Looking into the Past for Insight on the Future: Predictive Analytics and Machine Learning for Time Series Data

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This project takes a different approach to meteorological forecasting by investigating underlying patterns in local weather fluctuations and attempting to find a connection between these phenomena that can lead to larger weather effects. Using a dual-part approach, the goal was first to use time series modeling techniques such as the Box-Jenkins method to create a model that can forecast wind shifts to a reasonable degree of accuracy. A Raspberry Pi and sensor apparatus were used to collect data at 60 second intervals for two twelve day trials. A data analysis program created four models which either contained AR or ARIMA parameters and were set in either a static or dynamic environment. In the second part of the experiment, another analysis program used support vector machine algorithms to binarily classify the data points, searching for a relationship between wind direction and temperature. The first analysis program showed that the researcher's implementation of a dynamic rather than static ARIMA model allowed a dynamic ARIMA model of order (4,4,3) to achieve an average binary accuracy of 93% over two trials, which was significantly higher than that of static DAR models used. The second analysis program classified the compound temperature-wind shift data set with 71% accuracy. Thus, the researcher concluded that creating an environment that enables a time series model to evolve periodically along with a data set can substantially improve the forecasting ability of a model. The results also support the idea that relationships between local weather fluctuations could be used to increase the accuracy of current forecasting methods.

Awards Won:
Fourth Award of $500
Mu Alpha Theta, National High School and Two-Year College Mathematics Honor Society: Third Award of $1,000.