

Due to improvements in technology, functional datasets are becoming ever more prevalent. As a result, visualization of functional datasets and detection of outliers hiding in functional populations have become important problems in statistics. Moreover, functional outliers can be categorized into different types based on the nature of their anomaly compared to the entire population. Such tools are extremely useful in different application areas including environmental science, economics, financial market monitoring, medical diagnosis, etc.; detecting systematic risks and taking appropriate precautions helps avoid respective losses.

EXTREME WEATHER PREDICTION

Extreme weather events provide information about the health of our environment. Most measurements scientists collect to study such events, including temperature and precipitation, can be viewed as functional data objects. For example, sea surface temperature functions can be used for detecting and predicting El Nino events. Furthermore, a winter of normal length with extremely low temperatures, and an unusually long winter with typical temperatures belong to two different types of anomalies and need to be correctly categorized.



DISEASE DIAGNOSTICS

Many diagnostic measurements come in the form of functional data; such data are often referred to as biosignals and can include gait pressure curves, hand-grip strength functions for monitoring of rheumatoid arthritis, electroencephalogram (EEG), etc. For example, visualization and anomaly identification of electrocardiogram (ECG) signals can help detect congenital heart defects.



FINANCIAL MARKET MONITORING

Financial asset prices can be viewed as functional data. Instead of relying on derivative indices such as the Volatility Index or the Relative Strength Index, anomalies can be directly detected based on the price functions. In addition, different natures of possible crises can be categorized: underselling or overbuying activities, investor panic, the end of a bullish period, etc. Visualization of financial functional datasets can help in identifying systematic risks within markets and enhancing financial security.

