Instructions:

This document defines and explains the problem statement for the hackathon.
You have 12 hours to provide the technical solution to the problem.
All data and tools that you need to solve the problem are available for free in the public domain.
You are free to choose a technology stack of your choice to solve the problem, although we would suggest using open-source technologies.

The Hackathon deals with creating Performance Analytics data based on Stock Price and identifying the best stock based on highest return. Additionally, Problem Statement includes a momentum trading strategy and how the returns are with this strategy compared to equal distribution to a list of stocks.
This document has the following sections:

- Introduction
- Steps involved in creating Performance Analytics and implementing a trade strategy.
- Details of each step with the information on the technical solution that needs to be developed for
- Sample Calculations for Analytics and Trade strategy for year for illustration.

Take time to read the document carefully to fully understand the problem
You may look-up the internet to further understand/research the problem
Your technical evaluation will be based on

- Ability to understand a real–life problem
- Research on the problem domain
- Technical/Solution design
- Accuracy of the solution
- Presenting your approach and design to the tech team

A team of technical people are around you. You can ask them questions when you have exhausted all your means on Google.

Introduction

The ex post analysis of investment performance stands as a prominent and ubiquitous feature of modern investment management practice. Investing involves making decisions that have readily quantifiable consequences. Performance Evaluation refers to the measurement and assessment of the outcomes of these investment management decisions. While Performance Evaluation is broad subject that entails performance measurement, performance attribution and performance appraisal, the current problem statement deals with performance measurement of equity stocks with the objective of identifying the stock with the highest return.

Trade strategy of when to buy and sell a stock is aimed to improve the performance of equity stocks in a portfolio. Trade strategies are based on fundamental or technical analysis or both. The current problem statement deals with a momentum trading strategy based on price action when compared with equal allocation to a list of stocks.

Your objective as part of this hackathon is to come-up with an end-to-end solution as a part of performance measurement tech team.

Background

Performance Measurement and trade strategy comprises of below steps:

A. Capture given equity stocks with their respective benchmark against which their performance is measured.
B. Create Performance Measurement Dashboard based on historical stock prices
C. Implement a Momentum Trade Strategy and compare results with equal allocation to list of stocks

The goal of this hackathon is to come up with a Technical solution which facilitates each of the above steps. Let us look at each of the three steps closely:

A. Capture given equity stocks and respective benchmark

Technical solution should aim to capture given stocks and benchmark along with Start and End Dates for Performance through a web-based interface. After capturing above details, the solution should be able to connect to Yahoo Finance API to get Month End historical 'Adj Close' Price for these stocks and benchmark for the requested Start and End Dates. The interface should be intuitive and should make it easy for capturing the information with minimal scope for erroneous entries.

For the purposes of this problem statement, consider below Tickers for Equity Stocks, which are the list of 5 largest stocks in Nasdaq-100, a stock market index that measures stock performance of 100 largest non-financial listed companies in United States:

a) AAPL (Apple)
b) MSFT (Microsoft)
c) AMZN (Amazon)
d) FB (Facebook)
e) TSLA (Tesla)

The relevant benchmark ticker for these stocks is NDX (Nasdaq-100).

Consider Start Date as 01-Jan-2016 and End Date as 31-Dec-2020 for the purposes of performance measurement (5 years month end data including 31-Dec-2015).

B. Create Performance Measurement Dashboard based on historical stock prices

Performance Measurement:

Technical Tool should calculate 1M, 3M, 6M, 1Y, 2Y, 3Y and 5Y Cumulative and Annualized Returns as of the end date (31-Dec-2020) for Ticker ‘TSLA’ and Benchmark ‘NDX’ (Illustration is provided for Ticker ‘AMZN’). For this the Tool should capture historical **Month End** 'Adj Close' Prices for the last 5 years and calculate Monthly Returns. Based on Monthly Returns arrived, Cumulative and Annualized Returns should be calculated for multiple periods (1M, 3M, 6M, 1Y, 2Y, 3Y and 5Y) for ‘TSLA’ and Benchmark ‘NDX’.

Monthly Return = [(Current Month End’s 'Adj Close' – Previous Month End‘s 'Adj Close')/ Previous Month End’s 'Adj Close'] in % Terms.

