# Team: Surviving Bear (markets)

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## Goal

Goal of this project is to develop a system that can identify stocks for value investing, especially during a bear market.

## Idea / Hypothesis

Since there are no absolute ways to predict stock markets, we approach this goal more as a aid for a buyer to do the analysis on shortlisted stocks before making a final decision. The thought is we should be able to identify good value stocks by studying historical values and then applying that to current market. Typically, best values are found during bear markets so the thought is that purchases would be made in a bear market or if sudden market conditions affect certain stocks. Looking through all the stocks manually to identify such stocks is very tedious, so the thought is to leverage machine learning. Once a set of good stocks are identified and ranked, we will need to further analyze manually to work in other factors like future prospects for the company, current events, current market conditions etc. to determine when to buy a stock and at what price.

## High level system design:

Machine Learning module

Data ETL (Python)

Data Sources (Web)

Models

DB

Data Visualization

Data Source: Stock fundamentals data historical (alteast 20 years), current stock price data

Data ETL: This layer is for initial data analysis and loading data into the database. We may need to add some calculated fields.

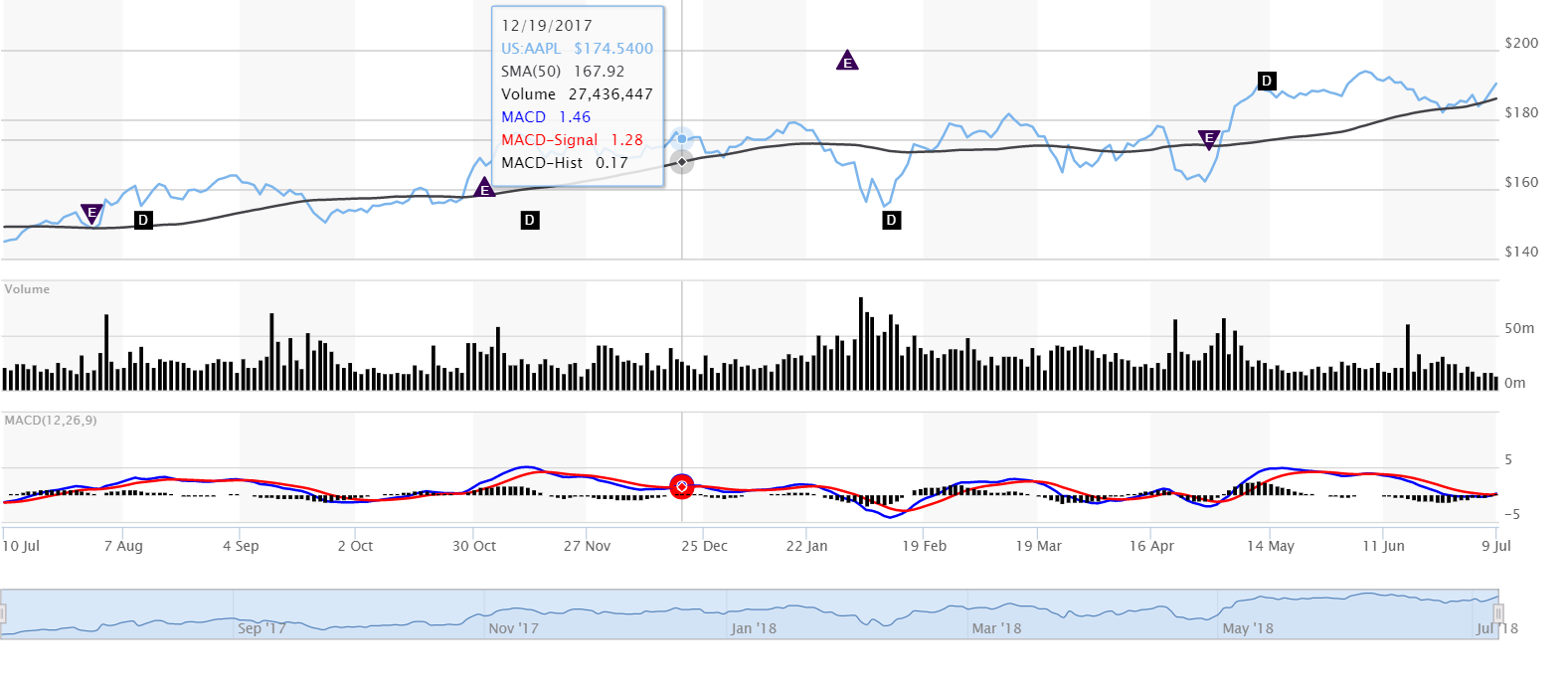
DB: Storage for data

Machine learning layer: This layer will be trained based on the data to create models. These models should then be tested and if satisfactory used for future. Multiple models could be produced and models should be re-trained over time. An ensemble model could be incorporated to bring together the results from the different models.

