

Improve Forecasting Using Anomaly Detection

Tom Gielow

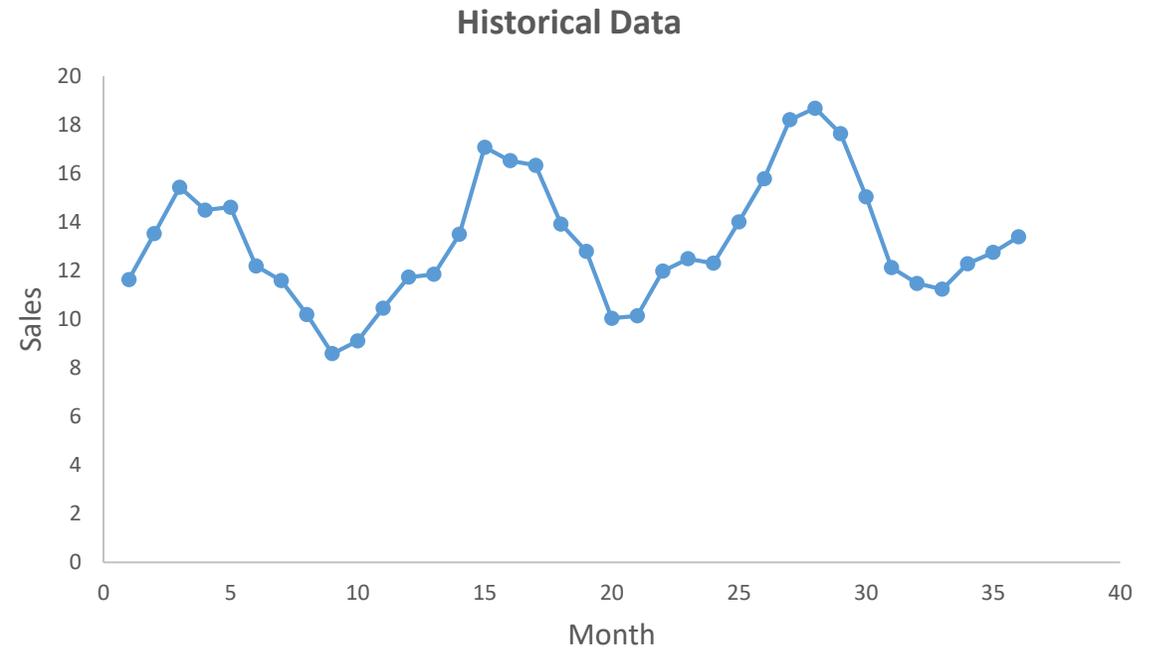
Vice President Technology & Architecture

velocity
CONNECT + ACCELERATE + INNOVATE



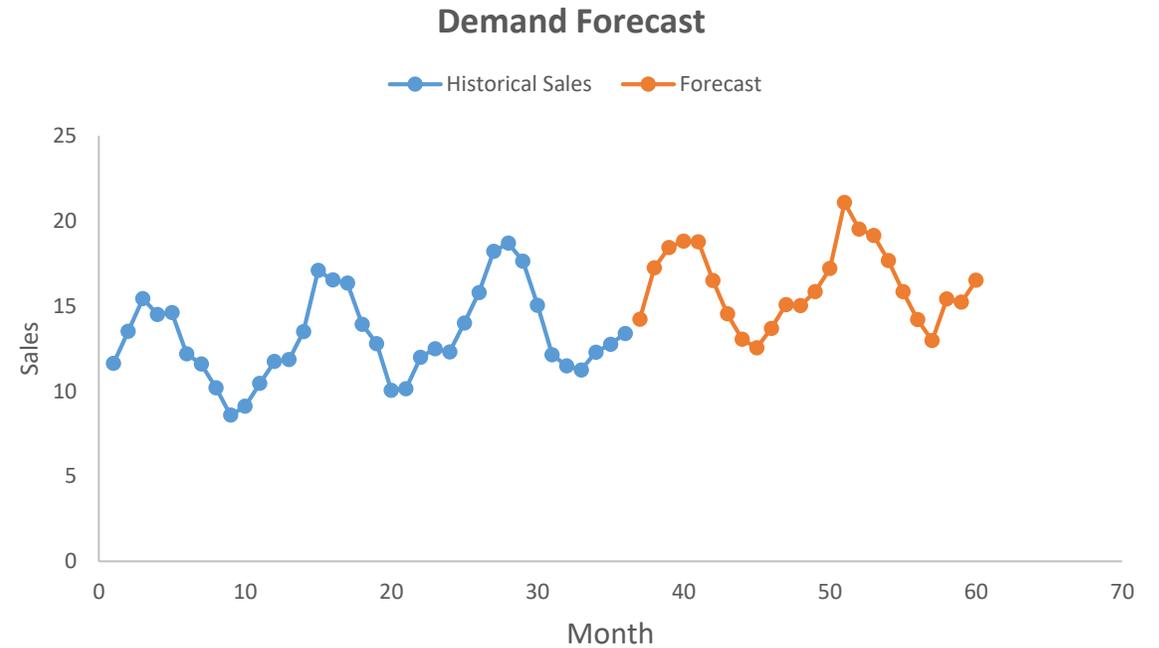
Demand Forecasting

- ▶ Predict future demand from historical data



Demand Forecasting

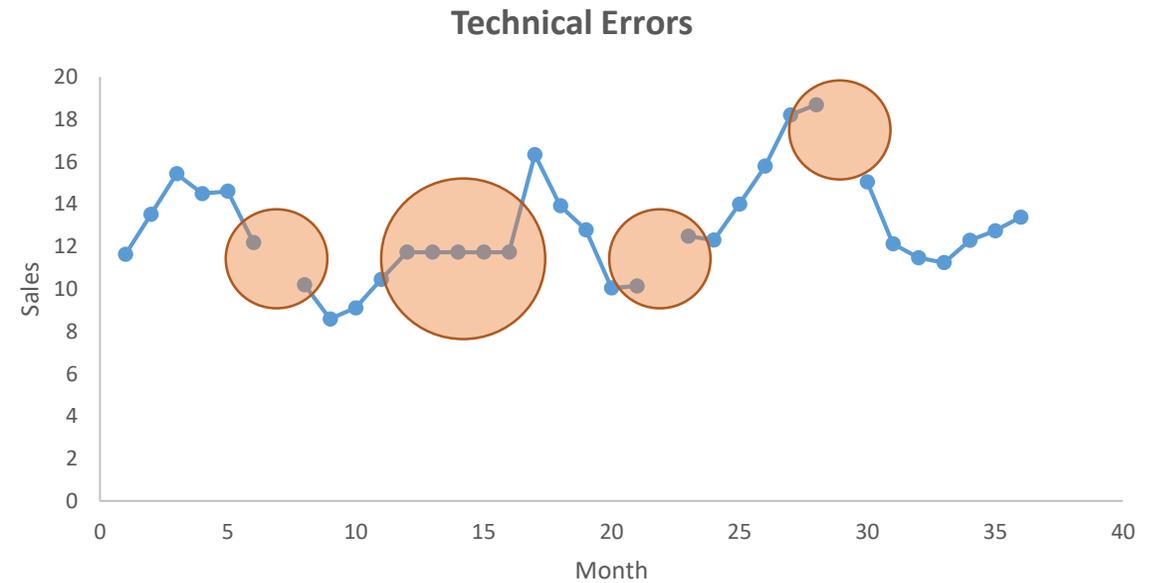
- ▶ Predict future demand from historical data
- ▶ Many different approaches
- ▶ All require good quality data



Demand Forecasting

- ▶ Predict future demand from historical data
- ▶ Many different approaches
- ▶ All require good quality data

