**Forecasting sales in Covid-affected industries using macroeconomic indicators and artificial neural networks given inoperative historic sales data.**

Kevin Xue, Nate O’Brien, Kaiyuan Zhao, Stella Zhang, Lingyan He, Kehan Yu, Haiyan Huang, George Lyu

**Abstract**

With the advent of the Covid-19 pandemic, many industries and companies suffered historic losses in the sales of products in a variety of areas, often to different degrees. In this paper, industries will be categorized as either Covid-unaffected industries or Covid-affected industries. By comparing the MSE to the standard deviation of industries using historic sales data as regressors, we can classify them as the before-mentioned groups. Results showed that the sales data predictions, especially for the year 2020, showed inaccurate results compared to the actual data. The solution of macroeconomic indicators which are representative of the economic downturn during this period is tested. A neural network is thus developed with both sales and nationwide macroeconomic indicators and thoroughly tested through a variety of public datasets in these different industries, including Costco sales figures, Maryland vehicle sales, and sales of S&P 500 companies. Previously found macroeconomic indicators such as Core-CPI and Inflation Rate continue to reduce loss, along with other indicators. A consistent model is developed which can thoroughly predict sales for most sales sets, and other macroeconomic indicators are identified as efficient regressors. Noise is added in the model to reduce overfitting and increase accuracy as has been shown by various other works in the subject works. The model parameters are calculated using the Adam optimizer, and experimental results show that the addition of macroeconomic indicators in Covid-affected industries can increase accuracy of sales models by a significant amount, almost <> greater in certain Covid-affected industries.