings



x = Percent Stock Price Change, 84 bins

Extracting Features from Earning Call Transcripts



Sentiment Scores

1. **Organized keywords into seven categories.**

Example:

financial_performance_keywords = {revenue, profit, loss, earnings, sales, expense, cost,....}

market_position_keywords = {market, share, grow, growth, decline, competitive, demand,....}

risks_challenges_keywords = {risk, challenge, uncertainty, regulation, legal, compliance, issue,....}

2. **For each category, we extracted sentences (with context) and computed average sentiment scores using VADER.**

spaCy

NLTK

Models

- **Baseline Model:** Predicts no change from previous day.
- **Linear Regression**

- **XGBoost** (parameters tuned using GridSearchCV)
- **Neural Network**

- Logistic Regression
- Neural Network (Classification)

Linear Regression

Training - Test Split: 0.8 - 0.2

Stratified by **symbol**

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Run 1000 times, after scaling features

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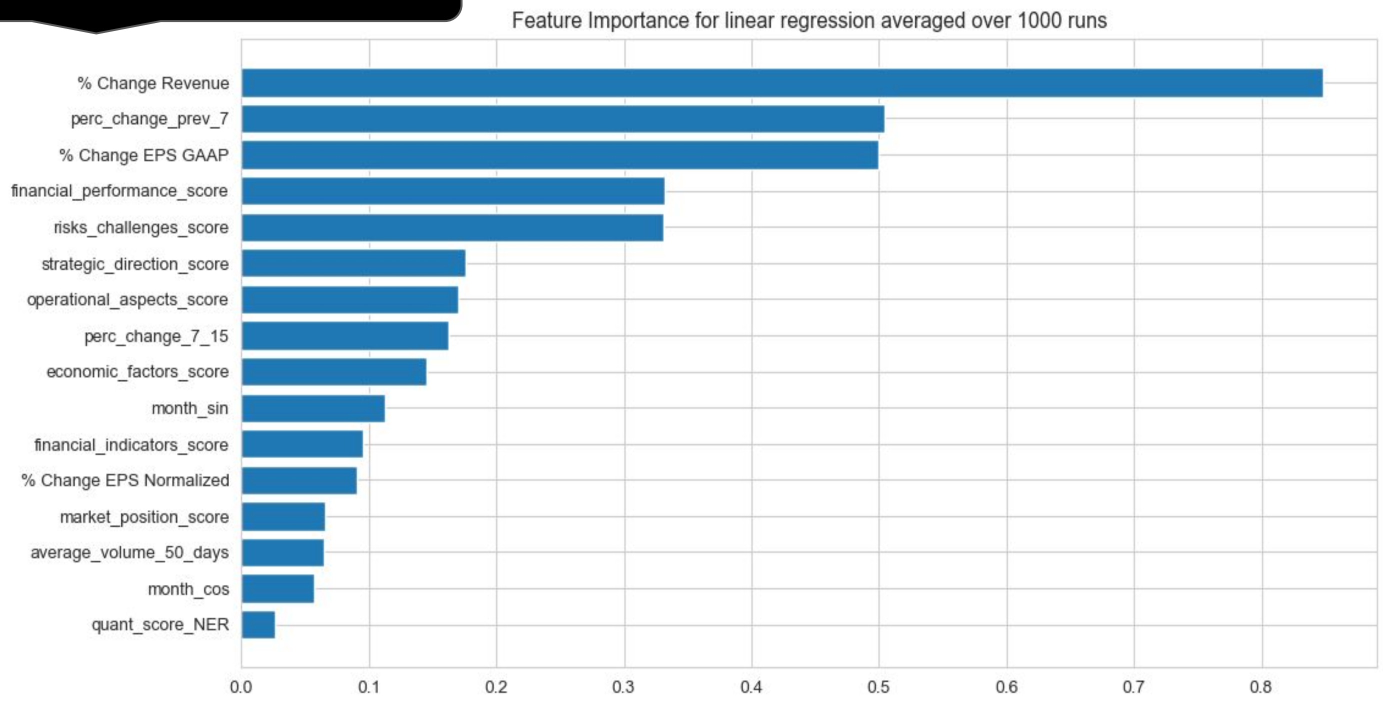
Record Actual and Predicted Values

Remark:

Technically, we should only be doing a time based split. However, we found that the performance is similar by doing that.

