

# **Anomaly Detection in Global Temperature Data Using PyOD's Isolation Forest**

Objective: To detect and analyze anomalies in global temperature data leveraging the Isolation Forest algorithm provided by the Python Outlier Detection (PyOD) library.

## **Chosen Model: Isolation Forest**

### **Technique**

The Isolation Forest is an unsupervised learning algorithm for anomaly detection that works on the principle of isolating anomalies instead of profiling and constructing normal points. It operates by randomly selecting a feature and then randomly selecting a split value between the maximum and minimum values of the selected feature. Anomalies are isolated closer to the root of the tree (with fewer splits), while normal points require more splits to be isolated.

### **Suitability**

The global temperatures dataset is characterized by its continuous nature and the presence of potentially subtle anomalies. The Isolation Forest is particularly suitable for this dataset as it does not impose any distributional assumptions on the data and is less susceptible to overfitting than many other anomaly detection methods.

### **Training the Model**

The Isolation Forest model was trained on the dataset, which includes yearly average temperatures. This dataset was treated as a univariate series for this exercise, despite the inherent time-series nature of the data, and without explicitly modeling the temporal dependencies.

### **Identifying Anomalies**

The trained Isolation Forest model successfully identified anomalies in the global temperature dataset. These anomalies correspond to years where the temperature readings were significantly different from the typical range observed in the dataset, suggesting unusual temperature behavior in those years.

### **Analysis of Results**

Upon analysis, the detected anomalies were seen to capture extreme temperature deviations from the overall trend. This could potentially signal extraordinary climate phenomena during those outlier years.

## **Interpretation**

While a comprehensive interpretation would involve cross-referencing the anomalous years with historical climate data for potential causes, this report focuses strictly on the technical aspects of anomaly detection. Thus, the climatological interpretation of these outliers is beyond the scope of this report.

## **Documentation of Anomaly Detection Technique**

The Isolation Forest method's robustness to outliers and its performance across different data distributions render it an excellent tool for datasets with complex or unknown distributions, such as climate data. It does not require prior knowledge of the number of outliers and maintains consistency in detecting anomalies, making it a powerful method for real-world data analysis.

## **Conclusion**

Utilizing PyOD's Isolation Forest has proven to be an efficient and effective method for detecting atypical years in the global average temperature dataset. These findings could pave the way for further investigation into the underlying causes of these temperature anomalies in a detailed climate study.