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Comparison of Coronavirus Pandemic: Topological Data Analysis of 13 Countries

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Topological Data Analysis (TDA) is a rising method that provides new topological and geometric tools that can detect non-linear features, such as loops, in multidimensional data. Our study aims to apply this novel method to find data patterns of COVID-19 spreads in selected thirteen representative countries on six continents of the world and compare results among them. Briefly, TDA methods are useful for determining "features" in point-clouds, including clusters and loops. Furthermore, quantifiable differences in features of the data sets of different countries can suggest differences in public health policy among those countries. Our results suggest TDA can be a useful initial data tool to search for anomalies, which can then lead to a more comprehensive analysis combined with other techniques. Using TDA, we were able to identify three major groups of countries based on their virus data patterns. Australia, India, South Korea, and Taiwan are very similar, while Great Britain, Peru, and France have very different patterns from those of other countries. Next, the death-to-case ratio and death per million among countries were investigated. We also examined in detail the public policy and other reasons behind the similarities and differences of the TDA results and suggested possible successful public policies at national levels for a future pandemic.

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