Critical risk analysis of intraday trading using algorithm like Black-Scholes, Random-Walk and comparison of those with TWAP, MACD strategy, through visual analysis.

By: Team Alpha

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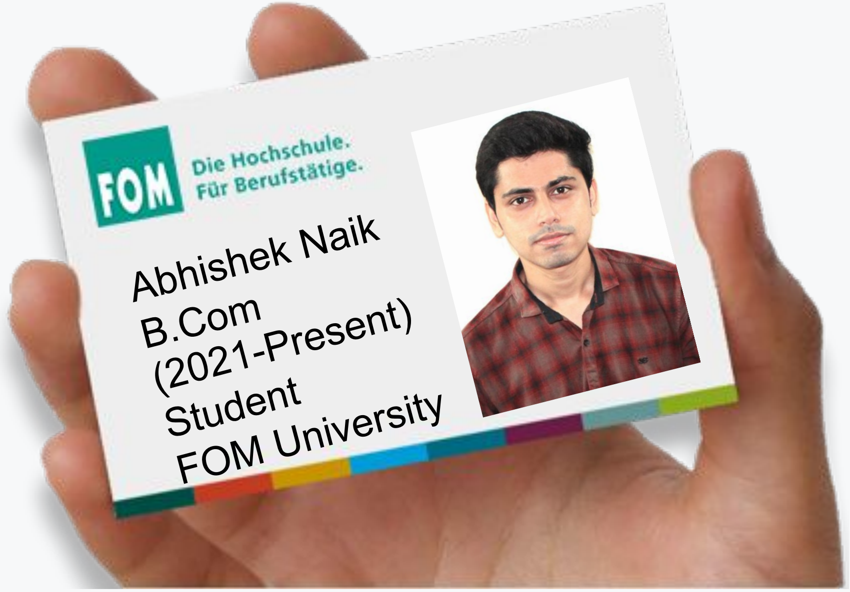
About Us:

Presenters



Content

Problem Statement

Critical risk analysis for intraday trading using widely used algorithm like Black-Scholes, Random-Walk and comparison of those algorithm with the help of TWAP MCAD strategy.

The questions we are trying to answer are:

- How much value do we put at risk by investing in a particular stock?
- Which algorithm gives better results?
- How algorithm perform for intraday trade.
- Does TWAP works well for intraday trade?
- Finding VAR(Value at Risk) for the stocks.
- Analysing performance using Moving Average Convergence Divergence (MACD) indicator strategy and identify entry and exit points.
- See how good option trading is for intraday trades.

Important Pointers

Intraday trade:

- Intraday trading means buying and selling stocks on the same trading day.
- Intraday trading is also known as Day Trading.
- Advantages of Intraday Trading: avoid tangible risk in holding shares overnight and reading the pulse of the market.

Option trading:

- It grants you the right but not the obligation to buy or sell an underlying asset at a set price on or before a certain date.

European Option:

- It is a version of an options contract that limits execution to its expiration date.

BSM- Black-Scholes model

- Is a differential equation widely used to price options contracts.
- Published by Mryon Scholes and Fischer Black in 1973.

Continuation…

Black-Scholes model assumptions:

- Interest rate is known and constant through time and so is the Volatility(%).
- The stock follows a random walk in continuous time, the variance of stock price follow a log-normal distribution.
- Stock pays no dividends or no transaction costs.
- The option can only be exercised at expiration.

Black Scholes Formula:

$$Call = S_0 N(d_1) - N(d_2) K e^{-rT}$$

$$Put = N(-d_2) K e^{-rT} - N(-d_1) S_0$$

$$d_1 = \frac{ln(\frac{S}{K}) + (r + \frac{\sigma^2}{2})T}{\sigma\sqrt{T}}$$

$$d_2 = d_1 - \sigma\sqrt{T}$$

$$N(x) = \int_{-\infty}^{x} \frac{e^{-x^2/2}}{\sqrt{2\pi}}$$

- S : current asset price
- K: strike price of the option
- N: CDF of normal distribution(left to right)
- r: risk free rate
- T : time until option expiration
- σ: annualized volatility of the asset's returns
- d1: the factor by which the present value of change of the stock exceeds the current stock price.
- d2: the risk-adjusted probability that the option will be exercised.

Continuation…

Black-Scholes model gives us Call and Put values:

- Put Call Parity must hold to avoid market arbitrage.

$$C + Ke^{-rT} = P + S_0$$

Time-weighted average price (TWAP):

- Is the average price of an asset over a specified time.
- TWAP is calculated by averaging the entire day's price bar, i.e., open, high, low, and close prices of the day.
- Advantages of TWAP: TWAP signals cover a considerable amount of risk with their calculations.

