Abstract of the PhD thesis

"Prediction methods in time series based on artificial intelligence in selected complex processes."

mgr inż. Łukasz Kupracz

supervisor: prof. dr hab. inż. Antoni Wiliński

The considerations in the doctoral dissertation concern the accuracy of statistical methods and models used for forecasting in time series based on artificial intelligence in selected complex processes. This task is quite obvious in science, and many methods have been developed, which are also abundantly cited in this work. A distinctive feature of the presented dissertation is that it links these tasks to current socially significant problems that concern the entire world in the case of the pandemic and Poland in the case of inflation. The applied predictive methods stand out in both research areas with innovative changes of an authorial nature.

The COVID-19 pandemic caused by the SARS-CoV-2 virus has brought more victims to humanity than any of the known natural disasters, war conflicts and pandemics. The virus spreading around the world was reaping a deadly toll. National authorities introduced, with varying degrees of success, radical preventive measures aimed at limiting infections. The pandemic caused a health service crisis in many countries. Previously used methods of forecasting the number of infections turned out to be inaccurate for various reasons.

The aim of the dissertation in the first task related to the pandemic was to develop methods and statistical models for forecasting the spread of the SARS-CoV-2 virus at the country level, taking into account vaccinations. These methods would allow for early evaluation of restrictive policies and preparation of services for upcoming waves of infections. For the purpose of achieving the goal, a literature review was conducted regarding the impact of the pandemic on social life, the economy, and the natural environment. In the second task concerning inflation, an original prediction method was also applied, resulting in a reduction of forecast error compared to the classical regression method. For both research areas, a review of the forecasting methods used was conducted. The goal and research hypothesis of the work were formulated.

In the application part of the dissertation, 3 methods of predicting time series of SARS-CoV- 2 infections and a criterion taking into account vaccinations – vaccination density – were presented. The next 2 methods with optimization and correction concerned the prediction of time series of inflation. In the case of infection predictions, the methods were based on series similarities, including vaccinations. The effectiveness of pandemic series forecasting using the proposed methods was evaluated depending on the prediction horizon, infection dynamics, vaccination density, and the geographical location of the country studied. In the method of forecasting inflation in a time series based on year-to-year values, an authorial correction of forecasts in a one-month horizon was introduced.

The dissertation concludes with conclusions from the considerations and research conducted in the work and indicating further directions for research.

12.04.2024

Łukasz Kupracz