CRUDE OIL PRICE FORECAST VIA AN EEMD-BASED FA-LSSVR ENSEMBLE LEARNING PARADIGM

Lean Yu, Beijing University of Chemical Technology,Phone+ 86 13717924216, E-mail: yulean@mail.buct.edu.cn
Xinxie Li, Beijing University of Chemical Technology,Phone+86 15210936447, E-mail:lixinxie000@163.com
Ling Tang, Beijing University of Chemical Technology,Phone+86 15810237921, E-mail: tangling@mail.buct.edu.cn

Overview

Fluctuations in crude oil price significantly impact the global economic market. A rise or a fall leads to redistribution of wealth in both oil-exporting and importing countries. Under such background, efficient and accurate predictions for crude oil price are critical for a stable economic development. However, crude oil price forecasting has been proved to be an extremely tough task, due to its various interactive intrinsic and extrinsic factors. Considering the importance and difficulty of crude oil price prediction, we propose a novel ensemble learning paradigm to forecast international crude oil price.

The paper is organised as follows: After the introduction, the second section describes the novel hybrid ensemble learning paradigm. For illustration and verification purposes, the crude oil spot price in West Texas Intermediate (WTI) market is taken as sample data. The experimental design is given in Section three and the results are further discussed in Section four. Finally, Section five concludes the paper and points out the future research.

Methods

A novel hybrid model is proposed in this paper. Three main steps are involved in the proposed model, i.e., data decomposition via EEMD, individual forecasting via LSSVR, and ensemble forecasting by simple addition. Particularly, FA, as a powerful intelligent optimization (AI) optimization algorithm, is especially introduced to address the essential but difficult task of searching optimal parameters in LSSVR (e.g., penalty coefficient and kernel function parameters).

Results

(1) The proposed model outperforms all considered benchmark models (including popular forecasting methods and hybrid ensemble counterparts) in both prediction and robustness.

(2) All the hybrid ensemble learning paradigms performs better than all the single models, indicating the effectiveness of “decomposition and ensemble” strategy.

(3) Through robustness analysis, FA can be proved the most efficient and robust tool amongst various AI optimization techniques, in parameter searching for LSSVR.

(4) Finally, with the concept of “decomposition and ensemble” and FA as a powerful parameter searching method, the proposed EEMD-based FA-LSSVR can be taken as an effective forecasting tool for crude oil price with nonlinear and irregularity.

Conclusions

We propose a novel ensemble learning paradigm to forecast international crude oil price. The empirical results indicate that the novel hybrid ensemble learning paradigm outperform all considered benchmark models (including existing popular models and hybrid counterparts with other parameter searching techniques), in both prediction accuracy and robustness. The results also suggest that the proposed model is a promising alternative to predict crude oil price with high volatility and irregularity.

References

Zhang X, Yu L, Wang S, et al. Estimating the impact of extreme events on crude oil price: An EMD-based event analysis method[J]. Energy Economics, 2009, 31(5): 768-778.

Tang L, Yu L, Wang S, et al. A novel hybrid ensemble learning paradigm for nuclear energy consumption forecasting[J]. Applied Energy, 2012, 93: 432-443.

Yu L, Wang S, Lai K K. Forecasting crude oil price with an EMD-based neural network ensemble learning paradigm[J]. Energy Economics, 2008, 30(5): 2623-2635.

Wang S, Yu L, Tang L, et al. A novel seasonal decomposition based least squares support vector regression ensemble learning approach for hydropower consumption forecasting in China[J]. Energy, 2011, 36(11): 6542-6554.