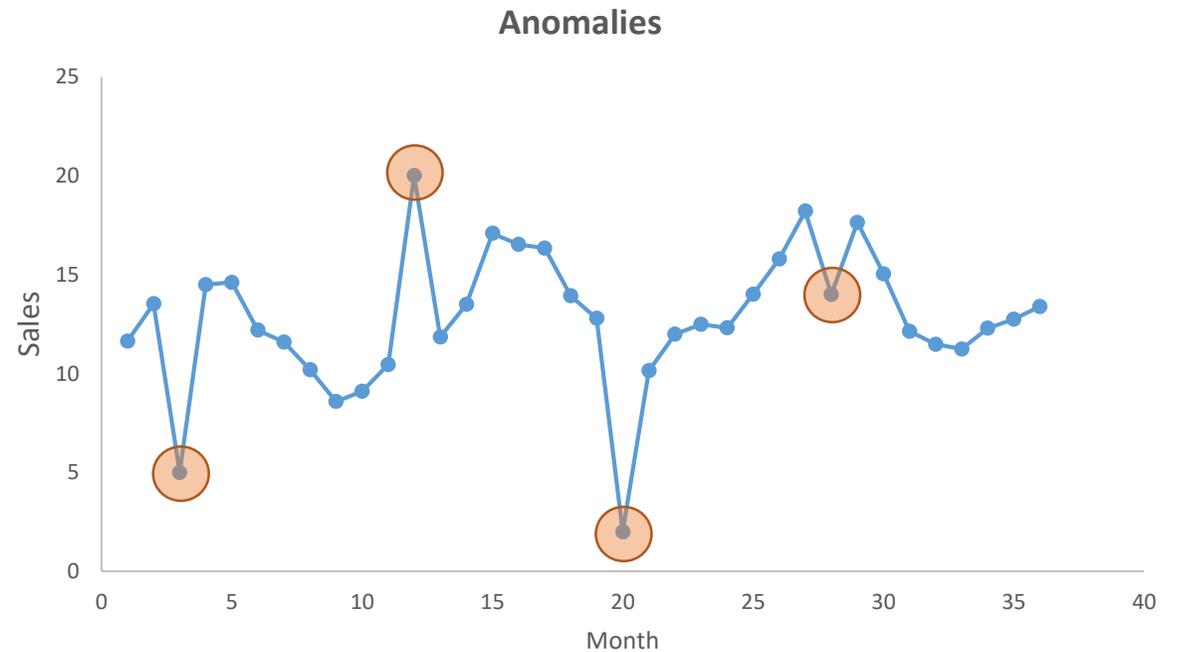
- ▶ Types of errors
 - Technical errors
 - Anomalies



What are Anomalies?

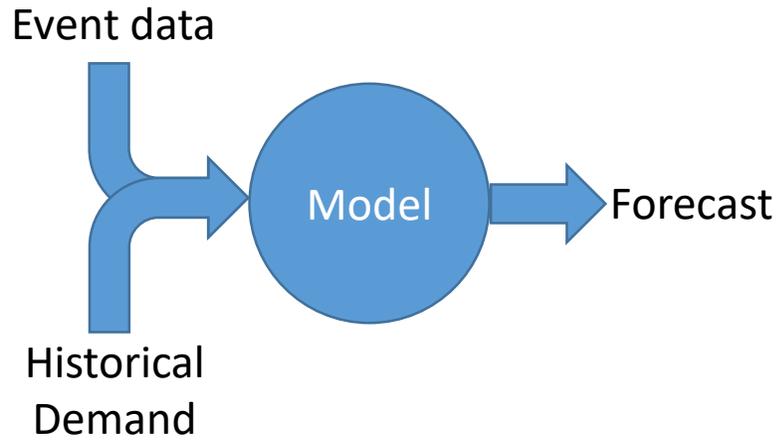
- ▶ Another name for outliers
- ▶ Data that does not accurately reflect historical demand

- ▶ Common Types
 - Simple spikes
 - Upward/downward shift
 - Change in level



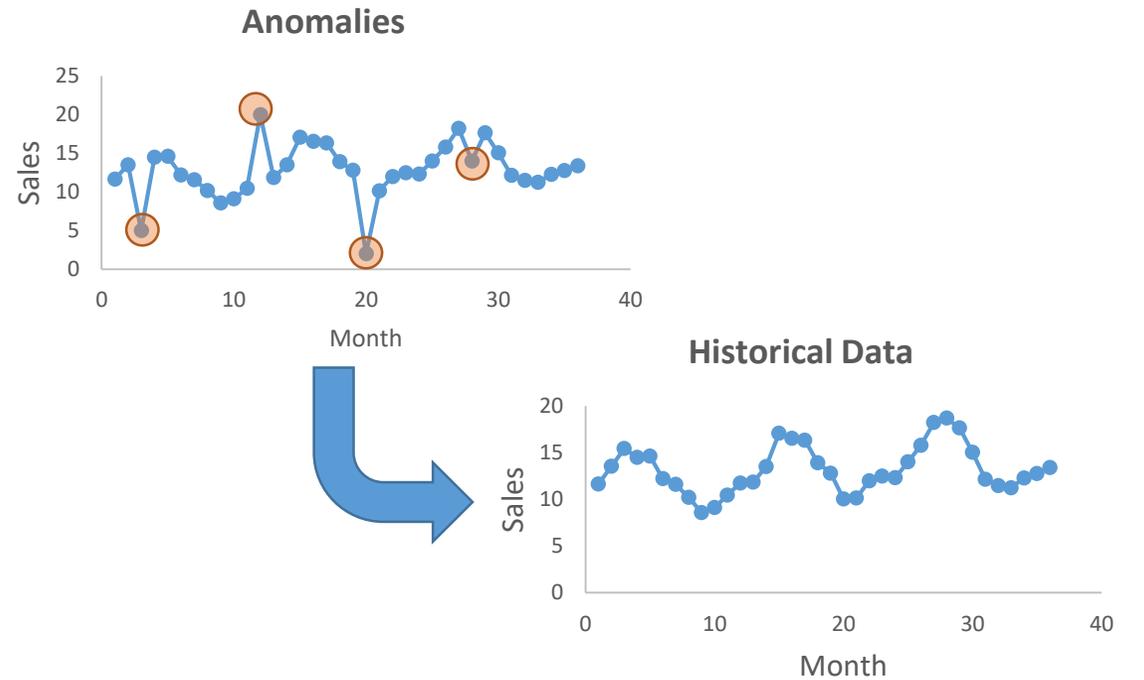
How do we deal with Anomalies?

Build Multivariate Model



- ▶ Predict effect of events before they occur
- ▶ Considerable effort to develop solution

Remove anomalies



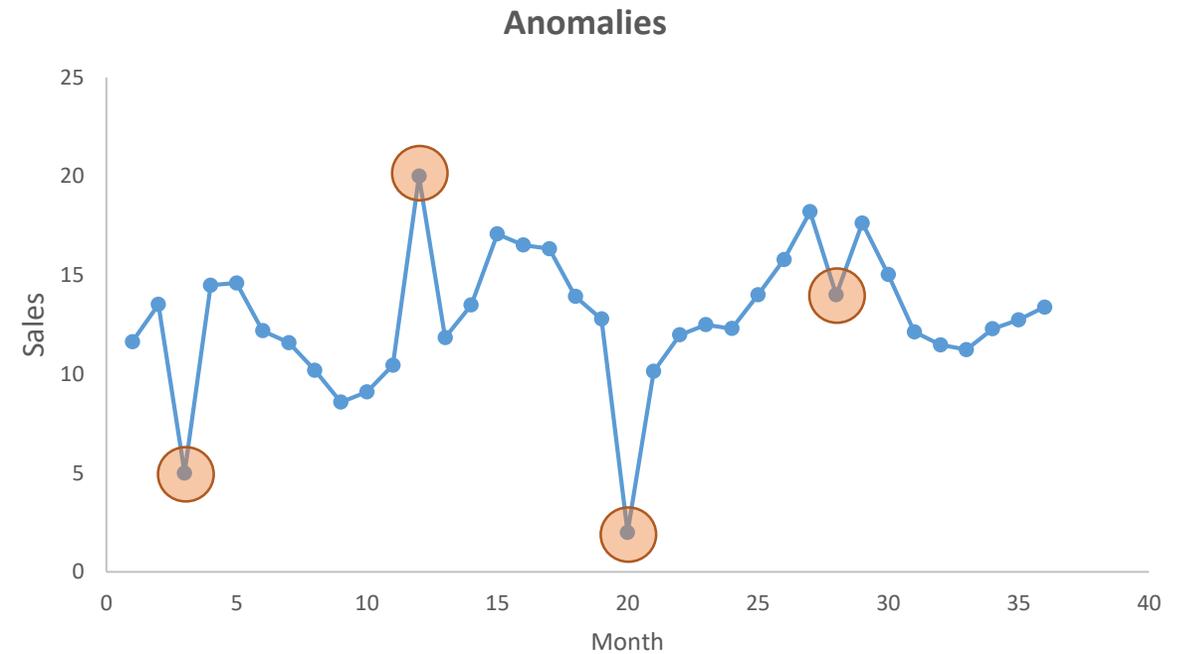
- ▶ Still need to manage events if possible
- ▶ Cheap solution with right method