Linear Regression

Feature Importance



XGBoost

Fine tune parameters using **GridSearchCV**

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Run 1000 times

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Record Actual and Predicted Values

Parameters tuned:

- alpha (L1 regularization)
- lambda (L2 regularization)
- n_estimators (number of trees used)
- max_depth of a tree
- learning_rate

Results

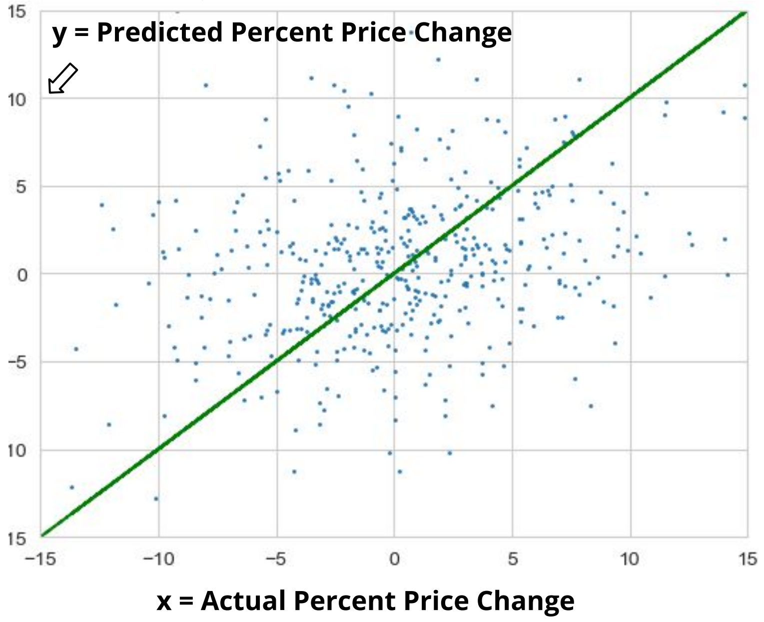
The numbers are **means** of multiple runs

	MSE	Correlation
Baseline	31.16	N/A
Linear Regression	24.16	0.18
XGBoost	23.85	0.22
Neural Network	35.62	0.31

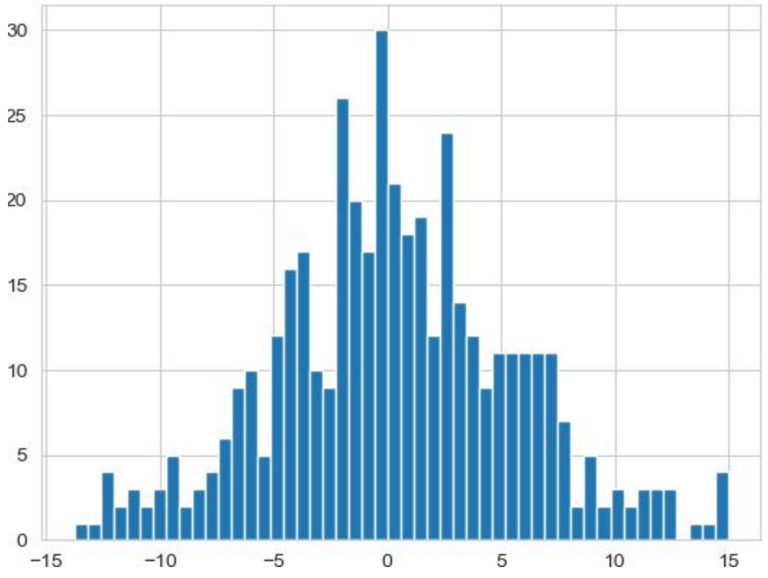
Results Visualization

Both are based on Neural Network

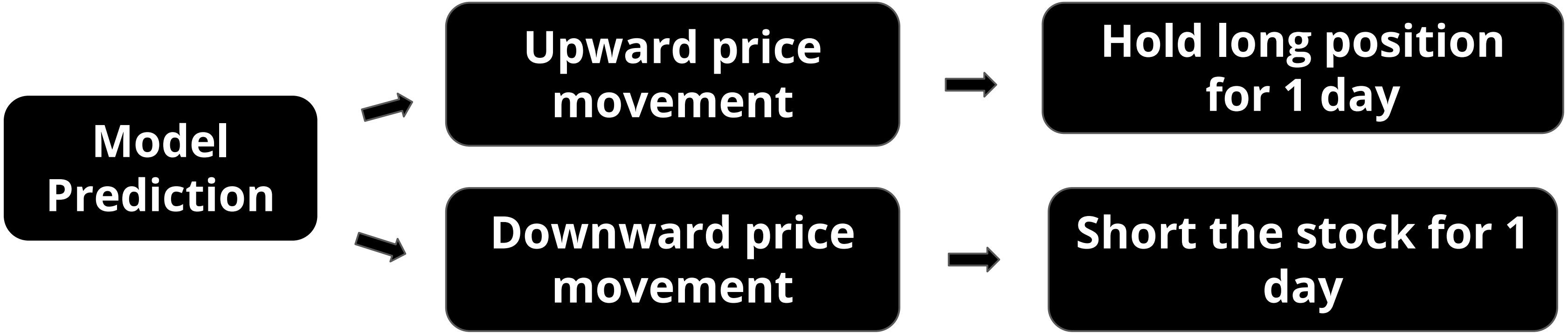
Scatter plot **Predicted percent price changes** vs **Actual**