Formula to calculate TWAP:

- Average of each day's price = (Open + High + Low + Close)/4
- Average of N days = (Average of first day's price + Average of second day's price +........+ Average of Nth day's price)/N

Moving Average Convergence/Divergence (MACD):

- To understand this we need to know: Exponential Moving Average (EMA), it automatically allocates greater importance to most recent data point and lesser to the one at a distance.
- MACD is a trend-following leading indicator that is calculated by subtracting two Exponential Moving Averages (one with longer and the other shorter periods).

Continuation…

MACD components:

- **MACD Line:** This line is the difference between two given Exponential Moving Averages.
  - `MACD LINE = FAST LENGTH EMA - SLOW LENGTH EMA`
- **Signal Line:** This line is the Exponential Moving Average of the MACD line itself for a given period of time.
- **Histogram**: It is a histogram purposely plotted to reveal the difference between the MACD line and the Signal line.

MACD Strategy:

- `IF MACD LINE > SIGNAL LINE => BUY THE STOCK`
- `IF SIGNAL LINE > MACD LINE => SELL THE STOCK`

About and Head of Our Dataset

- Unfortunately we are using temp data due to connection error currently with Workspace data access.

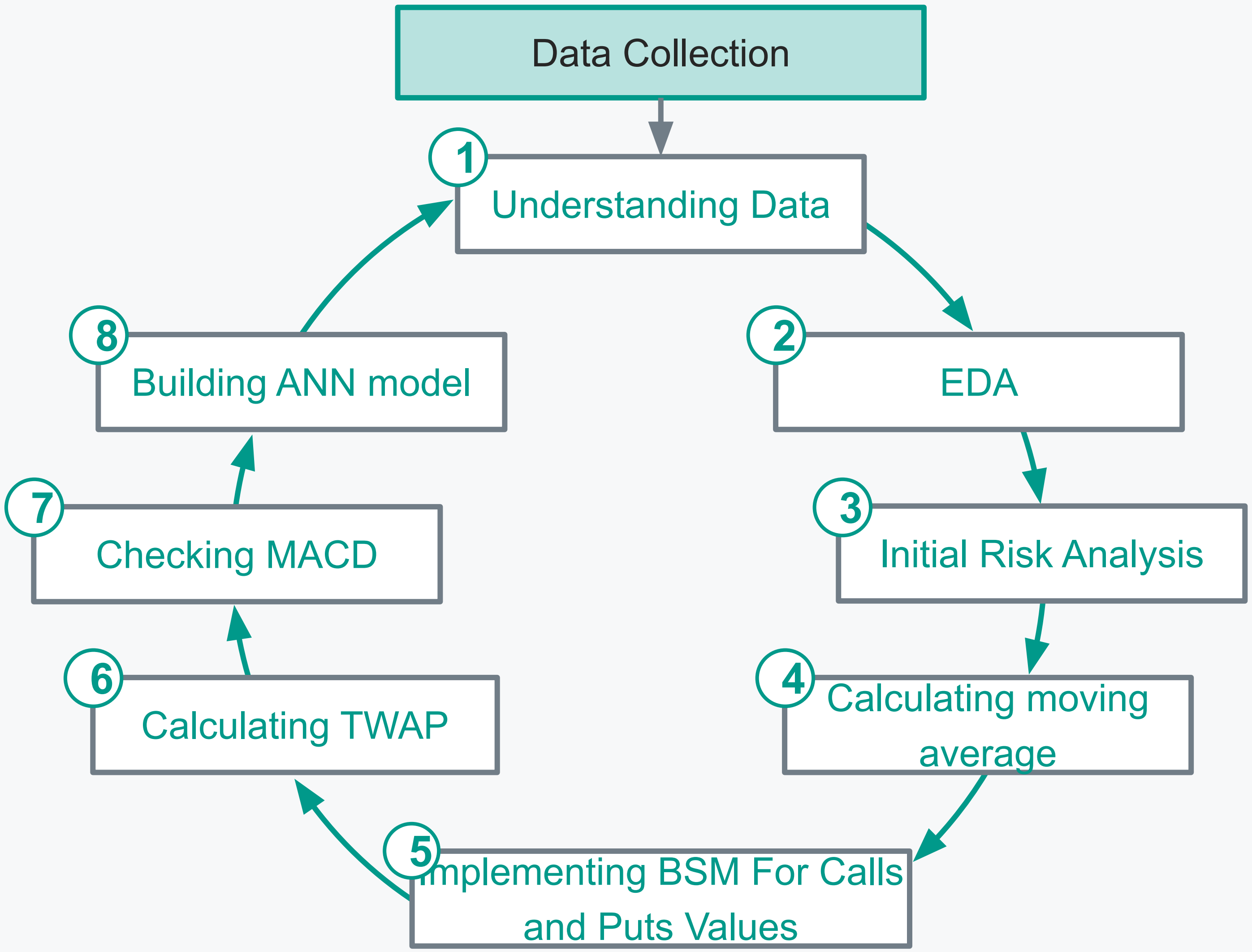
- We are considering two stock data for modeling needs.
- Apple and Amazon Data from 2013-2019 with 1 day interval is taken.
- The number of rows (observations) is 2376 and column (observations) is 6
  - **Data Dictionary**:
  - Volume: Volume of stock purchased in a day.
  - High: Highest value of the stock in the day.
  - Low: Lowest value of the stock in the day.
  - Open: The price at the opening of the trade day.
  - Close: Closing price at the end of the trade.

```
---------------------------------------------------------------------------
ModuleNotFoundError                       Traceback (most recent call last)
Input In [2], in <cell line: 1>()
----> 1 import refinitiv.dataplatform.eikon as ek
      3 ek.set_app_key('DEFAULT_CODE_BOOK_APP_KEY')
      5 df, err = ek.get_data(
      6     instruments = ['DAOO.O'],
      7     fields = [
   (...)
     14     ]
     15 )

ModuleNotFoundError: No module named 'refinitiv'
```

