Stock market forecasting: an extension of the Engle-Granger approach to machine learning and ensemble learning techniques.

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Abstract

This thesis builds on the work of W.T. Ziemba et al., who identified a long-run equilibrium relationship between the earnings yield and interest rates. The objective is to extend their findings by applying a two-step Engle-Granger cointegration approach, combined with machine learning and ensemble learning techniques. The research question is whether the linear dynamics underlying the Engle-Granger method can effectively forecast one-period-ahead S&P 500 returns, or if predictive accuracy can be improved using nonlinear learning models.

The methodology follows a backtesting cycle. At each iteration, data up to time *t* are loaded; the Engle-Granger procedure is applied, with the Error Correction Model estimated in the second step. In parallel, several machine learning algorithms and ensemble methods are trained. Their forecasts are stored and evaluated.

Results show that among the machine learning models, Random Forest achieves the lowest RMSE (3.946), slightly outperforming the Error Correction Model. Even simple ensemble models outperform three out of four individual models. The best performance is obtained by the "Combined Forecast (BIC)" ensemble, with an RMSE of 3.912 compared to 3.994 for the Error Correction Model.

In conclusion, integrating the Engle-Granger approach with nonlinear models may enhance short-term stock market forecasting. Further improvements could be achieved using higher-frequency data or more refined hyperparameter tuning.