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A Brief Study on the application of SVM Algorithm for Asset Price Prediction and Portfolio Optimization with respect to Risk and Return

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Abstract: Portfolio Optimization is to evolve models to compute an optimal proportion of capital for investing with respects to the assets in the portfolio. Portfolio optimization covers a wide range of financial assets, such as stocks, funds, bonds, commodities, currencies and loans, whereas similar concepts and ideas are also applicable to non-financial portfolios. Asset price prediction is an important challenge in portfolio optimization. This project utilizes Support Vector Machines, a Machine learning algorithm for asset price prediction. SVM is very accurate and gives better results compared to other techniques. This project is mainly concentrated on predicting asset price followed by portfolio optimization considering the risk and return associated with each and every asset using R programming.

Keywords: Portfolio optimization, Support vector machines, Asset price prediction, Risk and return analysis.

1. INTRODUCTION

A portfolio groups the stocks for proportional investment of capital such that the profit is maximized and the risk is minimized. Portfolio management aims to investment prediction for meeting the long-term financial aspirations of a firm. Portfolio management remains as an important research area in finance [26]. Portfolio optimization (PO) achieves the financial objectives by finding the optimal allocation of wealth to a set of real-world assets in the long run. An effective portfolio not only rises investors' revenue and will to wipe out inflation but also influences the sustainable progress and development of the markets. Securities Investment is done by many people. The critical challenge that an investor often comes across is how to plan for distributing one's wealth among its alternative set of assets [32]. Investors are always wary stocks investment because of the volatile nature of the market. Volatility has a significant role in asset pricing models, portfolio control, and trading measures [27]. The market risk is very challenging that the investors would ponder more before taking decisions on investments [28]. Portfolio choice in finance looks for optimal capital allocations to specific securities, so that an investment could maximize the profit or

minimize the risk. Optimization of portfolio includes a wide set of financial assets, like as stocks, funds, bonds, commodities, currencies and loans, whereas similar concepts and ideas are also applicable to non-financial portfolios [30]. Stock market investments are always risky as stock prices oscillate often because of exchange rates, economic situations and the flow of capital [34]. It is true that investors forecast the future trend based on such data and on present & past events [9]. Investors must choose many assets from thousands of available assets and create single portfolio to parallely maximize the return and minimize the risk. In order to solve and analyse portfolio investment issues there are many approaches. It must be take care for an active utilization of technical analysis techniques to estimate easily the stock's market value. Technical indicators rely on past price and volume patterns to identify price trends believed to persist into the future. Technical analysis users believe that the technical indicators derived from historical data potentially contain important information about future movements of the stock market [47].

Modern portfolio optimization is historically remarkable thanks to Markowitz and Merton [5]. Markowitz (1952) supports the capital diversification justifying that such a process diminishes the variance. These concepts of diversification resulted in the Modern Portfolio Theory (MPT), which brings the idea of selecting among the two conflicting objectives: risk and return [7]. The discipline of Portfolio Optimization deals with the formulation of models with an objective to compute the optimal proportion of capital. Diversification and the process of allocation, which involves investments in different assets, asset classes or markets, is a popular strategy to mitigate risk. Portfolio optimization is very tough and evolving portfolio optimization model is a burning topic always [8] and risk is always a serious issue in financial activities Hence the Portfolio research focuses on (1) asset returns optimization (2) evolve Portfolio model (3) analyse with an optimal portfolio effective algorithm. Many practical efforts indicate the impact on various risk control measures strategies on decision making and therefore obviously on expected returns. This article gives a brief study about the application of SVM algorithm for

2. MACHINE LEARNING

Machine learning is an extended application of artificial intelligence (AI) that enables automatically the learning and improvement without being explicitly programmed. Ml is about evolving of algorithms to access information and utilize to learn for themselves. Machine learning differs input and output data and sub-divided into supervised learning, unsupervised learning and reinforcement learning. ML extracts knowledge from data, which can then be used for anticipation and generating new information that information puts down uncertainty as it implies a strategy to resolve particular issues [18]. The efficiency of ML models in analyzing, classifying, and predicting with complicated and enourmous data, has made them popular for numerous applications. Machine learning algorithms find application to forecast financial data thanks to the fantastic outcome with nonlinear data [10]. ML has also been widely used in applications related to the economic and financial analysis of energy markets, such as price prediction and risk management.

Machine learning techniques integrate artificial intelligence set ups, aim to extract the patterns that are learnt from the past historical data. The various algorithms of machine learning are shown below in (figure 1),

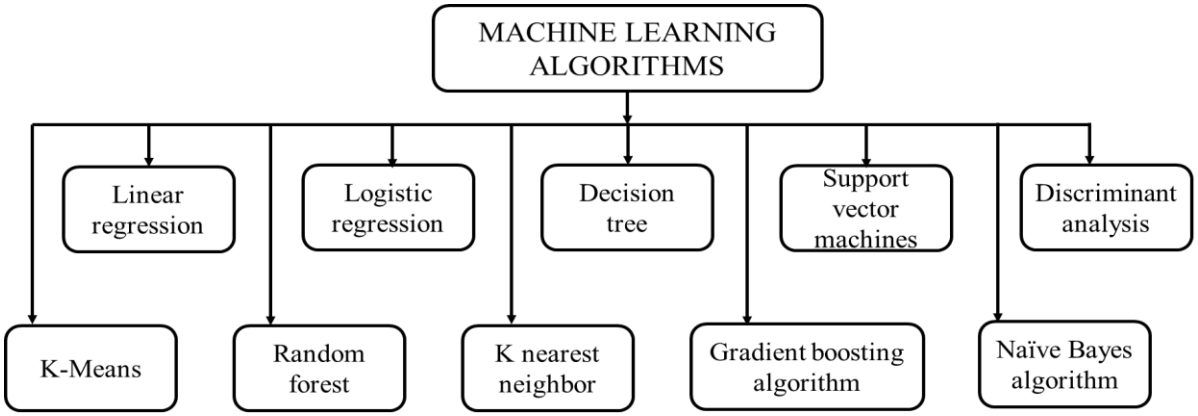

Figure 1

Linear Regression: Estimates real values based on continuous variables is divided into simple linear regression and multiple linear regression.

