Analyzing the European countries' SARS-CoV-2 policies via Bayesian deep learning and statistical inference

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Abstract

Even when the SARS-CoV-2 pandemic recedes, evidence-based researches regarding the effectiveness of pharmaceutical and non-pharmaceutical government interventions (NPIs) remain important. In this study, SARS-CoV-2 data of 30 European countries from early 2020 up to mid 2022 are analyzed using Bayesian machine learning. Four data sources containing each country's daily NPIs (consisting of 66 government measures, virus variant distributions of 31 virus types, the vaccinated population percentages by the first five doses as well as the reported daily infections in each country) are brought together to undertake a comprehensive assessment of the impact of SARS-CoV-2 influential factors on the spread of the virus. First, a Bayesian deep learning model is constructed with a set of input factors to predict the growth rate of the virus one month ahead of the time from each day. Based on this, the importance and the marginal effect of each relevant influencing input factor on the predicted outcome of the neural network model is computed by applying the relevant algorithms. Subsequently, in order to examine the performed deep learning analysis, a Bayesian statistical inference analysis is performed within each country's data. For each influencing input factor, the distribution of pandemic growth rates, in the days where the selected explanatory factor has been active, is compared with the distribution of the pandemic growth rates, in the days where the selected explanatory variable has not been active. The results of the statistical inference confirm the predictions of the deep learning model to a significant extent. Similar conclusions from the SARS-CoV-2 experiences of the thirty studied European countries have been drawn.

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