Visualization layer: This layer will be the front end for the user it will have multiple dashboards

1. Pick stocks by applying ML models. Present the results in an interactive manner. User input could be investment horizon
2. Further analyze selected stocks using dashboard

Here are some other charts that truly inspired us:



This chart shows a lot of possibility of user interaction. We would like to have similar functionality on our charts, allowing the user to see values at different points of time when they mouse over the map.

Steps

Data loading

1. CSV files for each stock downloaded and stored to DB using python and MySQL (webscraping, processing in python, saved to csv, loaded into MySQL, added more caculated columns like returns for different time periods)
2. Identify measures/features we want to use for modeling and the returns we want to use for target

## Data Analysis

### Decision tree analysis

Decision tree is the first model being used. The decision tree will also provide a subset of features/criteria to use for the other models.

The strategy is to compare decision tree model accuracy for different depths and pick the one which is most accurate but has the least depth, i.e, identify the depth after which increase in accuracy is not significant (<5%).

For the first round any row with positive returns is considered as a good investment.

Accuracy score by level of DT and for different time periods, for returns > 0

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Max depth** | **Quarterly** | **Yearly** | **Three** | **Five** |
| Full | 0.57980 | 0.67826 | 0.70822 | 0.687956 |
| 2 | 0.65704 | 0.7091 | 0.73524 | 0.6906175 |
| 3 | 0.65827 | 0.7074 | 0.741112 | 0.687683 |
| 4 | 0.65718 | 0.7311 | 0.746161 | 0.695667 |
| 5 | 0.65677 | 0.7308 | 0.749027 | 0.6960764 |

**Quaterly time period:** use the factors for 2 level, since best seems to be 3 level but there is not much difference between 2 and 3. If time allows use factors in 3 level as well.

Factors for level 2: P/B ratio, P/E ratio

Factors for level 3: P/B ratio, P/E ratio, Equity to Asset ratio, EPS Basic, ROA

**1 Year time period:** best level seems to be 4, however 2 may also be considered as it is not very different but 2 levels simpler

Factors for level 2: P/E ratio, ROE, EPS Basic

Factors for level 4: P/E ratio, ROE, EPS Basic, ROA, P/B Ratio

**3 Year time period:** accuracy seems to be increasingly marginally with additional levels, starting from level 2. Hence level 2 or 3 may be best. More than that add a lot more factors

Factors for level 2: ROA, P/B Ratio

Factors for level 3: ROA, P/B Ratio, P/E Ratio, EPS basic

**5 year time period:** accuracy at level 2 is higher than overall and it seems to only marginally increase with each level. Considering this level 2 and level 4 may be good alternatives.

Factors for level 2: ROA, P/B ratio

Factors for level 4: ROA, P/B ratio, P/E ratio, EPS Basic, Long term debt to equity ratio, Equity to assets ratio, mktcap\_revenue\_value, mktcap\_cash\_value

### Random Forest analysis

Score and feature importance by time period

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Feature | Qtr | 1 year | 3 year | 5 year |
| Score test data | 0.660798 | 0.766086 | 0.79167 | 0.77659 |
| P/B ratio | 0.111176 | 0.103744 | 0.095343 | 0.091823 |
| EPS basic | 0.097725 | 0.091190 | 0.080681 | 0.083922 |
| Free cash flow per share | 0.094145 | 0.075749 | 0.068647 | 0.079884 |
| P/E ratio | 0.093520 | 0.124377 | 0.124205 | 0.110018 |
| Equity to assets ratio | 0.0929425 | 0.081929 | 0.07339 | 0.079369 |
| ROA | 0.0905495 | 0.113523 | 0.16460 | 0.147120 |
| ROE | 0.0849126 | 0.107970 | 0.102764 | 0.098970 |
| Current ratio | 0.0840162 | 0.07347 | 0.070200 |  |
| Long-term debt to equity ratio | 0.0780208 | 0.068737 | 0.063495 |  |
| cash\_oper\_gt\_earnings\_value | 0.0652397 | 0.053291 |  |  |
| Dividend payout ratio | 0.0613678 | 0.062218 | 0.065663 |  |
| mktcap\_cash\_value | 0.0222126 | 0.02017 |  |  |
| mktcap\_revenue\_value | 0.0132831 | 0.011582 |  |  |
| marketcap\_bookvalue\_value | 0.0079633 | 0.009686 |  |  |
| mktcap\_free\_cash\_flow\_value | 0.0018081 | 0.001645 |  |  |
| entvalue\_earnings\_value | 0.0011156 | 0.000702 |  |  |
|  |  |  |  |  |

Similar to the Decision Tree analysis, best score seems to be for 3 years time frame, 1 qtr should probably be dropped. The top factors common for 1,3 and 5 yr terms are ROA, P/E ratio, ROE, P/B ratio, EPS basic we should proceed with just these features for the other models