Distribution of Stock Returns

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Overview

Objective

Importance of normality

- It is a common assumption that stock returns have normal distribution.
- The use of normal distribution in financial models is a convenient simplification, as it allows the application of a multitude of mathematical and statistical methods.
- Ex. Normal Distribution of Returns is one of the Black-Scholes Model Assumptions.

Dow Jones Industrial Average

What is DJIA?

- Dow Jones Industrial Average is a stock market index of 30 major publicly owned companies based in the United States.
- The index is calculated as $\frac{\sum p}{d}$, where p are the prices of the component stocks and d is the Dow Divisor(constant = 0.14523396877348) and used as indicator of the market performance.

Source of data

The data represents:

- 30 stocks in the Dow Jones Industrial Average for the past 10 years.
- Source: Yahoo Finance
- Link: `https://finance.yahoo.com/`

Normality tests

You have choice

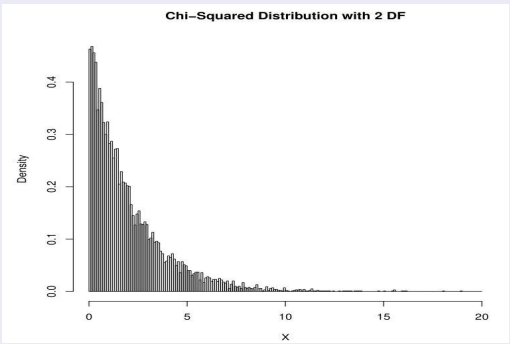
There are several normality tests, such as:

- Kolmogorov-Smirnov:
  - Not sensitive to problems in the tails.
  - For data sets > 50.
- Shapiro-Wilks:
  - Doesn't work well if several values in the data set are the same.
  - Works best for data sets with < 50, but can be used with larger data sets.
- Jarque-Bera:
  - Tests for skewness and kurtosis, very effective.

Jarque-Bera test

Core idea

The test uses skewness $\widehat{S}$ and kurtosis $\widehat{K}$ to check next hypothesis:

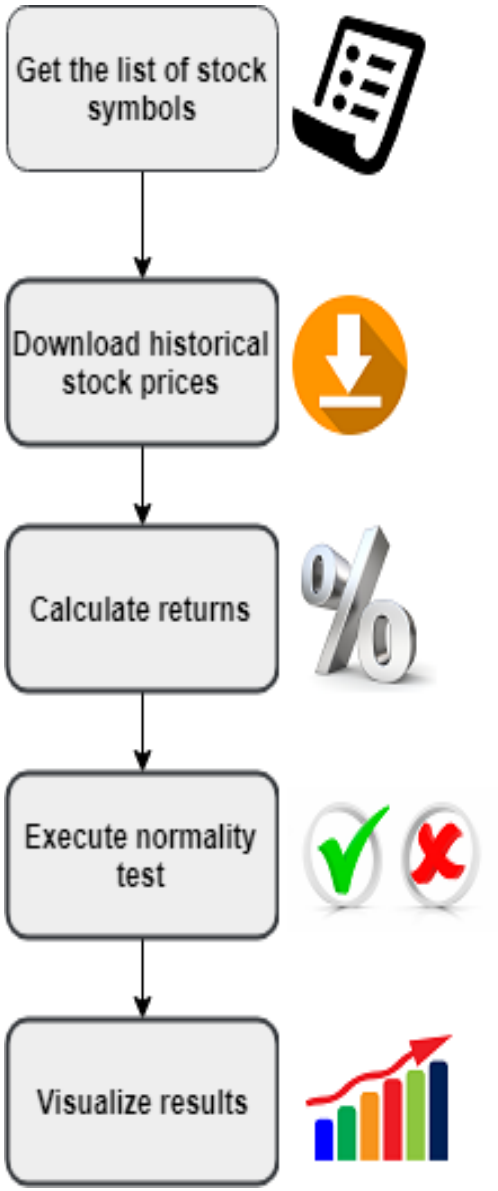


$$JB = n\left[\frac{\widehat{S^2}}{6} + \frac{\left(\widehat{K}-3\right)^2}{24}\right] \overset{H_0}{\sim} \chi^2_2,$$

where:

- $\mathcal{H}_0 : \widehat{S} = 0, \widehat{K} = 3$ vs $\mathcal{H}_1 : \widehat{S} \neq 0, \widehat{K} \neq 3$
- $\widehat{S} = \frac{1}{n}\sum_{i=1}^{n}\left(\frac{x_i-\bar{x}}{\sigma}\right)^3$
- $\widehat{K} = \frac{1}{n}\sum_{i=1}^{n}\left(\frac{x_i-\bar{x}}{\sigma}\right)^4$

Implementation



Parsing technique

To get required data often we should take it from a website. Functions below solve this problem.

```
tabs <- getURL(url)
```