Motivation

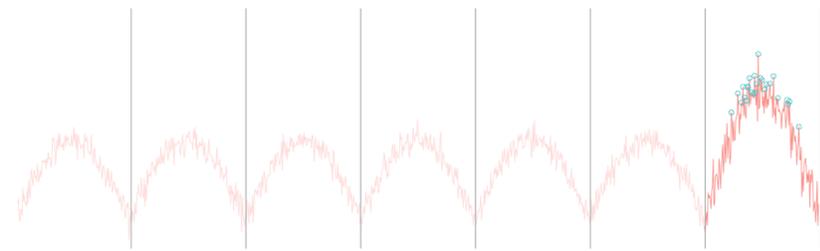
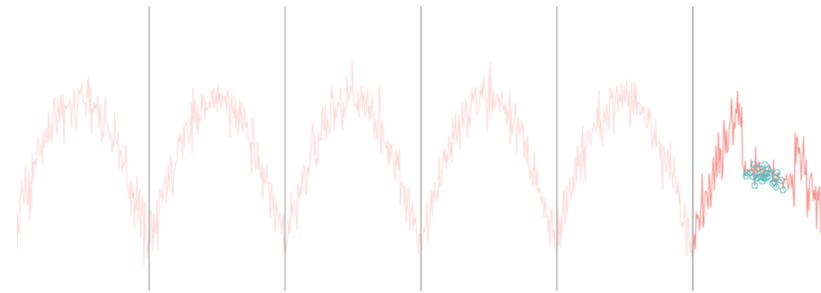
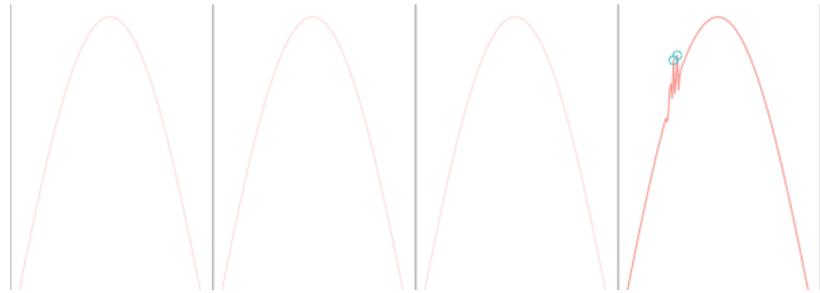
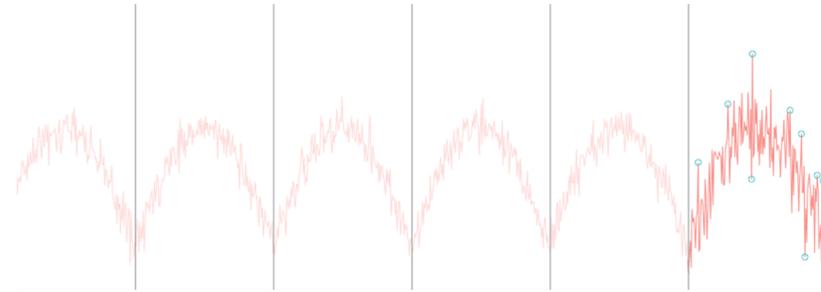
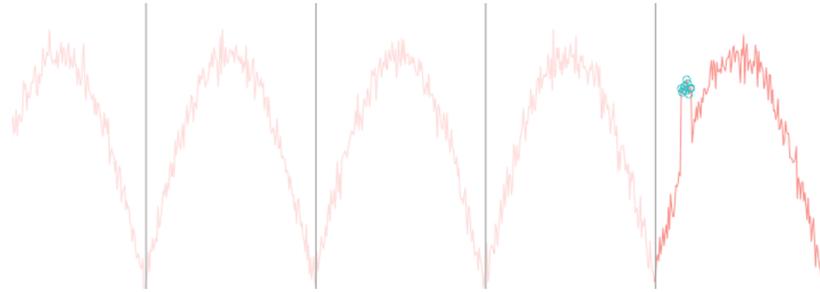
- ▶ Degradation in forecasting accuracy
 1. Large scale restructuring of supply chain
 2. Extensive use of promotions and “deep discounts”

Seasonal-Hybrid-ESD

- ▶ Method for anomaly detection in time series data
- ▶ Developed by researchers at Twitter
- ▶ Deals with local and global anomalies

