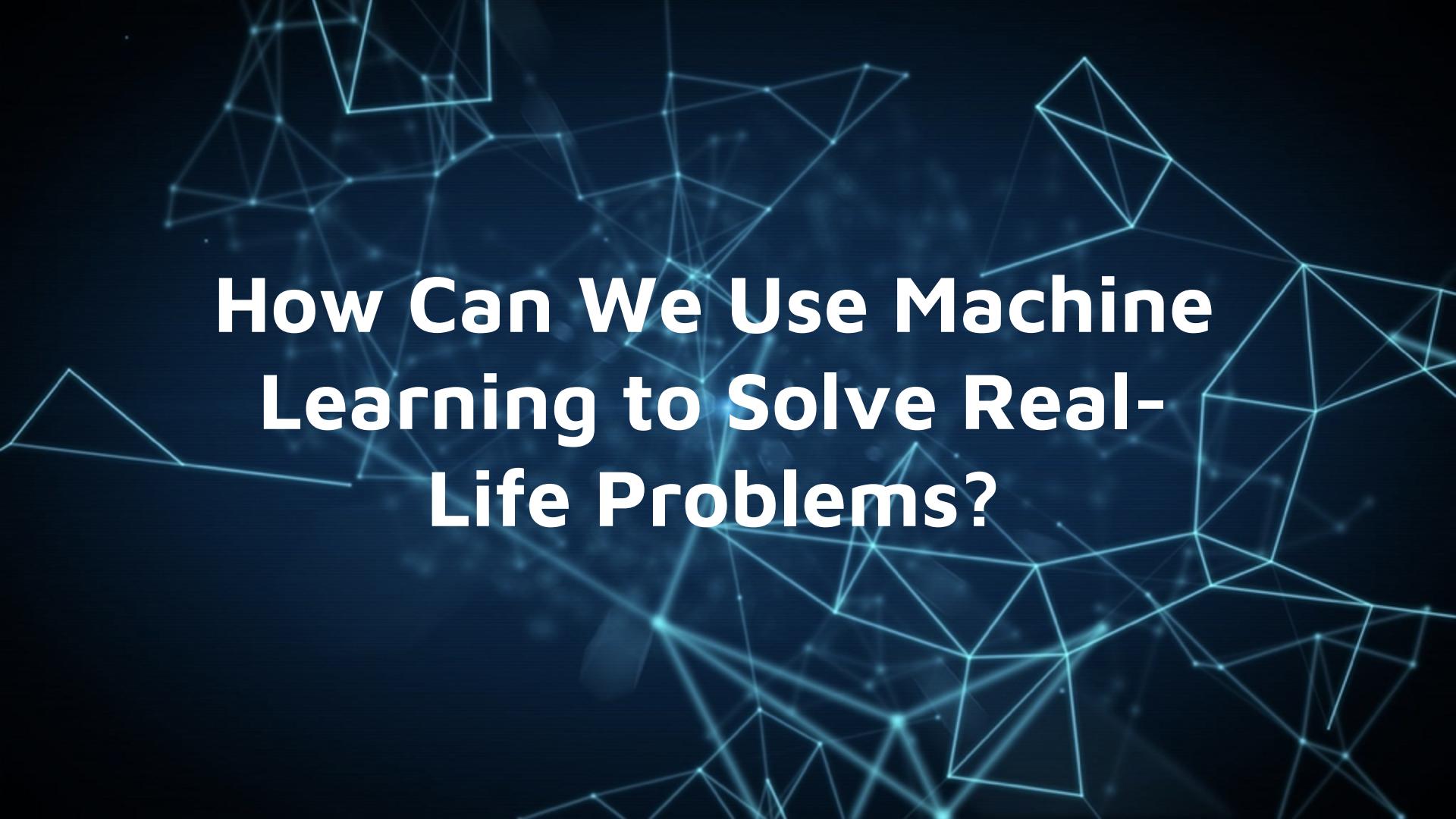


Using Machine Learning Models to Predict Stock Price Trends Based on External Events





A dark blue background featuring a complex network of glowing blue lines and dots, resembling a molecular or neural network. The lines vary in brightness, creating a sense of depth and connectivity.