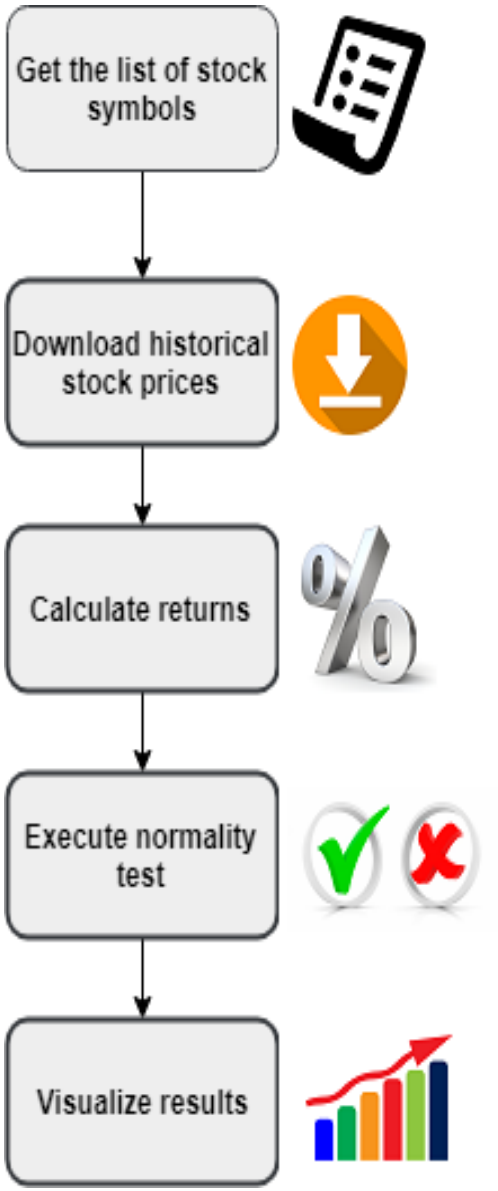
```
t <- readHTMLTable(tabs)
```

Data Download

Historical stock data can be downloaded using next function:

```
getSymbols()
```

Implementation



Returns Calculations

R rackage **quantmode** has poverful set of functions for calculation of period returns like **dailyReturn()**

Jarque-Bera test

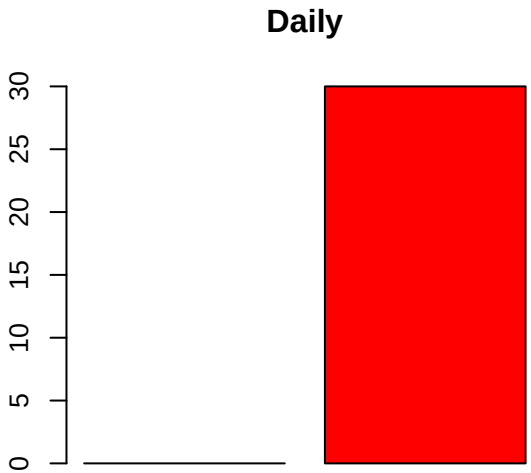
jarque.bera.test() is a function for required test, which is implemented in package **tseries**

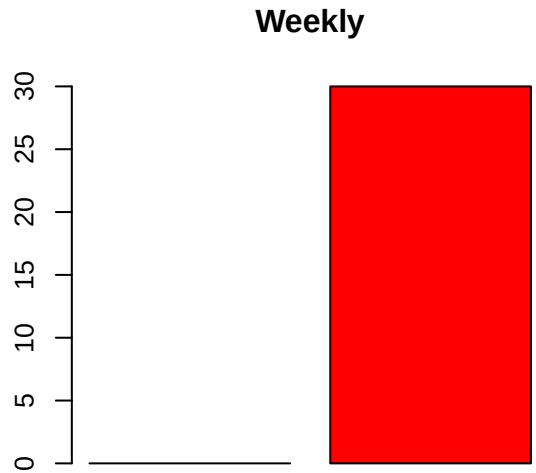
Visualization

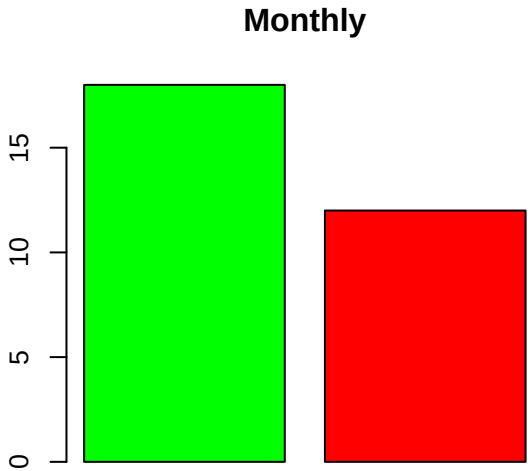
1. **par()** function allowes combine several graphs within 1 figure
2. **barplot()** function representing a barplot.

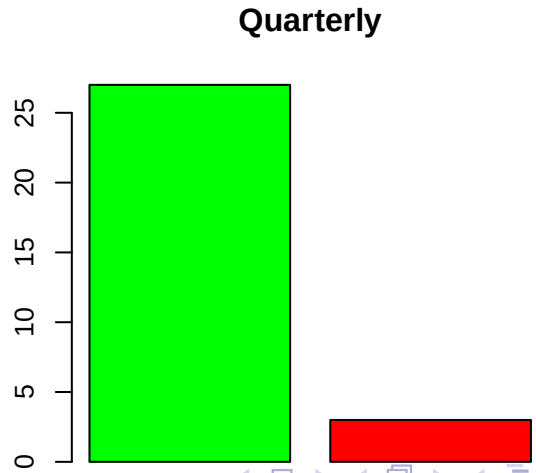
Results

Green - test passed, Red - test failed









Thank you for attention!