CS501 Research Report

1. Beta Hedging in investment

In finance, Alpha [1] measures the active return on an investment, which is the excess return of the investment relative to the return of a benchmark index. Alpha is the portion of a portfolio's return that cannot be attributed to market returns and is thus independent of them. Beta [2] measures of the volatility, or systematic risk, of a portfolio in comparison to the whole market and is the portion of the return generated from a portfolio that can be attributed to overall market returns. Alpha and Beta are two key coefficients in the capital asset pricing model (CAPM) [3] used in modern portfolio theory and are closely related to other important quantities such as standard deviation, R-squared and the Sharpe ratio [4].

Hedging is used to reduce the risk of adverse price movements in an asset class by taking an offsetting position in a related asset. Beta hedging involves reducing the overall beta of a portfolio by purchasing stocks with offsetting betas [5].

2. Deep learning approaches applied in investment

Deep neural networks models have proven powerful for tasks as diverse as language translations [6], video captioning [7], video recognition [8], and time series modeling [9].Recurrent neural networks and long short-term memory (LSTM) networks[10] are state-of-the-art techniques for sequence learning and are suitable for the financial time serials prediction. A number of recent papers and hedge funds[11] consider deep learning approaches to predicting stock market performance.

J. Alberg and Z. C. Lipton [12] proposed an investment strategy that constructed portfolios of stocks today based on predicted future fundamentals. They trained deep neural networks to forecast future fundamentals based on a trailing 5-years window, then sorted the set of available stocks according to the fundamental factor and construct investment portfolios comprised of those stocks which score highest. Simulations demonstrate that investing based on the predicted factors yields a compound annualized return (CAR) of 17.1%, vs 14.4% for a normal factor model and a Sharpe Ratio of 0.68 vs 0.55.

O. B. Sezer, etc.[13] presented a new stock trading and prediction model based on a multilayer perceptron(MLP) neural network utilizing technical analysis indicator values as features. Three most commonly used technical indicators, RSI, MACD, and William % R were selected to be used. The model was trained and tested on Dow 30 stocks in order to see the evaluate the model. The results indicated that comparable results were obtained against the baseline Buy and Hold strategy even without fine tuning and optimizing the model parameters.

S. Edet [14] predicted the movements of the S&P 500 index using variations of the recurrent neural network. In predicting the S&P 500 index, they considered 14 economic variables, 4 levels of hidden neurons of the networks and 5 levels of epochs. In applying these networks (i.e.

Simple RNN, LSTM, GRU) to forecast the movement of S&P 500 index, they used the concept of experimental design to choose the features that were most appropriate for prediction. In each case of the three neural networks to be used for prediction, they performed 20 experiments to determine which of the experiments gave the best accuracy score. The three selected experiments for these models were able to predict the movement of the S&P 500 index with an accuracy of 75%, 74% and 74% respectively.

T. Fischer and C. Krauss [15] applied LSTM networks to a large-scale financial market prediction task on the S&P 500, from December 1992 to October 2015. They framed a proper prediction task, derive sensible features in the form of 240-day return sequences, standardize the features during preprocessing to facilitate model training, discuss a suitable LSTM architecture and training algorithm, and derive a trading strategy based on the predictions, in line with the existing literature. With daily returns of 0.46 percent and a Sharpe Ratio of 5.8 prior to transaction costs, they found LSTM networks to outperform memory-free classification methods, i.e., a random forest (RAF), a deep neural network (DNN), and a logistic regression classifier (LOG).

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