How Can We Use Machine Learning to Solve Real- Life Problems?

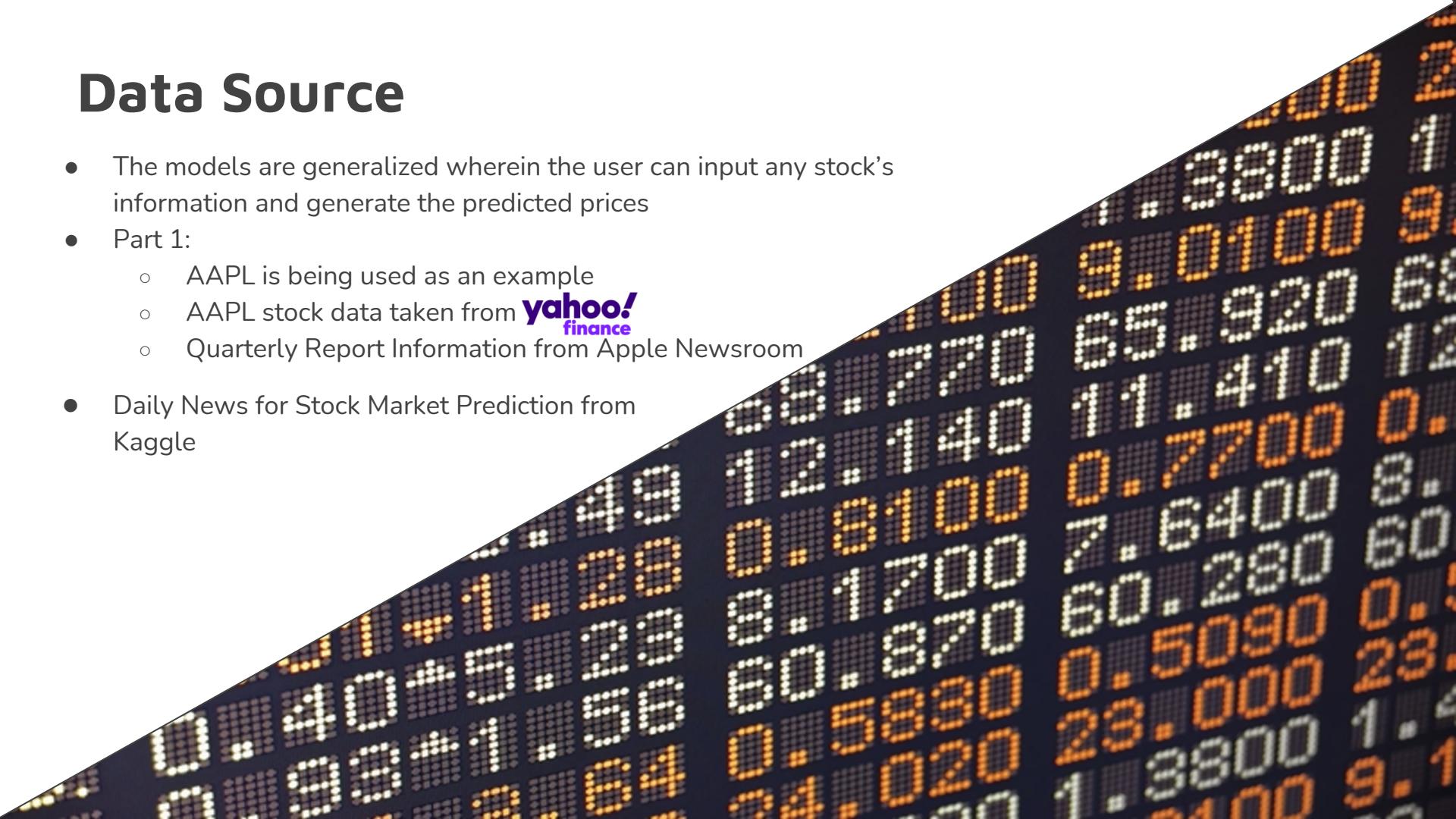


Problem

- Several people invest in the stock market
- Knowing how a stock will perform will be advantageous to investors
- Stock prices fluctuate based on several external factors like the coronavirus, tax season, end of quarters, etc
- Predicting future stock prices will help maximize profit
- We want to use two machine learning models - Logistic Regression and Naive Bayes - to predict future stock prices to help investors maximize their profit margin.
- We compare the models to see which one is more accurate