TimeStamp	Company	volume	high	low	open	close
2013-01-02	Apple	140.13M	79.29	77.38	79.12	78.43
2013-01-03	Apple	88.24M	78.52	77.29	78.27	77.44
2013-01-04	Apple	148.58M	76.95	75.12	76.71	75.29
2013-01-05	Apple	121.04M	75.61	73.6	74.57	74.84
2013-01-06	Apple	114.68M	75.98	74.46	75.6	75.04

Workflow



Data Collection
1
Understanding Data
2
EDA
3
Initial Risk Analysis
4
Calculating moving average
5
Implementing BSM For Calls and Puts Values
6
Calculating TWAP
7
Checking MACD
8
Building ANN model

Progress so far

Analysing Closing value of stock per day.

```
[22]  df['close'].describe()
```

```
count    2376.000000
mean      148.431098
std        67.475508
min        55.790000
25%       106.887500
50%       135.345000
75%       174.102500
max       506.090000
Name: close, dtype: float64
```

```
[26]  # The following code is to set to show the flow

      from pylab import rcParams
      rcParams['figure.figsize'] = 20,5
      df[['close', 'high', 'low']].plot(grid=True)
```

<matplotlib.axes._subplots.AxesSubplot at 0x7fde2dc68c50>

A good thing for our model is that for now the min and max for our data is positive.

Progress so far

```
[31]  sns.distplot(df['close'])
      plt.title('Distribution of Apple stocks')
      plt.show()
```

We get almost a highly right-skewed, let's do a Log transfromation data.

```
[32]  df['close_log'] = np.log(df['close'])
      sns.distplot(df['close_log'])
      plt.title('Log Distribution of Apple stocks')
      plt.show()
```

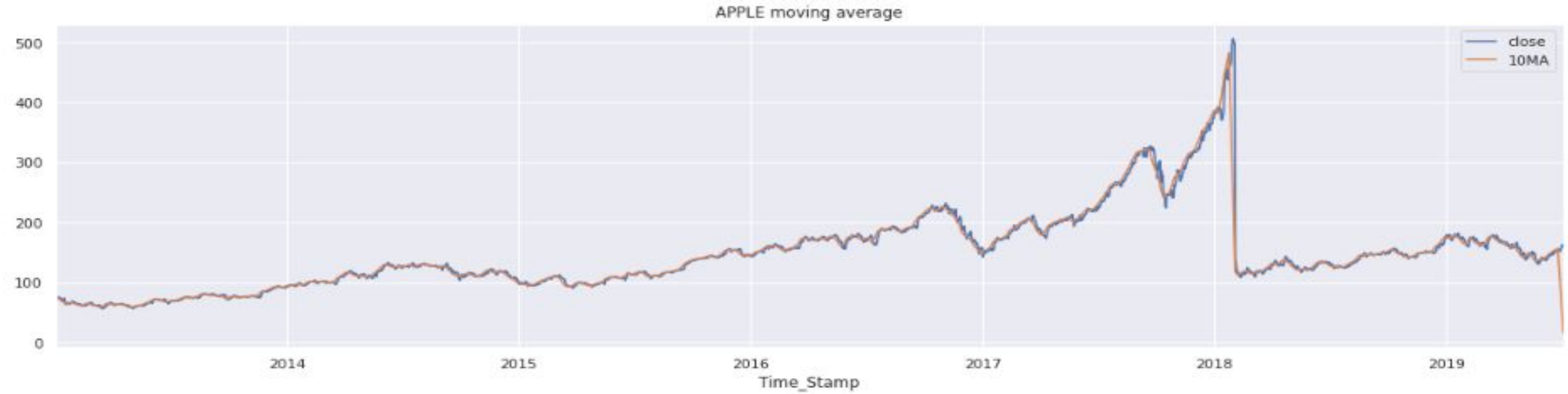
Progress so far

```
[41]
df['10MA'] = moving_averages
df.head()
```

