

When Forecasts Fail: Using Decision Trees to Detect Weaknesses of Forecasting Algorithms

Chen-Zhi (Carolyn) Su

Institute of Service Science, National Tsing Hua University

Abstract

Error analysis of statistical and machine learning models is an active research area due to its importance in practice. We focus on error analysis in the time-series forecasting domain, which is useful in many applications including forecasting demand of products or services (e.g. electricity usage, transportation demand). Extremely wrong forecasts can cause economic and social losses as well as customer dissatisfaction and inconvenience. We propose a method for identifying patterns of forecast errors when forecasting algorithms are applied to a given time series. Our proposed error analysis method, called "EvalTree", helps detect patterns among extreme forecast errors by creating human-understandable rules. EvalTree first applies a decision tree to the most extreme forecast errors resulting from one or more forecasting algorithms. A set of special rules is then used to condense the resulting tree results, thereby arriving at a parsimonious yet understandable set. Finally, we visualize the analysis results to further enhance the interpretability of the identified patterns. We illustrate EvalTree by applying it to data from a Kaggle competition for forecasting bike sharing usage. We show how EvalTree detects interesting patterns of weaknesses of the top winning forecasting algorithms. For example, we detect not only specific holidays, but also certain pre- and post-holiday effects which are not easy to specify in advance.

Keywords: Error analysis, Decision tree, Understandable rules, Forecasting, Time series, Visualization