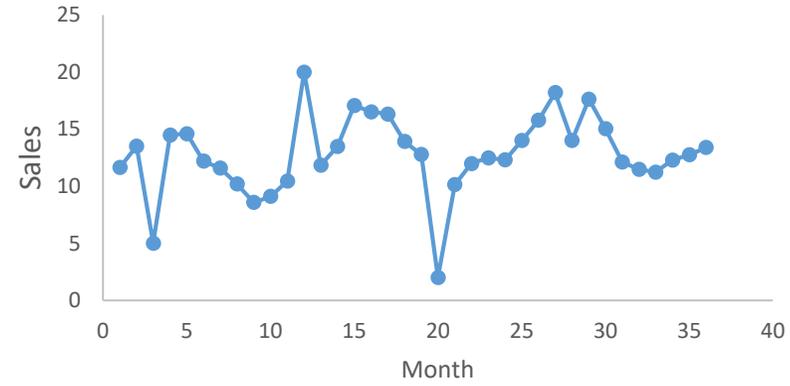


Seasonal-Hybrid-ESD

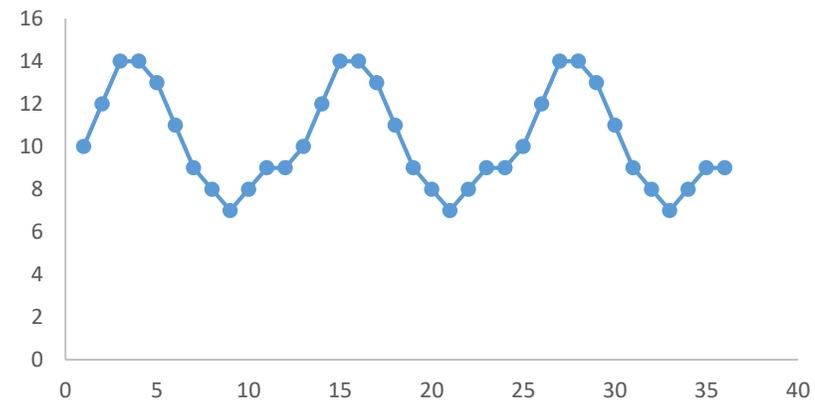


Algorithm

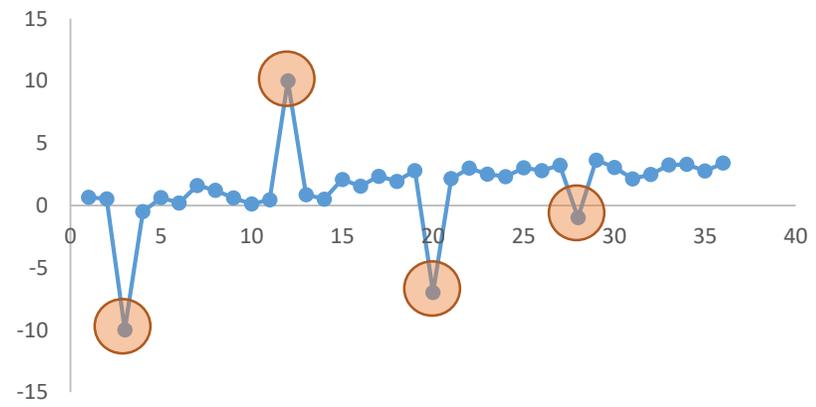
Anomalies



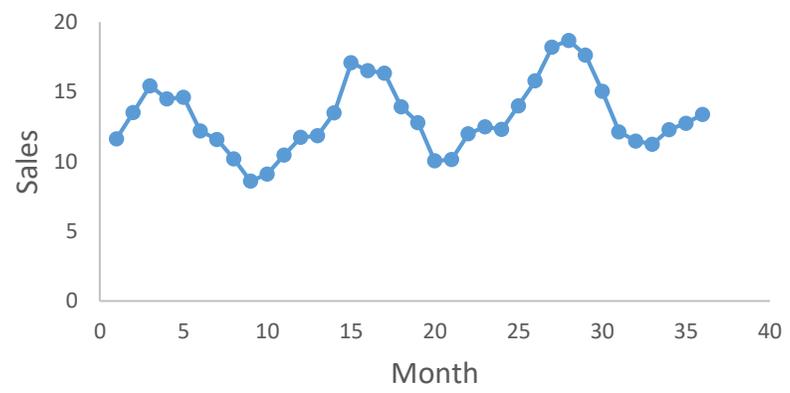
Seasonal Component



Residual

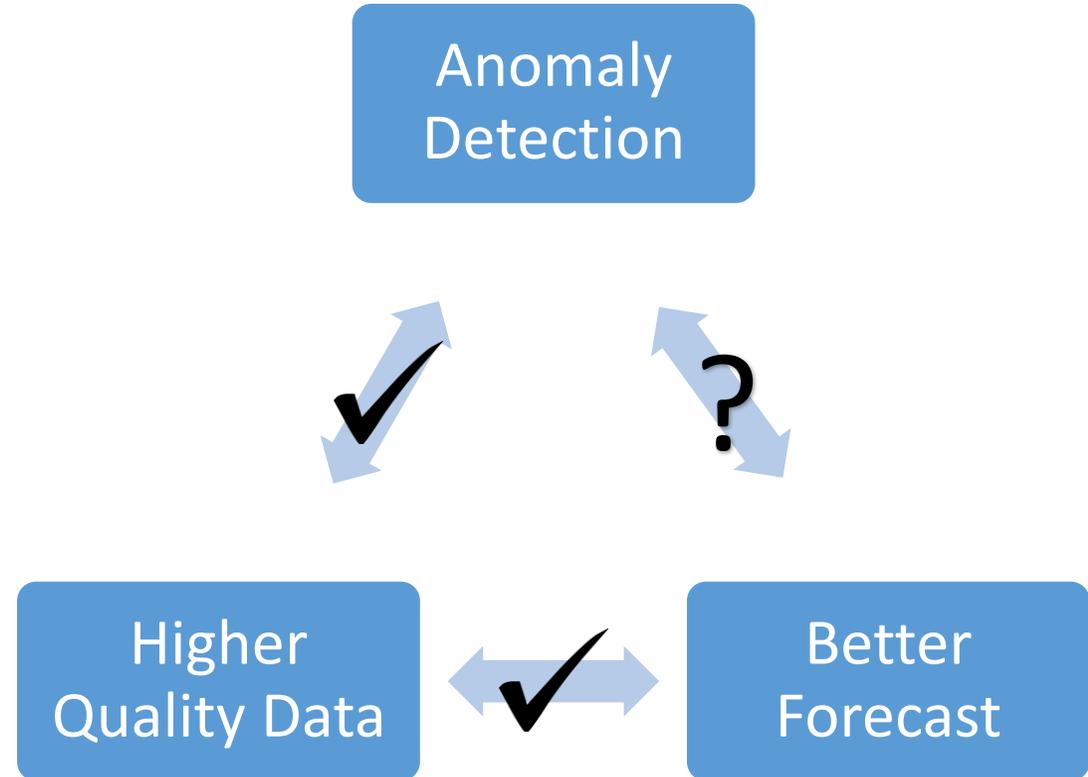


Cleaned Data

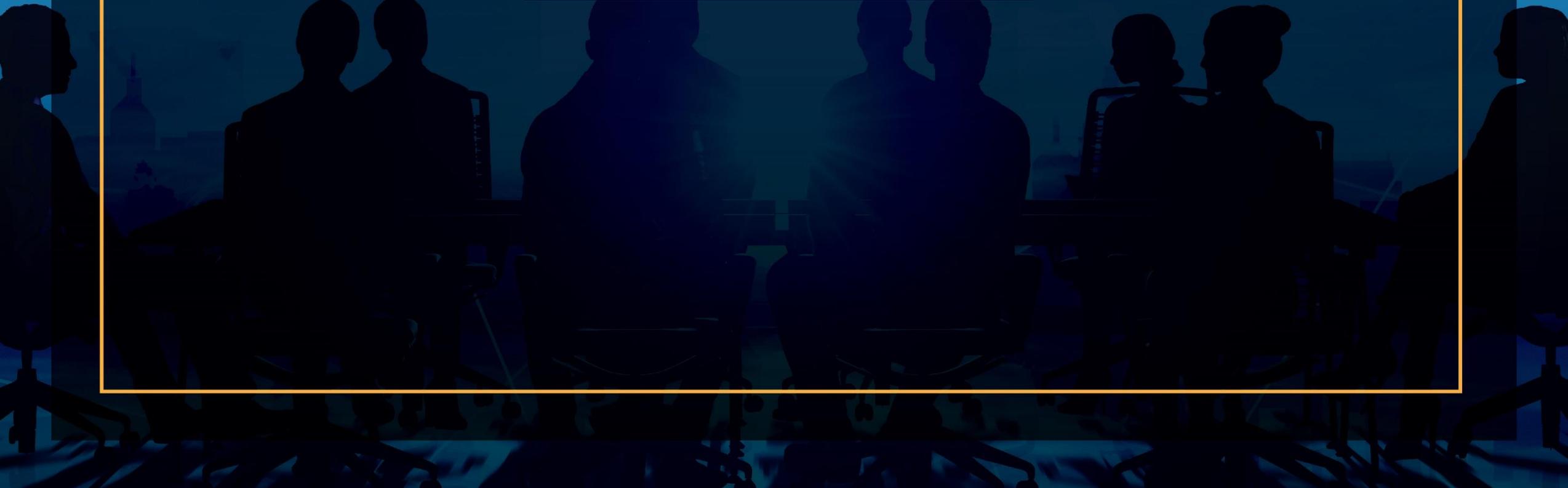


Our Prototype

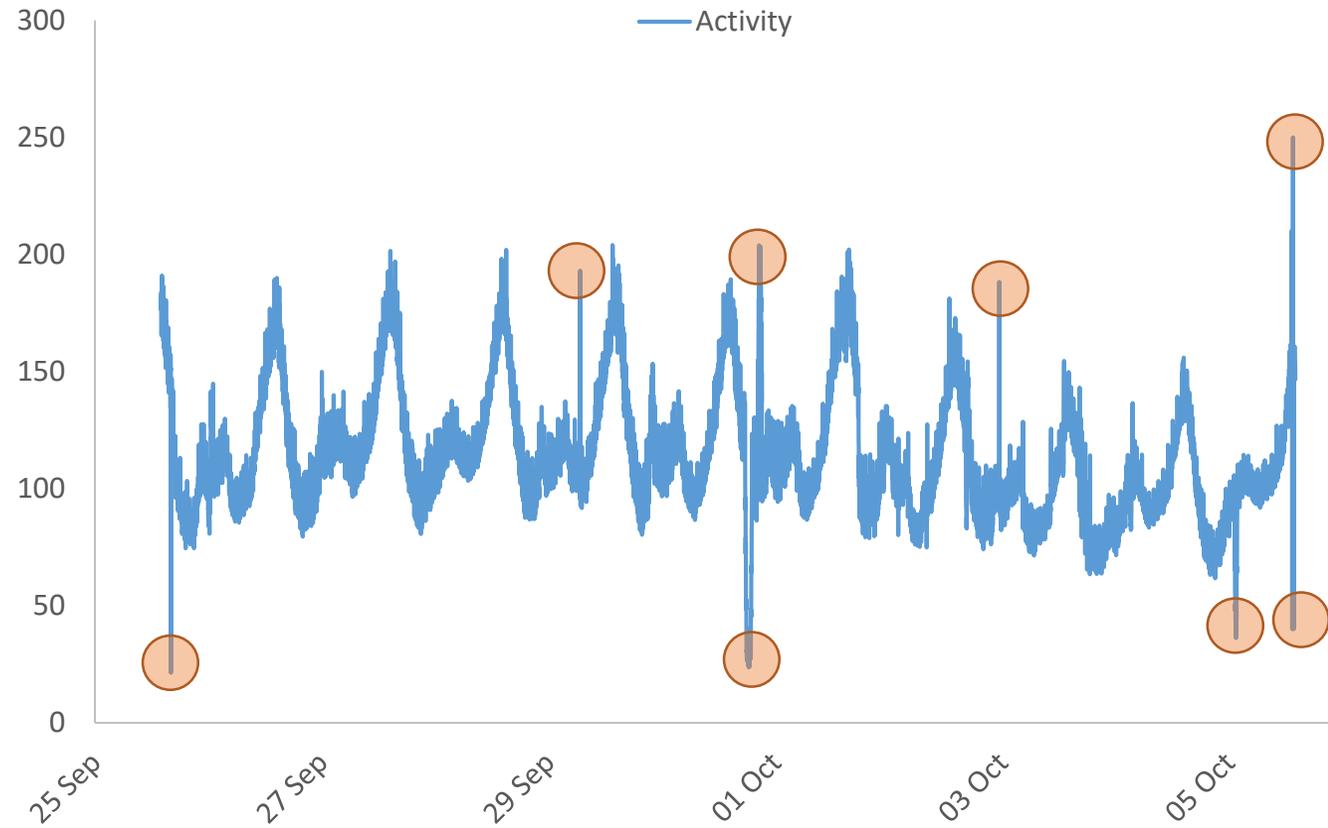
- ▶ Prototype developed
 - Proof on concept
 - Available software not compatible with low frequency data
- ▶ Lives outside of DSX
 - Reads data from database
 - Performs anomaly detection
 - Write results back