	Company	volume	high	low	open	close	close_log	10MA
Time_Stamp								
2013-01-02	Apple	140.13M	79.29	77.38	79.12	78.43	4.362207	74.51
2013-01-03	Apple	88.24M	78.52	77.29	78.27	77.44	4.349503	73.90
2013-01-04	Apple	148.58M	76.95	75.12	76.71	75.29	4.321347	73.34
2013-01-05	Apple	121.04M	75.61	73.60	74.57	74.84	4.315353	72.95
2013-01-06	Apple	114.68M	75.98	74.46	75.60	75.04	4.318021	72.68

```
df[['close', '10MA']].plot().set_title('APPLE moving average')
```

```
Text(0.5, 1.0, 'APPLE moving average')
```



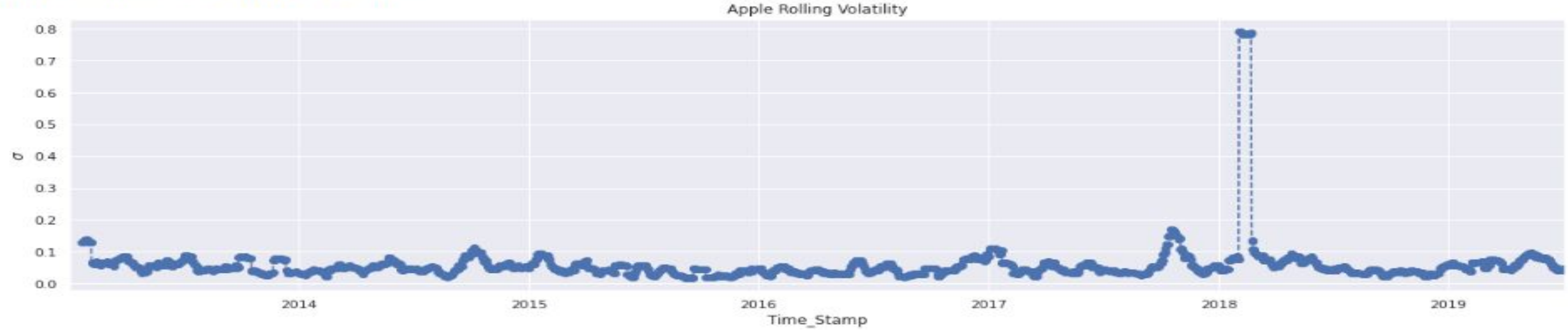
Progress so far

```
df['rolling_sigma'] = df['Change/return'].dropna().rolling(20).std() * np.sqrt(255)
df.head()
```

Time_Stamp	Company	volume	high	low	open	close	close_log	10MA	20MA	50MA	Change/return	rolling_sigma
2013-01-02	Apple	140.13M	79.29	77.38	79.12	78.43	4.362207	74.51	71.42	66.94	NaN	NaN
2013-01-03	Apple	88.24M	78.52	77.29	78.27	77.44	4.349503	73.90	70.75	66.64	-0.002912	NaN
2013-01-04	Apple	148.58M	76.95	75.12	76.71	75.29	4.321347	73.34	70.12	66.40	-0.006473	NaN
2013-01-05	Apple	121.04M	75.61	73.60	74.57	74.84	4.315353	72.95	69.52	66.19	-0.001387	NaN
2013-01-06	Apple	114.68M	75.98	74.46	75.60	75.04	4.318021	72.68	69.04	65.98	0.000618	NaN

[67]
```
df.rolling_sigma.plot(linestyle='--', marker='o')
plt.ylabel('$\sigma$')
plt.title('Apple Rolling Volatility')
```

```
Text(0.5, 1.0, 'Apple Rolling Volatility')
```



We see that the probability of deviation is very less, except for 2018

Thank you.
Feedback pointers & Questions.