Based on Monthly Return, Cumulative Returns are calculated as:

$((1 + MR_1) * (1 + MR_2) .... * (1 + MR_M) - 1)$ in % Terms

MR_1, MR_2,…MR_M = Monthly Return of the Stock
M = Number of months

For periods greater than 1Y, Annualized Returns are calculated as:

$$\left(\left(\sqrt[12/M]{(1 + MR_1) * (1 + MR_2) \ldots . (1 + MR_M)}\right) - 1\right)$$ in % Terms

MR_1, MR_2,…MR_M = Monthly Return of the Stock
M = Number of months
N = Number of Years (M/12)

Calculate Active Return as (Stock's Return - Benchmark's Return (NDX)) for each time horizon (1M, 3M, 6M, 1Y, 2Y, 3Y and 5Y).

Please review the Illustration in the below sections on the format of output expected.

Generate below Visualizations:

Create graph with Stock Price Rebased to 100 based on Cumulative Monthly Returns for last 5 years along with Benchmark. **Include all stock Tickers** along with Benchmark NDX in a single chart as in illustration.

Please refer to illustration for calcs.

Create 1M, 1Y and 3Y Annualized Active Return for years 2019 and 2020 for Ticker ‘TSLA’. Please refer to illustration for Active Return on AMZN.

C. Implement a Trade Strategy and compare results with equal allocation to list of stocks

Momentum Trade Strategy:

Trade Strategy is based on Monthly Price Action of below list of stocks. With the calculated Monthly Returns starting end of Dec-2015, identify the stock which has the highest Monthly Return each month. Assuming momentum in that stock will continue for the next month (Jan-2016), invest the entire capital of $10000 on that stock (momentum stock) starting end of Dec-2015. Repeat the process every month. Continue this monthly process till the end of 2020.

a) AAPL (Apple)
b) MSFT (Microsoft)
c) AMZN (Amazon)
d) FB (Facebook)
e) TSLA (Tesla)

Consider Investment as $10000 at the end of 2015 and calculate Investment Value at the end of 2020 based on the above strategy.

Equal Allocation to all stocks:

Arrive at Investment Value with equal allocation of $10000 across five stocks (i.e. $2000 for each stock) starting end of 2015 based on Monthly Return of each stock and continue till the end of 2020.

Compare the result of Investment Value arrived with Momentum Trading Strategy vs Investment Value arrived with equal allocation across all five stocks for periods starting from end of 2015 to end of 2020.

Please refer to illustration for the year 2015.

For First Month (Jan 2016):

Momentum Trade Strategy:

Investment Value 1 = 10000 * (1 + Monthly Return on momentum stock for Jan 2016)

For Next Month

Investment Value 2 = Investment Value 1 * (1 + Monthly Return on momentum stock for Feb 2016)
.
.
.

For last Month:

Investment Value N = Investment Value (N -1) * (1 + Monthly Return on momentum stock for Dec 2020)

Illustration

B. Create Performance Measurement Dashboard. Below is the illustration for Ticker 'AMZN' as of end of 31-Dec-2020. Please arrive at these calculations for 'TSLA'.