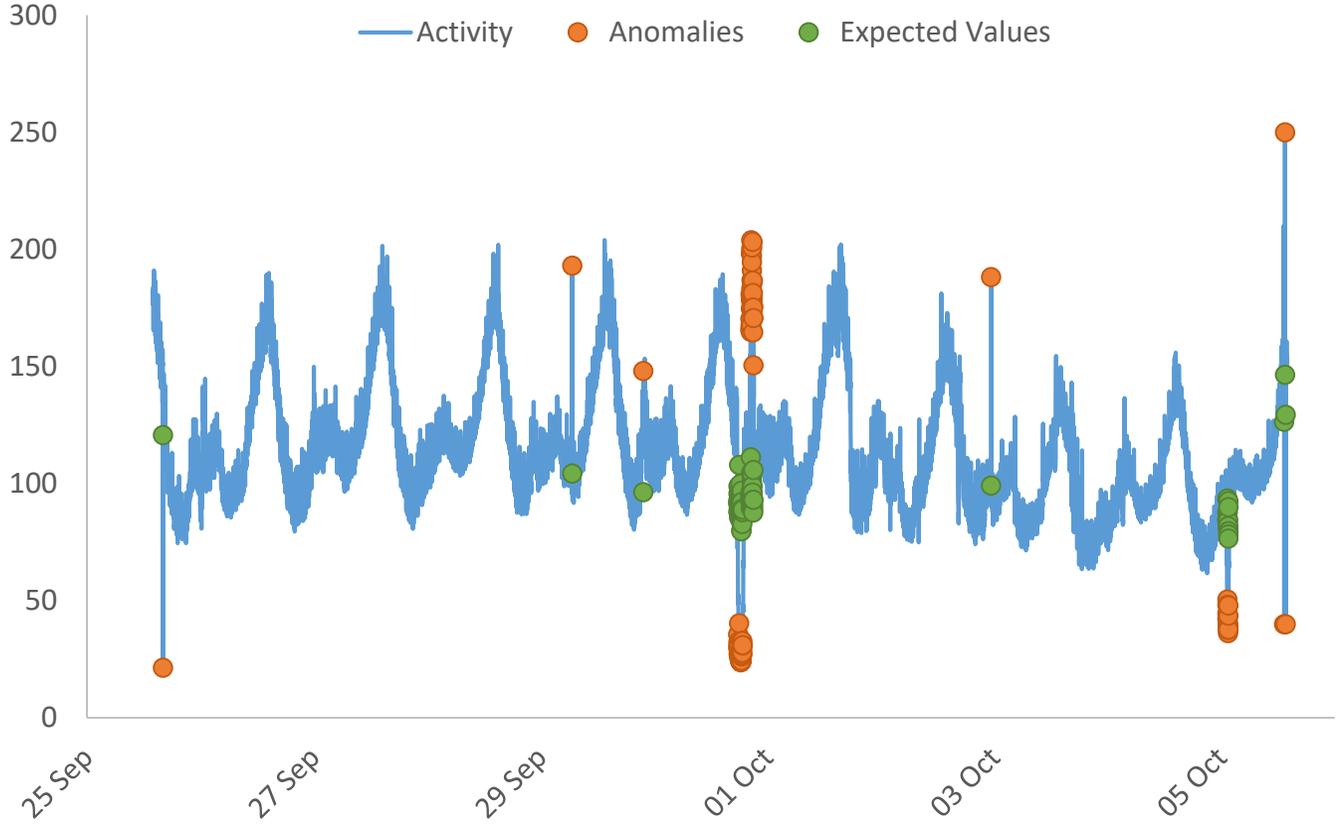
Results



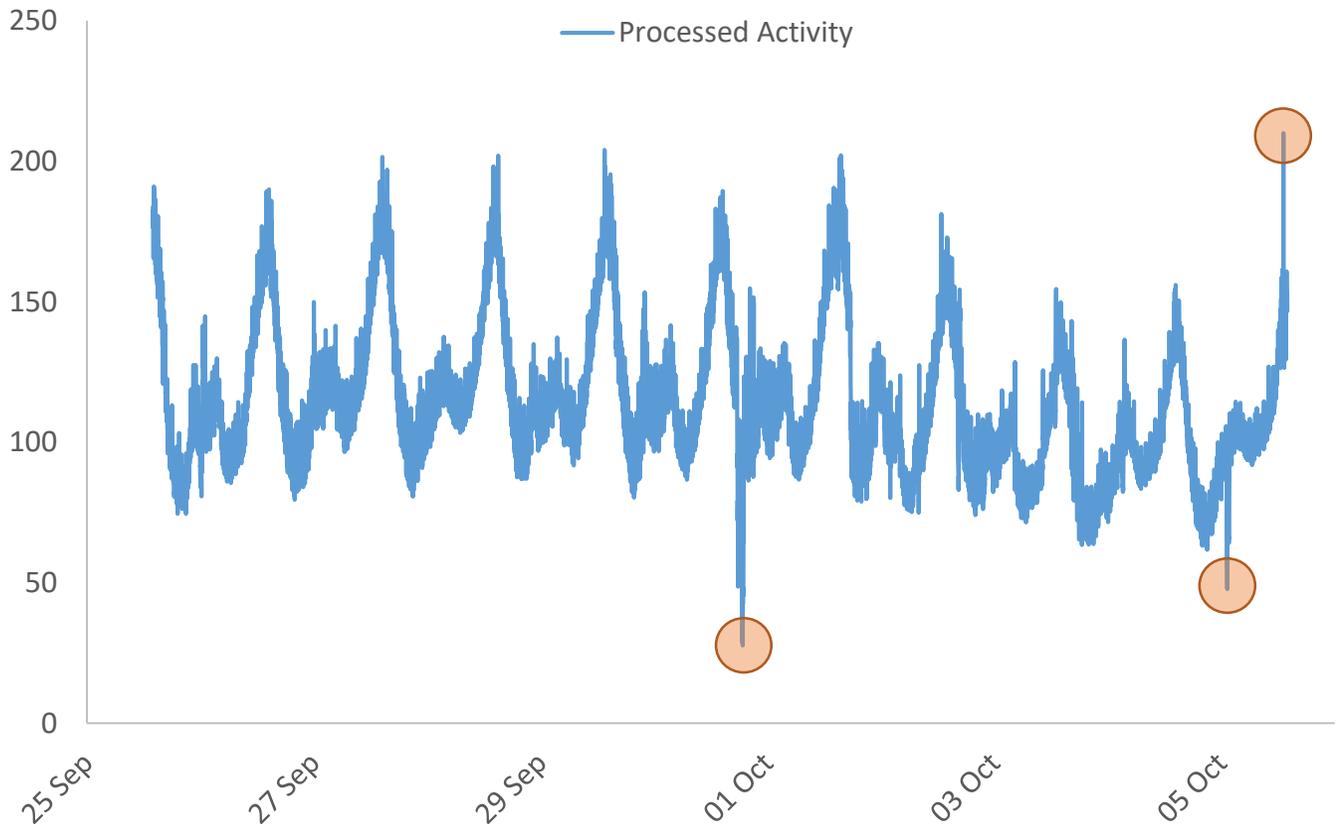
Anomaly Detection Example



Anomaly Detection Example

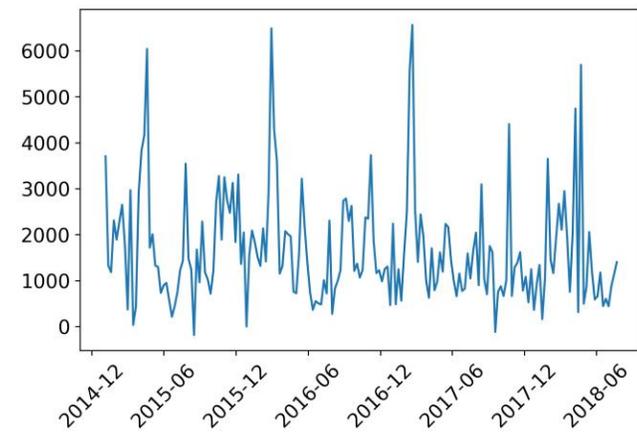
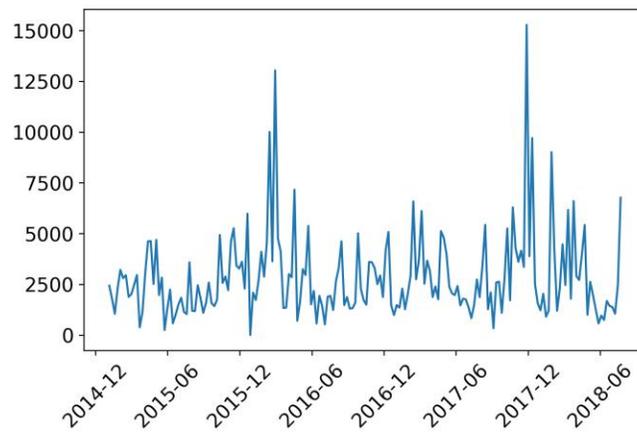
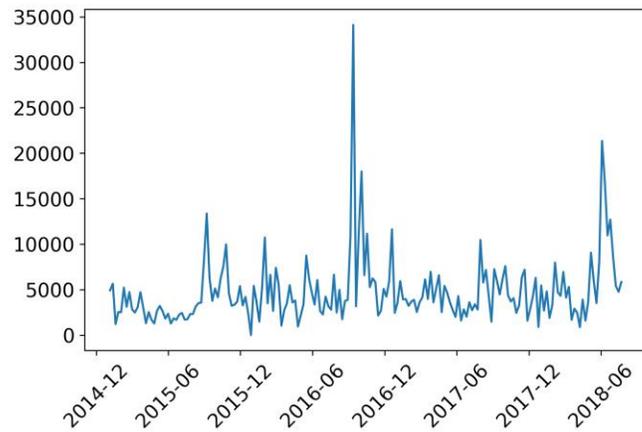
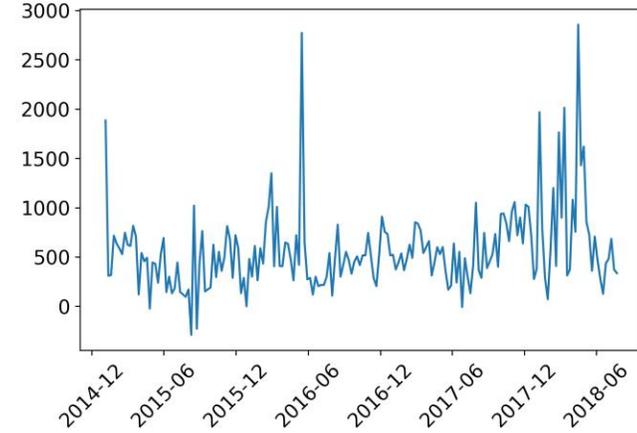
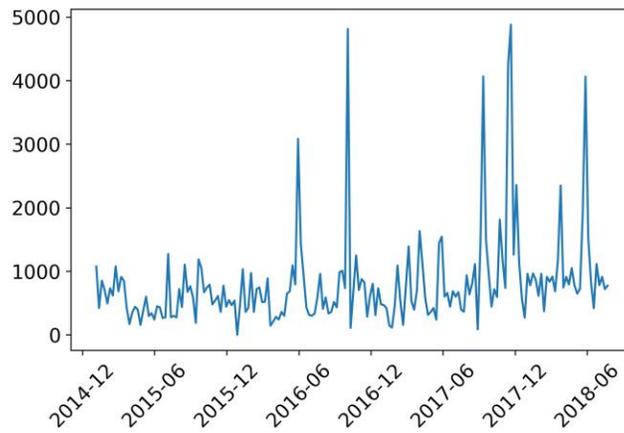
