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Nonlinear combinational dynamic transmission rate model and COVID-19 epidemic analysis and prediction in China. (Chinese. English summary) [Zbl 07404499]

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Summary: Due to the difficulty in accurately estimating the basic infectious number $R_0$ and the low accuracy of single model prediction, the traditional epidemic infectious diseases studying is blocked and not widely implemented operationally. To overcome this challenge, this paper proposes a nonlinear model with time varying transmission rate based on the support vector regression instead of basic infection number $R_0$. The non-linear model is applied to analyze and predict the COVID-19 outbreak in China. Firstly, the discrete values of the dynamic transmission rate are calculated. Secondly, the polynomial function, exponential function, hyperbolic function and power function are used to fit with the discrete values of the dynamic transmission rate and the corresponding prediction model is rebuilt on basis of the optimal sliding window period $k = 3$. Then, on account of the evaluation indexes such as goodness of fitting, the best three prediction models are selected, and the prediction results are nonlinearly combined. Finally, the combined dynamic transmission rate model is used to analyze and predict the COVID-19 epidemic in Hubei province, outside of Hubei provinces, and the whole China. The empirical results show that the combined dynamic transmission rate model is in relatively good agreement with the COVID-19 epidemic data in different regions. The prediction of COVID-19 epidemic infection points in most provinces well reproduce the real situation. The goodness of fitting of the epidemic prediction curves in Hubei province, outside of Hubei provinces and the whole China from February 27, 2020 are 98.53%, 98.06% and 97.98%, respectively.

MSC:
92D30 Epidemiology
62M20 Inference from stochastic processes and prediction
62P10 Applications of statistics to biology and medical sciences; meta analysis

Keywords:
COVID-19; dynamic transmission rate; combined prediction model; support vector regression

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