Histogram of **Residuals**



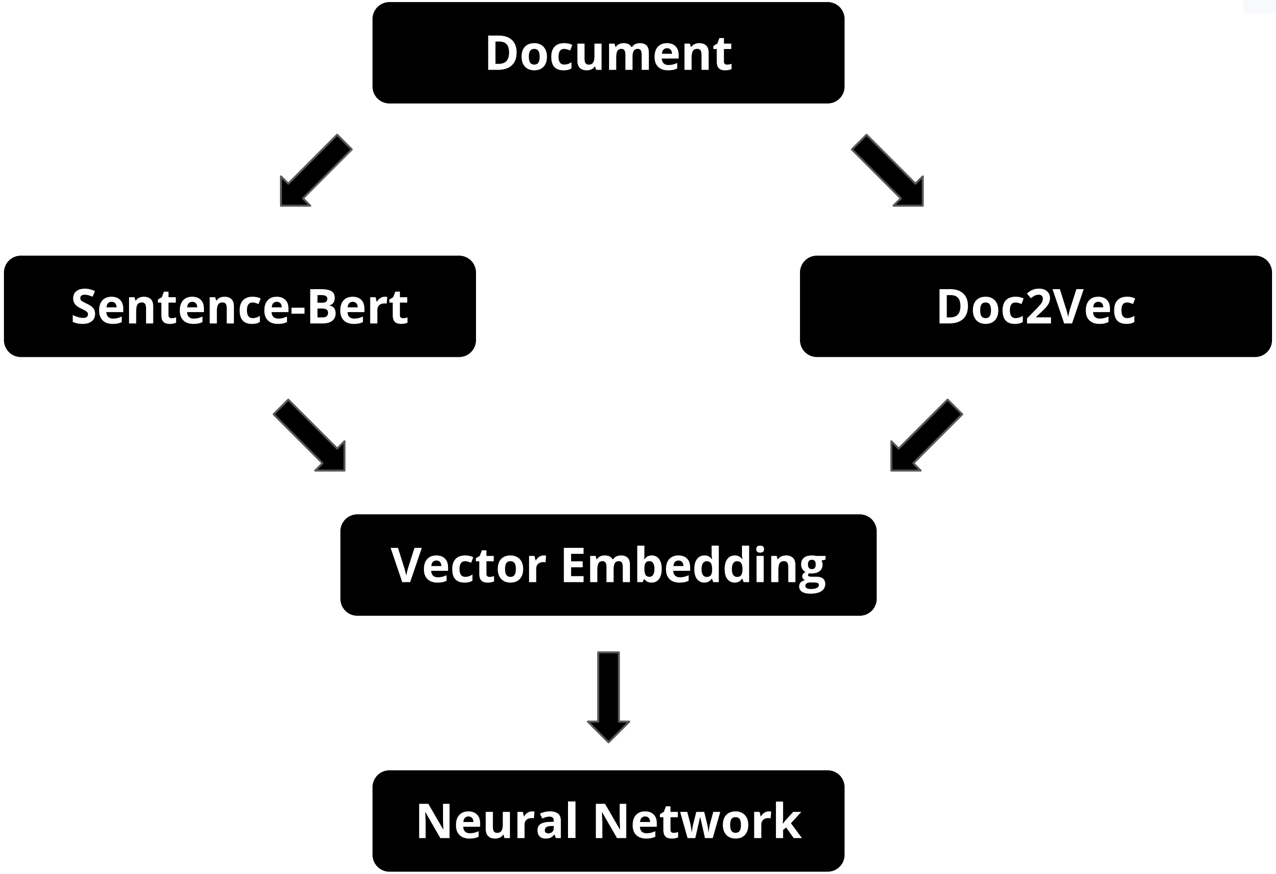
A Simple Trading Strategy

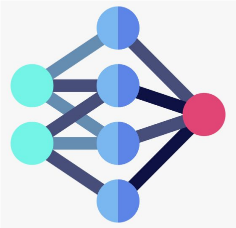


Results:

- We obtain **returns of 4.8%** over trades around 4 earnings call days.
- In comparison, blindly buying the stock on the day of earnings call and selling it the next day gives **a return of 2%.**

Future Research





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