(a) Performance Measurement

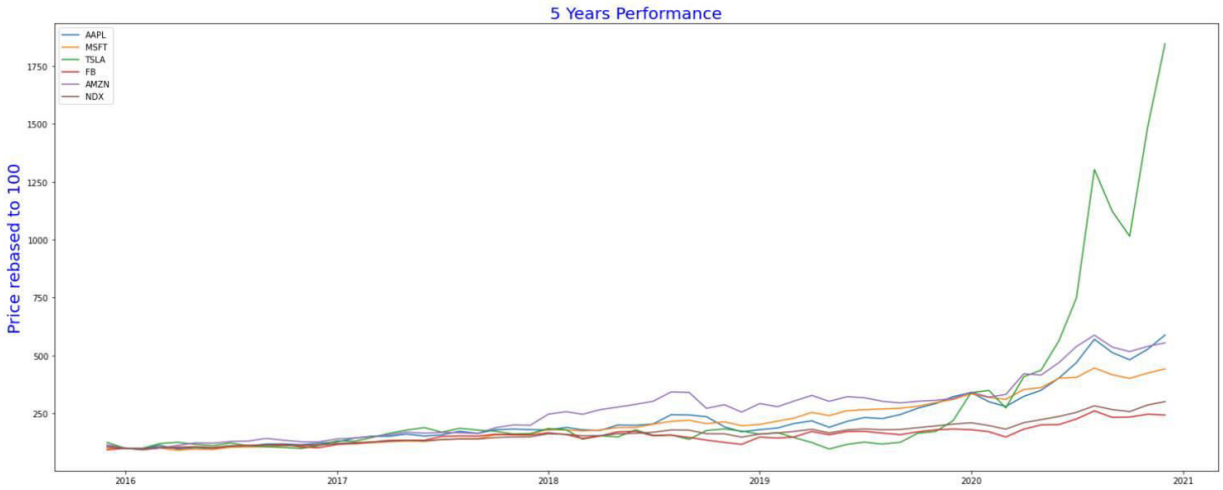
AMZN Stock Performance							
Trailing Period Performance							
Cumulative Return	**1M**	**3M**	**6M**	**1Y**	**2Y**	**3Y**	**5Y**
Stock	2.81%	3.44%	18.06%	76.26%	116.84%	178.50%	381.87%
Benchmark	5.05%	12.88%	26.89%	47.58%	103.61%	101.49%	180.59%
Active Return	-2.25%	-9.44%	-8.84%	28.68%	13.24%	77.00%	201.28%
Annualized Return	**1M**	**3M**	**6M**	**1Y**	**2Y**	**3Y**	**5Y**
Stock	2.81%	3.44%	18.06%	76.26%	47.26%	40.69%	36.96%
Benchmark	5.05%	12.88%	26.89%	47.58%	42.69%	26.30%	22.92%
Active Return	-2.25%	-9.44%	-8.84%	28.68%	4.57%	14.39%	14.04%

Generate below Visualizations:

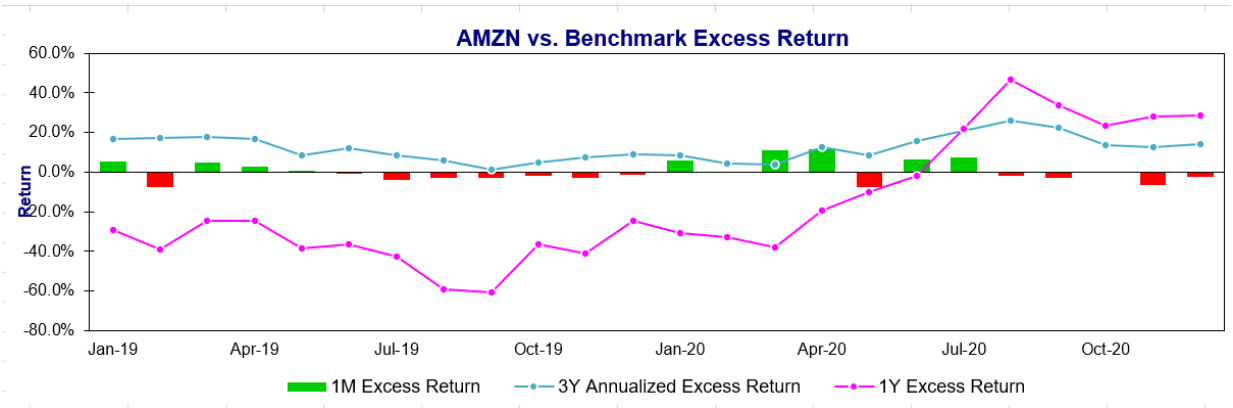
Create graph with Stock Price Rebased to 100, as of 31-Dec-2015, based on Cumulative Monthly Returns for last 5 years along with Benchmark. Include all stocks along with Benchmark NDX in a single chart.

Please find below calculated values for AMZN.

Rebased_100_AMZN.xlsx



Create 1M, 1Y and 3Y Annualized Active Return for Ticker 'TSLA' for 2019 to 2020. Below is the illustration for AMZN for 2019 and 2020.



C. Implement a Momentum Trade Strategy based on Monthly Price Action and calculate Investment Value starting end of 2015 till the end of 2020.

Also Calculate Investment Value starting end of 2015 till the end of 2020 when allocation is done equally on all five stocks.

For illustration purposes please find enclosed spreadsheet with calculations and comparison of trade strategies for 2015.

Excel to include:

(1) identifying highest Monthly Return among all stocks for Dec-2014.
(2) Calcs for arriving at Investment Value at the end of 2015 for Investment of $10000 at the end of 2014 based on momentum trade strategy and Equal Allocation across the five stocks.

Trade Strategy.xlsx