Published Online: 05 April 2022

A modified ordinary differential equation approach in price forecasting

AIP Conference Proceedings **2459**, 030008 (2022);
https://doi.org/10.1063/5.0083542

Ivan Georgiev[a], Virginia Centeno[b], Vesela Mihova[c], *and* Velizar Pavlov[d]

View Affiliations
View Contributors

ABSTRACT

For the assets' prices analysis proposed on the financial markets, it is common to use big amounts of data. By making those observations, the movement of the prices can be predicted. Working with big data sets requires more complicated forecasting methods based on numerical methods for solving ordinary, partial, and stochastic differential equations. This paper presents a modified ordinary differential equation approach with different forms of polynomials and periodic functions. The coefficients of the studied forms are calculated using Weighted Least Squares Method. Different variants of parameter settings are considered depending on the time of the horizon chosen by the researcher and the weight function assigned to the observations. Of the set of possible solutions about the model coefficients, those that give the best approximation on the test data are suggested, with the help of a weighted error. This approach is empirically tested to forecast the trends in the stock prices. A validation is made that allows to be chosen the best decision from the whole set of possible decisions, which are calculated by the Nonlinear Least Squares Method. That method is used for finding the coefficients of the model. The presented approach gives the opportunity to choose from a huge set of parameters, which makes it widely applicable. A Matlab programming code is developed for the purposes of the study. The code could be applied in the practice of portfolio managers and investors.

REFERENCES

1. V. Centeno and E. Raeva, "An Analysis on Prices of Assets of Four American Banks from 'The Big Four' according to their Index Standard&Poor's 500," in *Proceedings of Financial Mathematics and Informatics*, University of Ruse, vol. **58** (2019), pp. 41–48. Google Scholar

2. A. Krause, *An Overview of Asset Pricing Models* (University of Bath School of Management, UK, 2001). Google Scholar

3. P. Hordahl and F. Packer, *Understanding asset prices: an overview* (Bank for International Settlements, Monetary and Economic Department, 2007). Google Scholar

4. V. Kostadinova, I. Georgiev, V. Mihova, and V. Pavlov, "An Application of Markov Chains in Stock Price Prediction and Risk Portfolio Optimization," in *New Trends in the Applications of Differential Equations in Sciences*, AIP Publishing, vol. **2321**, Issue 1 (2021), pp. 030018-1–11. https://doi.org/10.1063/5.0041119, Google Scholar, Scitation

5. Statistics Solutions, <https://www.statisticssolutions.com/free-resources/directory-of-statistical-analyses/time-series-analysis/>. Accessed 10 June 2021. Google Scholar

6. T. H. D. Ngo and W. Bros, "The Box-Jenkins methodology for time

Conference, vol. **6** (2015), pp. 1–11. Google Scholar

7. V. Centeno, I. Georgiev, V. Mihova, and V. Pavlov, "Price forecasting and risk portfolio optimization," in *Application of Mathematics in Technical and Natural Sciences*, AIP Publishing, vol. **2164** (2019), pp. 060006-1-15. Google Scholar

8. A. Sładkowski, *Modelling of the Interaction of the Different Vehicles and Various Transport Modes* (Springer International Publishing, 2019). Google Scholar

9. S. G. Georgiev and B. B. Idirizov, „TSA & DL predictive modelling of Bulgarian financial and economic indices as a part of EU," in *Application of Mathematics in Technical and Natural Sciences*, AIP Publishing, 2021, (to appear). Google Scholar

10. S. G. Georgiev and B. B. Idirizov, „Predictive analysis and evaluation of the Bulgarian economy's most significant indicators," in *Proceedings of Financial Mathematics and Informatics*, University of Ruse, vol. **59** (2020), pp. 97–110. Google Scholar

11. Deepak Singhal and K.S. Swarup, "Electricity price forecasting using artificial neural networks," in *International Journal of Electrical Power & Energy Systems*, Volume **33**, Issue 3 (2011), pp. 550–555. https://doi.org/10.1016/j.ijepes.2010.12.009, Google Scholar, Crossref

12. M. Markova, "Foreign exchange rate forecasting by artificial neural

Sciences, AIP Publishing, vol. **2164** (2019), p. 060010. Google Scholar, Scitation

13. M. Markova, "Credit card approval model: An application of deep neural networks," in *New Trends in the Applications of Differential Equations in Sciences*, AIP Publishing, vol. **2321**, Issue 1 (2021), pp. 030023-1-8. Google Scholar, Scitation

14. S. Georgieva, M. Markova and V. Pavlov, "Using Neural Network for Credit Card Fraud Detection," in *New Trends in the Applications of Differential Equations in Sciences*, AIP Publishing, vol. **2159** (2019), pp. 030013-1-10. Google Scholar, Scitation

15. M. Xue and C. H. Lai. "From time series analysis to a modified ordinary differential equation," in *Journal of Algorithms & Computational Technology*, **12.2** (2018), pp. 85–90. https://doi.org/10.1177/1748301817751480, Google Scholar, Crossref

16. M. Lascsáková. "The analysis of the numerical price forecasting success considering the modification of the initial condition value by the commodity stock exchanges," in *Acta Mechanica Slovaca*, **22**.3 (2018), pp. 12–19. https://doi.org/10.21496/ams.2018.021, Google Scholar, Crossref

17. S. G. Georgiev, „Numerical and analytical computation of the implied volatility from option price measurements under regime-switching," in *Application of Mathematics in Engineering and Economics*, AIP Publishing, vol. **2172** (2019), p. 070007.

Google Scholar

18. Y. Dimitrov, I. Dimov, V. Todorov, “Numerical solutions of ordinary fractional differential equations with singularities,” in *Studies in Computational Intelligence*, **793** (2019), pp. 77–91. Google Scholar

19. Matlab Site, <https://www.mathworks.com/products/matlab.html>. Google Scholar

20. Bulgarian Stock Exchange, <https://www.bse-sofia.bg/bg/>. Google Scholar