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2021 International Conference on Applied Mathematics, Modeling and Computer Simulation

Modeling of COVID-19 transmission using machine learning

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Abstract

A susceptible-infected-susceptible (SIS) model with a nonlinear infection rate, a forecast model based on autoregressive integrated moving average (ARIMA), and a forecast model based on long short-term memory (LSTM) artificial neural networks were developed using the COVID-19 epidemic data from four countries (China, Italy, the United Kingdom, Germany, France, and Poland) to simulate and forecast the epidemic trends in these countries. The models were compared in terms of forecast errors, and the LSTM model was found to forecast virus transmission very well.

Introduction

The virus that causes COVID-19 has spread rapidly since the outbreak of the epidemic in Wuhan at the end of December 2019. As of November 21, 2020, there was a cumulative total of 57,839,814 individuals with confirmed COVID-19 and a cumulative total of 1,373,300 deaths from COVID-19 worldwide; this disease continues to severely threaten human lives around the globe. Therefore, it is necessary to study virus transmission models so that the epidemic trends can be understood and forecast in a timely manner and early preventive and control measures can be taken.

Methods

1.SIS model with a nonlinear infection rate

2.ARIMA model

3.LSTM model

Results

To facilitate the analysis of the forecast performance of the three methods, the forecast results obtained for the four countries using the three models in this study are provided in the following figures.

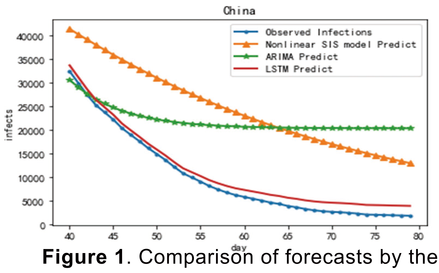

Figure 1. Comparison of forecasts by the three models for the epidemic in China.

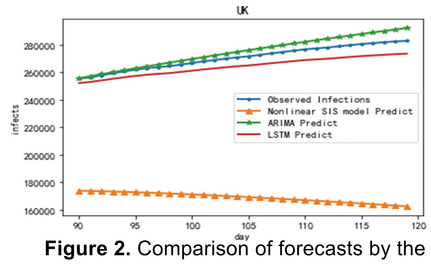

Figure 2. Comparison of forecasts by the three models for the epidemic in the UK.

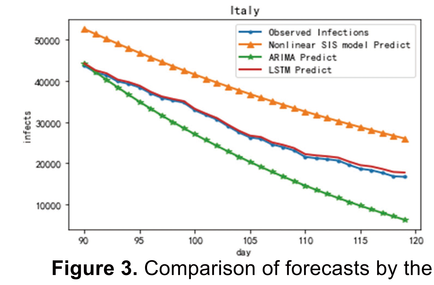

Figure 3. Comparison of forecasts by the three models for the epidemic in Italy.

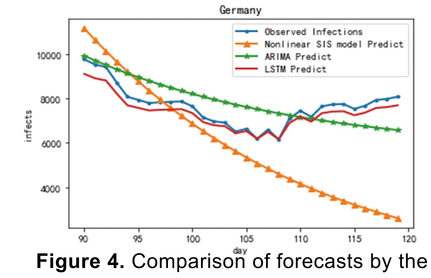

Figure 4. Comparison of forecasts by the three models for the epidemic in Germany.

Conclusion

Based on data for the COVID-19 epidemic in China, Italy, the UK and Germany, this study discussed and established an SIS model with a nonlinear infection rate, an ARIMA model, and an LSTM model and used them to forecast the development trends of the COVID-19 epidemic. The MAEs between the simulated forecast values and the actual values were calculated as the basis for model comparison. The LSTM model had the best forecast performance among the three models. The forecast results for the LSTM model based on the available data had high accuracy. In addition, the LSTM model has a built-in function for preventing overfitting, which indeed served the purpose. Therefore, the LSTM model can well forecast the future transmission trends of the COVID-19 epidemic, which has far-reaching significance for the prevention and control measures in response

Acknowledgments

Project funded by the Key Research and Development Program of Liaoning Province:Research on Scientific Early Warning, Prevention, and Control of the COVID-19 Epidemic (2020JH2/10300040) and the Liaoning Provincial Department of Education:Research on Mining and Modeling of Factors Associated with Epidemic Transmission Using Machine Learning (L2020031).

if you have any questions,you can contact us through the corresponding author's Email or mobile phone number 13683839564