Optimizing Forecasting Methods for Intermittent USTRANSCOM Railcar Demands

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Introduction
- US Military heavily relies on rail freight operations to meet its logistical needs during both peacetime and wartime efforts
- Irregular and intermittent nature of railcar demands create an extremely challenging task for forecasters
- Forecasts drive distribution and placement of railcar commodities resulting in critical costs and impacts

Problem Statement
- USTRANSCOM requires an improved process for determining accurate timely forecasting strategies for intermittent demands and a system to better understand forecasting accuracy.

Methodology

Step 1. Data Gathering and Organization
- USTRANSCOM Surface Deployment and Distribution Command’s (SDDC) rail freight movement records
- Monthly train demands by origin (Jan 2011 – Dec 2014)
- Further filtered and organized by rail commodity type

Step 2. Optimize Forecasts Based On Specific Cost Functions
- 2011-2013 Estimation Data
- 2014 Validation Data
- Improved Methods
  - Current ARIMA (Baseline)
  - SES
  - Croston's

Results and Analysis

Initial Results
- Out-of-Sample. Percentage when each technique is the top option is shown for each metric
- In case of ties, wins are given to ARIMA as it is used as a baseline and research seeks improvements

Overall Rankings for Methods
- Out-of-Sample. Methods are ranked and averaged across the board for each error metric
- Green lines indicate statistical equivalence $\alpha=0.05$

Hit Rate Analysis
- Based on the best forecasting method from the In-Sample dataset, what percentage of the time is that method also the best method for the Out-of-Sample dataset?

Conclusion/Recommendations
- For railcar demands, simpler is better
- Optimized SMA and SES performed very well compared to more complex techniques
- Hit Rate Analysis suggests MAD to be most valuable in optimizing and determining future forecasts
- Croston’s Method should only be used for research purposes and would be disadvantageous in practical settings

Future Research
- Adding cost dimensions to forecasts with expenditures and savings
- Tangible and intangible costs
- Classification and categorization strategies for lumpy time series data
- Intermixing and combining usage of various railcars for common missions

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