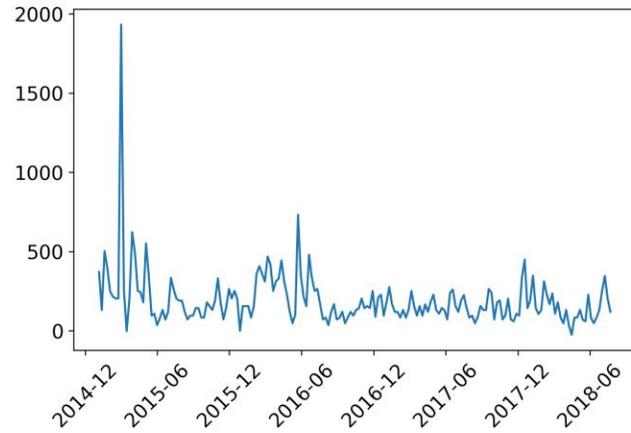


Anomaly Detection Example



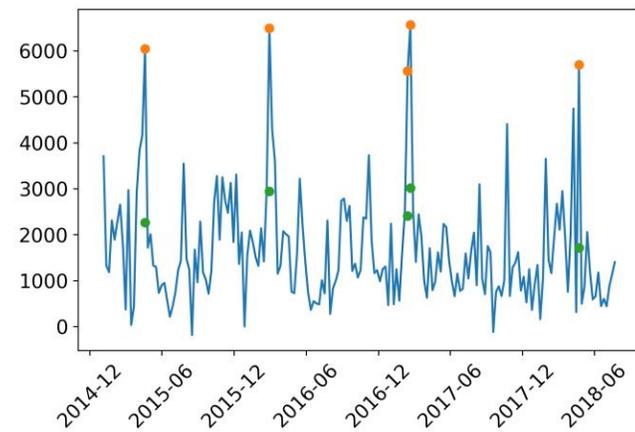
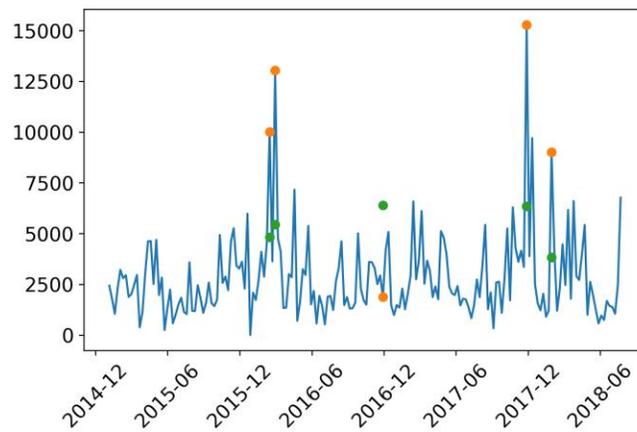
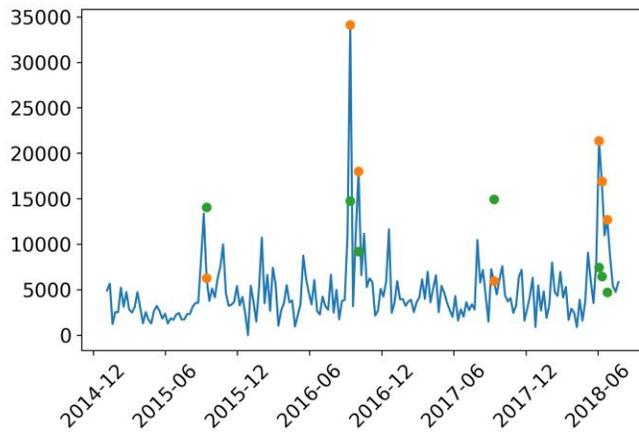
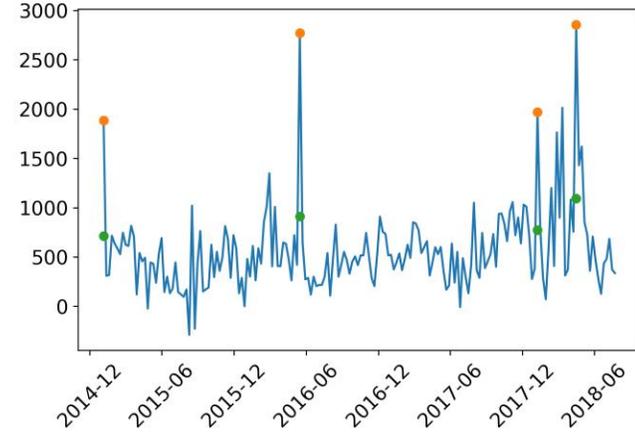
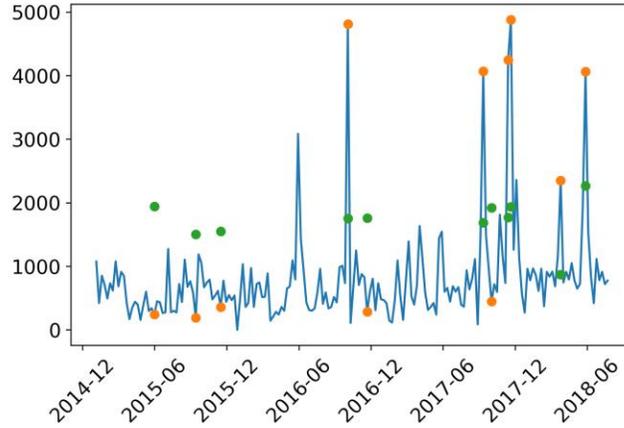
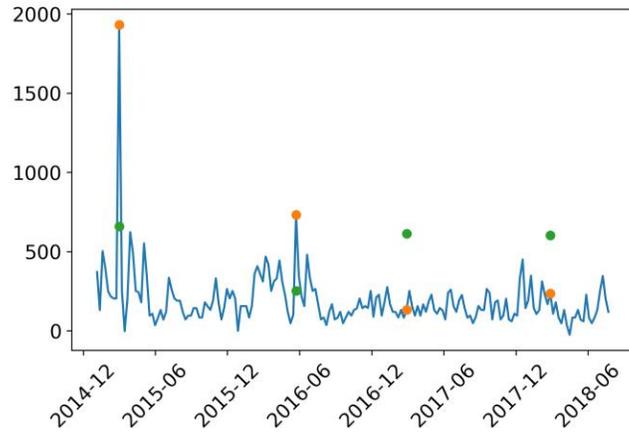
Anomaly Detection with Real Data

