Functional Data Visualization and outlier detection on the anomaly of El Niño Southern Oscillation Index

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Abstract:

The El Niño-Southern Oscillation (ENSO) is known to be a major force of earth's year-to-year climate variability. Several indices have been proposed to monitoring ENSO, but the multivariate ENSO index (MEI) is the most representative indices since it links both oceanic and atmospheric variables into a single index. Statistical methods, including linear and nonlinear models, have intensively been used in modeling the ENSO index. However, these models can still not capture sufficient information on ENSO index variability, particularly on temporal aspects. Hence, this study adopts the functional data analysis theory by representing a multivariate ENSO index as functional data in climate applications. This study includes the functional principal component, which is purposefully designed to find new functions that reveal the most important type of variation in the MEI curve. Simultaneously, graphical methods have been used to visualize functional data and capture outliers that may not be apparent from the plot of the original data. The findings suggested that the outliers obtained from the functional plot are related to El Niño and La Niña phenomenon. In conclusion, the functional framework is found to be more flexible in representing the climate phenomenon as a whole.

Keywords: El Niño; La Niña; Functional data analysis; functional principal component;

functional outlier