Logistic Regression: Anticipates an occuring event by fitting data to a function. It is also known as logit regression whose output values lies between 0 and 1.

Decision Tree: A supervised learning algorithm, mostly used for classification problems with categorical and continuous dependent variables.

Support vector machines: The SVM classification algorithm has tremendous application like corporate default predictions. This algorithm emplyes a separating hyperplane that classifies n trials, each of which has p features. The SVM algorithm identifies the farthest separating hyperplane, and thus allows some misclassifications to get rid of from the overfitting problem [3].

Multi variant Discriminant Analysis (MDA): Uses Bayes theorem and the important assumptions that both positive and negative classes consist of Gaussian distributions havingequal covariance matrices [19].

K-Means: Ann unsupervised algorithm to take care of the clustering problems.

Random Forest: The consensual classifications of accurate trees are agglomerated into one with a RF algorithm. The grouping of decision trees in the RF technique could be applied in regressions or classifications and they yield wonderful results for financial market forecasting [12].

kNN (k nearest neighbor): Applied for classification and regression related problems. K-nearest neighbour collects all the given cases and evolves a new classification case by means of a majority vote of its k neighbors.

Naive Bayes algorithm: It is a classification method based algorithm that uses Bayes theorem. It assumes the given dataset possess a particular feature in a class, that is unrelated to any other feature. Naïve Bayes algorithm is a simple algorithm for very big datasets and outperforms highly complicated classification techniques [15].

Gradient Boosting algorithms: A Machine Learning that yields a forecasting model that resembles ensemble of weak forecasting models, especially decision trees.

Support Vector Machines (SVM)

Support-vector machines are supervised learning algorithms that deal with related learning algorithms to peruse data required for classification and regression analysis. The Support Vector Machine (SVM) algorithm offers solutions for both classification and regression issues. Many SVM algorithms handle complex problems that are modelled with high end optimization techniques including meta heuristics [1]. Off late, the SVM is applied for stock

price forecasting. Stock prices often fluctuate due to environmental and economical variations. Support vector machines (SVM) are best performing algorithms [34].
The aim of SVM is to identify a hyperplane in an N-dimensional space (N-Number of features) that distinguishes the data points. And many possible hyperplanes are could be identified in a problem. It is important to calculate the maximum distance between data points of both classes. Maximization of the margin distance yields reinforcement so that future data points to enable easily classification.

Application of SVM in Stock Market

The Model's Probable Architecture

The structure of SVM's Model for the purpose of stock closing price forecasting is represented by the following diagram with details about subsequent sections [20].

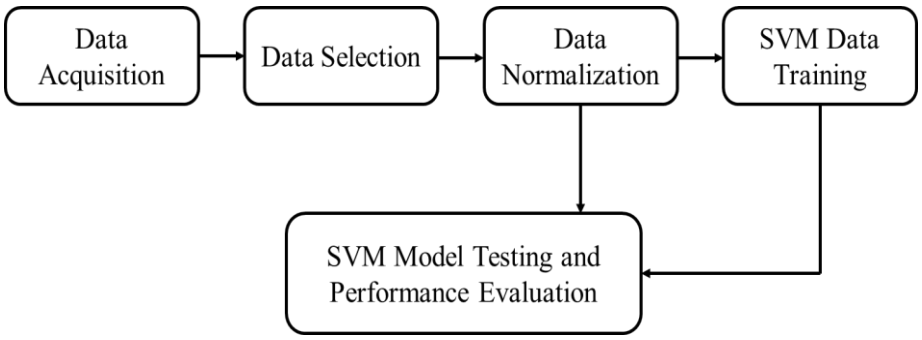

Figure 2

Data Acquisition and Description

The data required was gathered from the website from yahoofinance.com which is the stock price data for S&P 500 representing the daily trading from 23/02/1950 to 11/03/2016 and the related components are the initial price, higher price, lower price, finalprice, volume and adjacent close of each trading day

Data Selection

The data selected from the acquired data is from 10th July, 2015 to 11th March, 2016 summing up to total of 170 trading days which is categorized into 70% for training and 30% for testing.

Data Normalization

Because of the inconsistency present in the data, it is normalized to the range of 0 and 1to enhance the performance of the models while being handled during testing.

Model Training

The period from the data was categorized into training and testing data, with training data taking 70% (119 trading days) of the selected data.

Model Testing

Once the training is over, each model was automatically first saved and then subsequently tested outside considering 30% (51 trading days) of selected information and then behaviour of every model was recorded and analysed.

3. CONCLUSION

Portfolio optimization calculates optimal weight of each asset simultaneously by maximizing the expected return and minimizing the risk. In order to achieve the task it is necessary to predict the stock prices as accurately as possible. From the literature review it is evident that Support vector machines are widely used in asset price prediction as they tend to produce more approximate results. Stock market is very volatile and tend to fluctuate a lot. So it is important to consider all the parameters involved and create a model which is highly efficient.

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