Forecasting Backlog of Cross-Dock Operations using Regression and Machine Learning Algorithms

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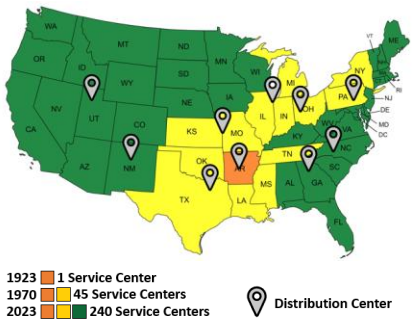
ABF Freight

ABF Freight, an ArcBest company, is one of the nation's largest, most trusted less-than-truckload carriers. With over a century of experience, 240 service centers spanning North America, and an unwavering commitment to quality, safety and customer service, ABF offers best-in-class LTL transportation for companies of all sizes and industries.



Capacity Metrics

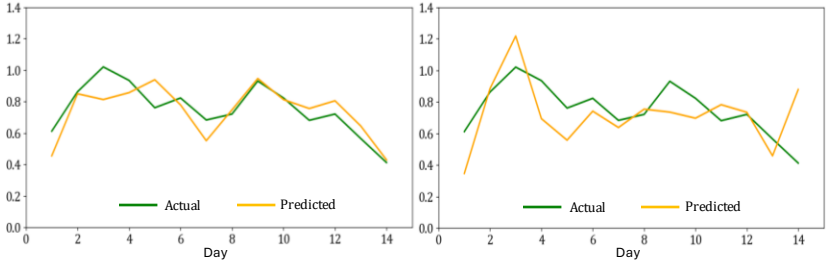
ABF Freight has developed an array of metrics to analyze the state of their network at any given point. Some of these metrics are used to evaluate the available capacity at their cross-dock facilities. These metrics were created with the goal of providing insight into the current state of operations and to help inform ABF Freight decision-makers what adjustments need to be made to optimize labor and equipment at each facility. These strategic adjustments allow ABF Freight to respond to fluctuations in demand through agile resource management. This ensures that their goal of providing excellent customer experiences is effectively prioritized while also highlighting opportunities for growth.

Current Process

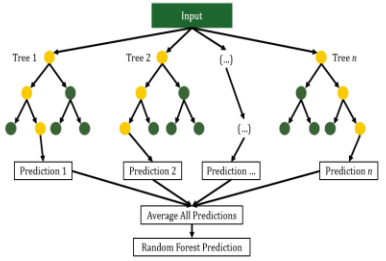
Currently, ABF Freight is making operational decisions based on what shipments are at their facility and soon to arrive. While ABF has shown to be capable of handling their operations in this manner, they would like more insight into how their facilities will be performing days into the future so they can make proactive decisions in order to reduce their operations' variability.

Models

Our team conducted stepwise regression after acquiring the final data and eliminating physically-related features, aiming to forecast capacity levels for the upcoming five days. While this proved to be successful, ABF encouraged our team to look into machine learning techniques for a more modern and advanced approach to predicting freight levels.

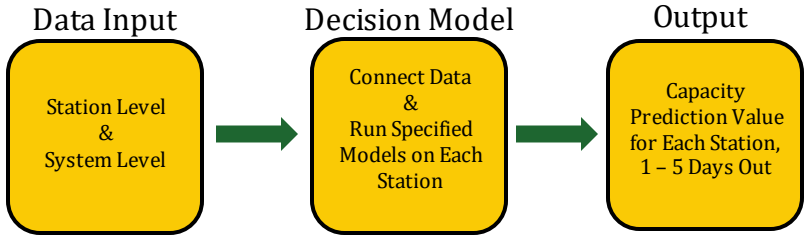


After regression, we implemented more sophisticated machine learning algorithms using Python, with Random Forest standing out as one of the most effective models in our analysis due to its accuracy and robustness in predicting numerical outcomes.



Capacity Level Prediction Tool

Once we were satisfied with our modeling efforts, we developed a tool enabling ABF to effectively make predictions. With this user interface, ABF will be able to input diverse data that will then be used to build the models. The tool then produces Excel outputs containing the five-day predictions for each station, along with other operational insights.



Results and Impact

Our tool is equipped with a multi-model solution composed of LightGBM, XGBoost, Random Forest and Stepwise Regression outputs so they can tailor their decisions as a combination of model and station. In addition, we converted station error metrics into station metrics to better quantify error and allow for system pickups adjustments to update predictions. This tool will equip ABF Freight with invaluable foresight, enabling proactive adjustments to labor and equipment, allowing them to maintain operational efficiency and customer satisfaction, while maximizing revenue opportunities.