Data Source

- The models are generalized wherein the user can input any stock's information and generate the predicted prices
- Part 1:
 - AAPL is being used as an example
 - AAPL stock data taken from **yahoo!**
finance
 - Quarterly Report Information from Apple Newsroom
- Daily News for Stock Market Prediction from Kaggle



Apple Inc. (AAPL) ⭐

NasdaqGS - NasdaqGS Real Time Price. Currency in USD

124.69 -0.16 (-0.13%)

At close: 4:00PM EDT

124.64 -0.06 (-0.04%)

After hours: 5:31PM EDT

Technical Events

All 18 Events

Short Term
Bullish

Mid Term
Bearish

Long Term
Bullish

Support - Resistance
51.12 133.46

Stop loss
116.5

Indicators

Comparison

Events

Date Range

1D

5D

1M

3M

6M

YTD

1Y

2Y

5Y

Max

Interval

5Min

Line

Draw

AAPL 123.61

yahoo!finance



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AAPL

Date	Open	High	Low	Close	Adj Close	Volume
2020-05-12	79.457497	79.922501	77.727501	77.852501	77.331436	162301200
2020-05-13	78.037498	78.987503	75.802498	76.912498	76.397720	200622400
2020-05-14	76.127502	77.447502	75.382500	77.385002	76.867065	158929200
2020-05-15	75.087502	76.974998	75.052498	76.927498	76.412621	166348400
2020-05-18	78.292503	79.125000	77.580002	78.739998	78.212997	135178400
2020-05-19	78.757500	79.629997	78.252502	78.285004	77.761040	101729600
2020-05-20	79.169998	79.879997	79.129997	79.807503	79.273354	111504800



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12:00 PM 5/13 12:00 PM 5/14 12:00 PM 5/17 12:00 PM 5/18 12:00 PM 5/19 12:00 PM 6:00

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Newsroom

quarterly reports ×

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April 28, 2021 PRESS RELEASE

Apple Reports Second Quarter Results

Apple reported its second quarter financial results for the fiscal year after the market close on Wednesday, April 28, 2021.

January 27, 2021 PRESS RELEASE

Apple Reports First Quarter Results

Apple reported its first quarter financial results for the fiscal year after the market close on Wednesday, January 27, 2021.

October 29, 2020 PRESS RELEASE

Apple Reports Fourth Quarter Results

Apple reported its fourth quarter financial results for the fiscal year after the market close on Thursday, October 29, 2020.

July 30, 2020 PRESS RELEASE

Apple Reports Third Quarter Results

Apple reported its third quarter financial results for the fiscal year after the market close on Thursday, July 30, 2020.

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Newsroom

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PRESS RELEASE

April 28, 2021

Apple Reports Second Quarter Results

Revenue up 54 percent to new March quarter record

Services and Mac revenue reach new all-time high



CUPERTINO, CALIFORNIA — APRIL 28, 2021 — Apple today announced financial results for its fiscal 2021 second quarter ended March 27, 2021. The Company posted a March quarter record revenue of \$89.6 billion, up 54 percent year over year, and quarterly earnings per diluted share of \$1.40. International sales accounted for 67 percent of the quarter's revenue.