— Historical Data



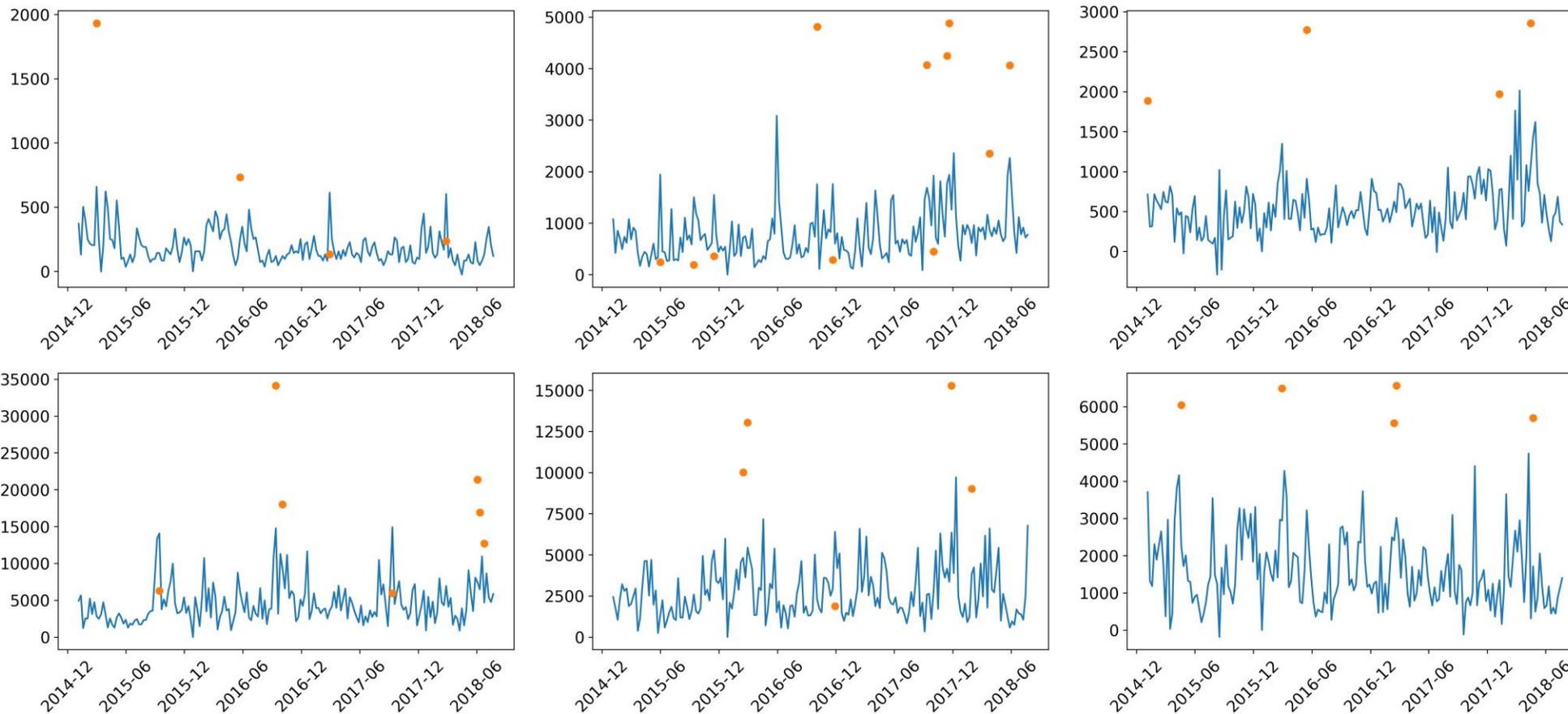
Anomaly Detection with Real Data

— Historical Data
 ● Anomalies
 ● Expected Values



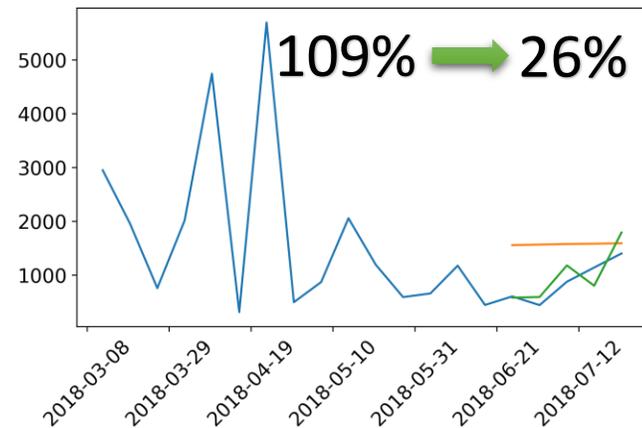
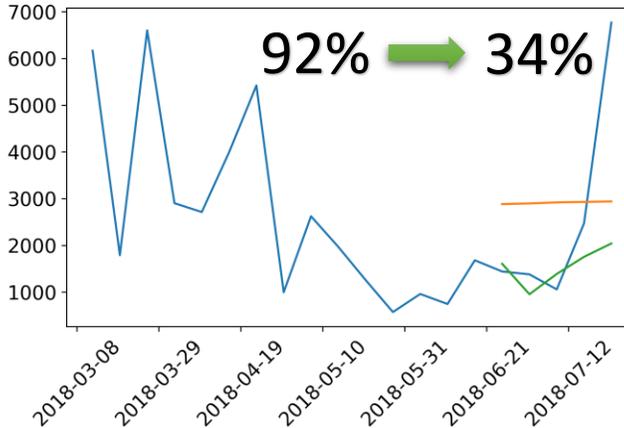
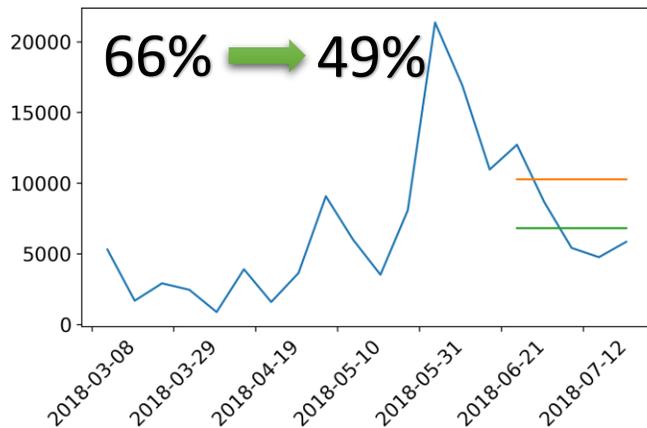
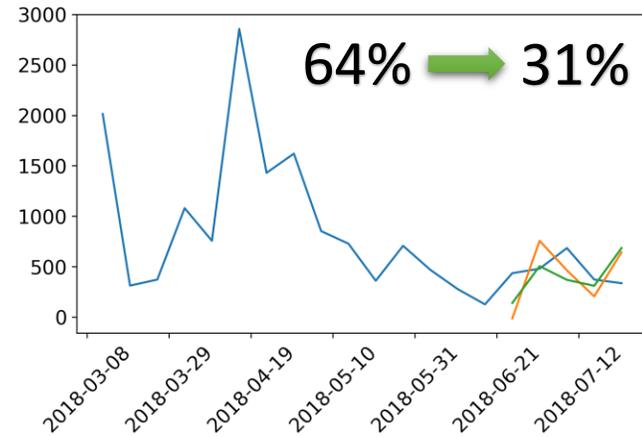
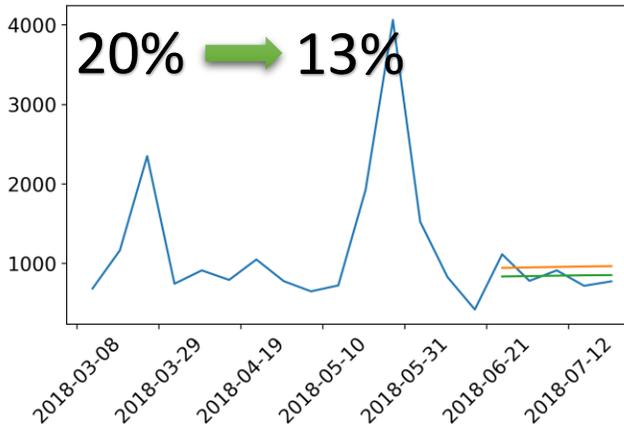
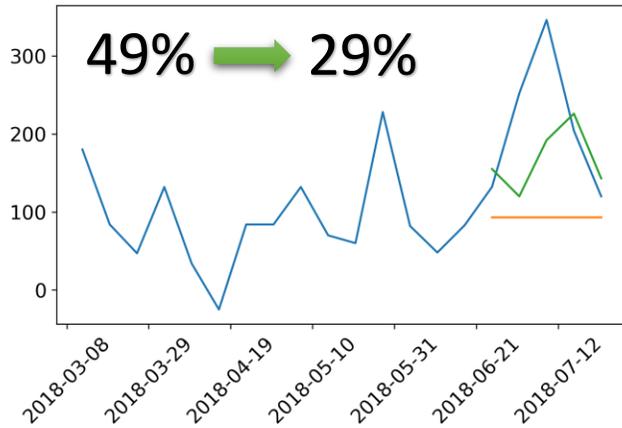
Anomaly Detection with Real Data

