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A Long Short-Term Memory Based Deep Learning Model for Corporate Bond Price Predictions

Authors : Vikrant Gupta, Amrit Goswami

Abstract : The fixed income market forms the basis of the modern financial market. All other assets in financial markets derive their value from the bond market. Owing to its over-the-counter nature, corporate bonds have relatively less data publicly available and thus is researched upon far less compared to Equities. Bond price prediction is a complex financial time series forecasting problem and is considered very crucial in the domain of finance. The bond prices are highly volatile and full of noise which makes it very difficult for traditional statistical time-series models to capture the complexity in series patterns which leads to inefficient forecasts. To overcome the inefficiencies of statistical models, various machine learning techniques were initially used in the literature for more accurate forecasting of time-series. However, simple machine learning methods such as linear regression, support vectors, random forests fail to provide efficient results when tested on highly complex sequences such as stock prices and bond prices. hence to capture these intricate sequence patterns, various deep learning-based methodologies have been discussed in the literature. In this study, a recurrent neural network-based deep learning model using long short term networks for prediction of corporate bond prices has been discussed. Long Short Term networks (LSTM) have been widely used in the literature for various sequence learning tasks in various domains such as machine translation, speech recognition, etc. In recent years, various studies have discussed the effectiveness of LSTMs in forecasting complex time-series sequences and have shown promising results when compared to other methodologies. LSTMs are a special kind of recurrent neural networks which are capable of learning long term dependencies due to its memory function which traditional neural networks fail to capture. In this study, a simple LSTM, Stacked LSTM and a Masked LSTM based model has been discussed with respect to varying input sequences (three days, seven days and 14 days). In order to facilitate faster learning and to gradually decompose the complexity of bond price sequence, an Empirical Mode Decomposition (EMD) has been used, which has resulted in accuracy improvement of the standalone LSTM model. With a variety of Technical Indicators and EMD decomposed time series, Masked LSTM outperformed the other two counterparts in terms of prediction accuracy. To benchmark the proposed model, the results have been compared with traditional time series models (ARIMA), shallow neural networks and above discussed three different LSTM models. In summary, our results show that the use of LSTM models provide more accurate results and should be explored more within the asset management industry.

Keywords : bond prices, long short-term memory, time series forecasting, empirical mode decomposition
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