Dow Jones Industrial Average (DJIA) From Yahoo Finance

News Articles From Reddit WorldNews Channel

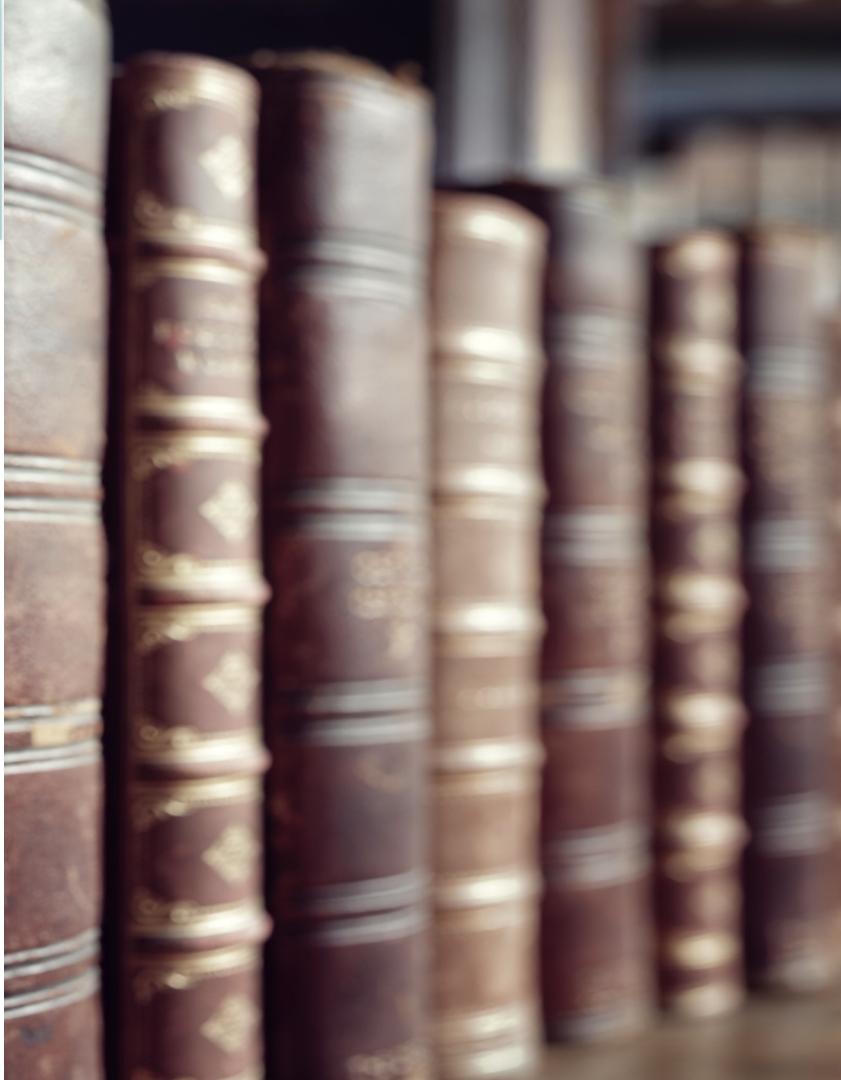
Dates From
2008-08-08
to
2016-07-01

	Date	Label	Top1	Top2	Top3	Top4	Top5	Top6	Top7
0	2008-08-08	0	b"Georgia 'downs two Russian warplanes' as cou...	b'BREAKING: Musharraf to be impeached.'	b'Russia Today: Columns of troops roll into So...	b'Russian tanks are moving towards the capital...	b"Afghan children raped with 'impunity,' U.N. ...	b'150 Russian tanks have entered South Ossetia...	b"Breaking: Georgia invades South Ossetia, Rus...
1	2008-08-11	1	b"Why wont America and Nato help us? If they w...	b'Bush puts foot down on Georgian conflict'	b"Jewish Georgian minister: Thanks to Israeli ...	b"Georgian army flees in disarray as Russians ...	b"Olympic opening ceremony fireworks 'faked'"	b"What were the Mossad with fraudulent New Zea...	b'Russia angered by Israeli military sale to G...
2	2008-08-12	0	b'Remember that adorable 9-year-old who sang a...	b"Russia ends Georgia operation"	b"If we had no sexual harassment we would hav...	b"Al-Qa'eda is losing support in Iraq because ...	b'Ceasefire in Georgia: Putin Outmaneuvers the...	b"Why Microsoft and Intel tried to kill the XO...	b'Stratfor: The Russo-Georgian War and the Bal...
3	2008-08-13	0	b' U.S. refuses Israel weapons to attack Iran:...	b"When the president ordered to attack Tskhinva...	b' Israel clears troops who killed Reuters cam...	b'Britain's policy of being tough on drugs is...	b'Body of 14 year old found in trunk; Latest (...	b'China has moved 10 *million* quake survivors...	b"Bush announces Operation Get All Up In Russi...
4	2008-08-14	1	b>All the experts admit that we should legalis...	b'War in South Ossetia - 89 pictures made by a ...	b'Swedish wrestler Ara Abrahamian throws away ...	b'Russia exaggerated the death toll in South O...	b'Missile That Killed 9 Inside Pakistan May Ha...	b'Rushdie Condemns Random House's Refusal to P...	b'Poland and US agree to missile defense deal. ...