— Cleaned Data — Anomalies

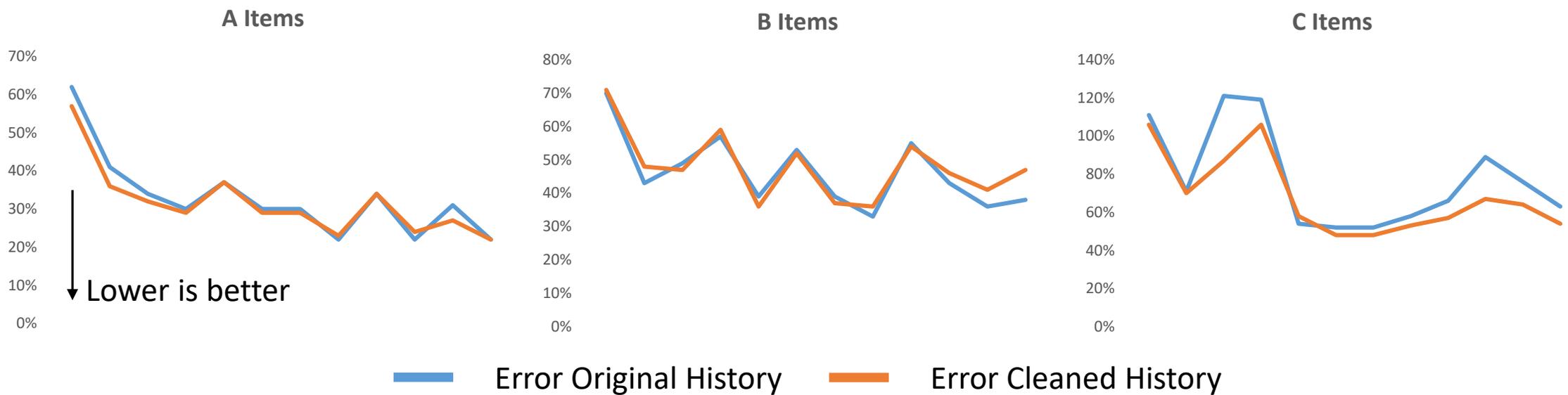


Forecasting Comparison

— Historical Data
 — Forecast Original History
 — Forecast Cleaned History



Accuracy Improvement

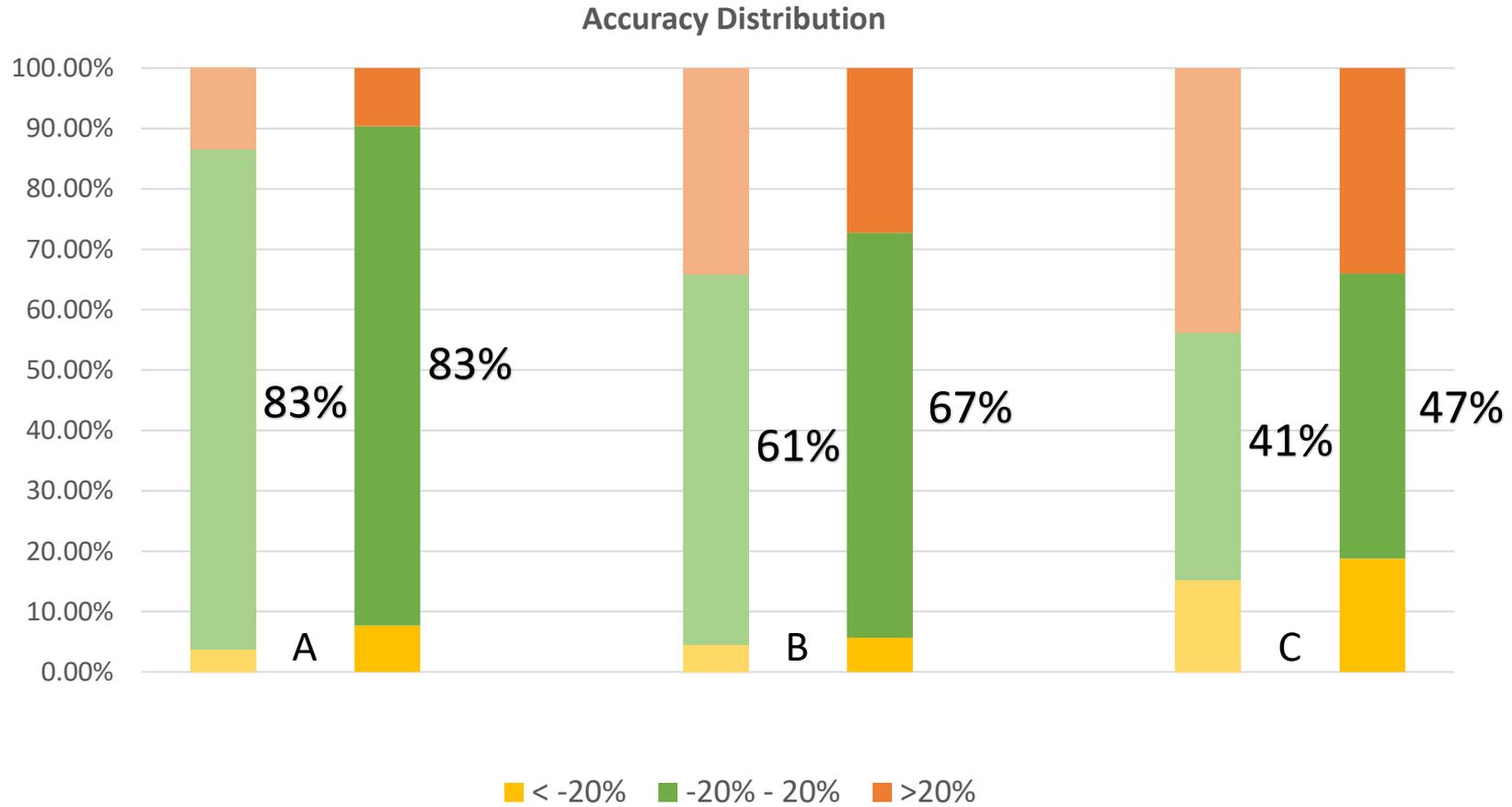


33% → 32%

46% → 48%

78% → 68%

Accuracy Improvement



A 1% Improvement in Forecast Accuracy Leads to...

Consumer Goods (nonfood and beverage)



2.4% decrease in order-to-delivery days (cycle time)



0.4% increase in perfect order performance (on time, in full)



2.7% reduction in finished goods inventory (days)



3.2% reduction in transportation costs (percent of sales)

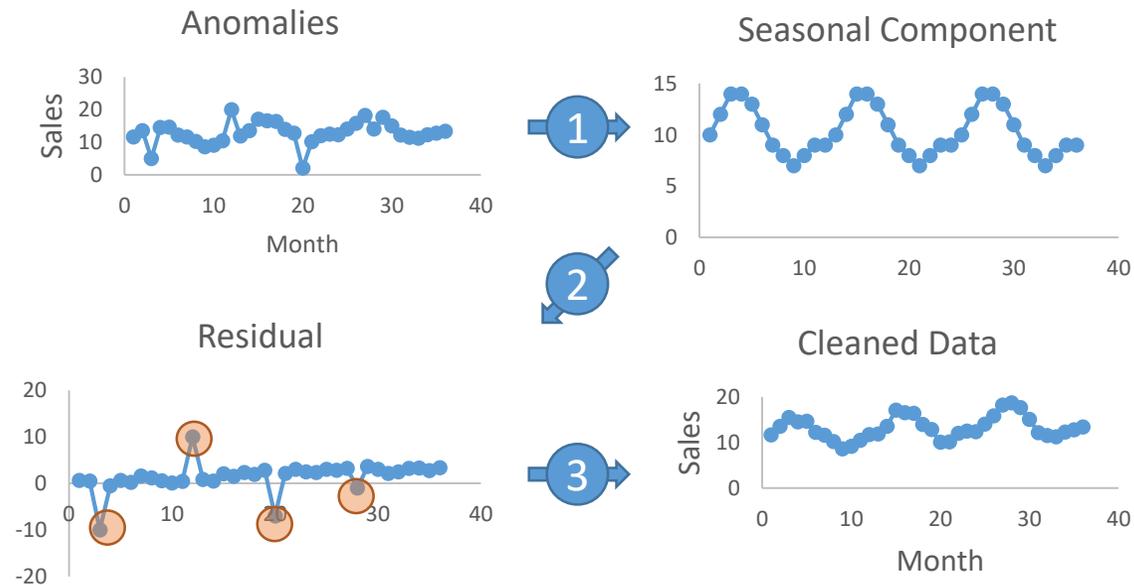


3.9% reduction in inventory obsolescence (percent of inventory value)

Source: "Win the Business Case for Investment to Improve Forecast Accuracy," Gartner, May 2017

Conclusion

- ▶ S-H-ESD has a good success rate for detecting/removing anomalies
- ▶ Removing anomalies generally leads to improved forecasts
- ▶ Simpler/cheaper solution than alternatives





QUESTIONS?



THANK YOU