Resources



- CS 383- Machine Learning Lecture Material
- Stock Trend Prediction Using Regression Analysis– A Data Mining Approach
- Impact of Company Performances on the Stock Price: An Empirical Analysis on Select Companies in Serbia
- Regression Techniques for the Prediction of Stock Price Trend



Basic Approach



- Gather data from Yahoo Finance, Apple Newsroom and Kaggle
- Two factors to account for -
 - a. Most recent quarterly report
 - b. Daily news from Reddit WorldNews Channel
 - Words for 25 headlines on a single date were vectorized by counted there occurrence
- Apply Logistic Regression model and Naive Bayes Classification model
- Compare the precision, recall, f-measure score and accuracy of the two models



Results and Observations

Quarterly Report Prediction Stock Trends				
Models	Precision	Recall	f-Measure	Accuracy
Logistic Regression	0.627	0.682	0.642	0.682
Naive Bayes Classifier	0.588	0.545	0.563	0.545

Results and Observations

News Article Prediction Stock Trends				
Models	Precision	Recall	f-Measure	Accuracy
Logistic Regression	0.496	0.326	0.393	0.465
Naive Bayes Classifier	0.54	0.558	0.549	0.511



Conclusion

- Quarterly Report Prediction:
 - Small sample size
 - Logistic Regression results in higher f-measure and accuracy values than Naive Bayes
- News Article Prediction:
 - Large sample size
 - Naive Bayes results in a higher precision rate to Logistic Regression while the opposite is said for recall
 - Logistic Regression reports in a better harmonic balance between precision and recall than Naive Bayes
 - Accuracy of both models was low for both models with Logistic Regression being only 6% more correct

How does this approach/problem relate to what we're doing in this class?

- The class focuses on applying machine learning models to real life problems
- Investing is a huge part of people's lives
- To be able to apply machine learning models that we learned in class, such as logistic regression and naive bayes, to a real life problem involving investing is a great way to understand how theoretical knowledge from class translates into practical implementations in the real world





Future Extensions of Work

- Larger dataset
 - Different stocks and indexes
 - Larger time frame
- Look at more factors:
 - Focused news articles - COVID News
 - Tax season
 - Dividend release
- Another model for comparison
 - Least Absolute Shrinkage and Selection Operator (LASSO) Model

References

H. L. Siew and M. J. Nordin, "Regression techniques for the prediction of stock price trend," *2012 International Conference on Statistics in Science, Business and Engineering (ICSSBE)*, 2012, pp. 1-5, doi: 10.1109/ICSSBE.2012.6396535.

Miloševic Avdalovic, S., & Milenković, I. (2017). IMPACT OF COMPANY PERFORMANCES ON THE STOCK PRICE: AN EMPIRICAL ANALYSIS ON SELECT COMPANIES IN SERBIA. *Economics Of Agriculture*, 64(2), 561-570. doi:10.5937/ekoPolj1702561M

Olaniyi, Abdulsalam & S., Adewole & G, Jimoh. (2011). Stock Trend Prediction Using Regression Analysis – A Data Mining Approach. ARPN Journal of Systems and Software. 1. 154-157.

