Effect of Override Size on Forecast Value Add

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Motivation & Background

• Forecasting drives supply chain response.
• Important in Sales & Operations Planning, where long term, cross-functional decisions are made.
• Overrides often fail to improve forecast accuracy.

Less Wasted Effort
• Decreased error & bias
• Fewer stock-outs
• Reduced schedule changes and expedites

Profitability
• Higher Customer Service
• Engaged experts
• Lower Working Capital
Key Research Questions

Can a framework be created to increase the accuracy of the final forecast and maximize the value which experts add to the consensus forecasting process?

- Does statistical forecast performance impact improvement opportunities?
- Does the size of the override in relation to the underlying variability impact the ability to improve upon it?
- Does direction of forecast adjustment matter?
Case Study – Sporting Goods Manufacturer

- 19 Business Units
- 703 forecasts
  - 345 (+) Overrides
  - 355 (-) Overrides
  - 3 no overrides

- Forecast Value Add
  - Difference between Statistical and Consensus Forecasts
- Error (MAPE) should decrease with expert input
- MAPE, (-) Overrides
  - 180% Stat ➔ 69% Consensus
- MAPE, (+) Overrides
  - 54% Stat ➔ 200% Consensus
Case Study – Sporting Goods Manufacturer
Methodology

• Inputs – Demand, Stat Fcst, Consensus Fcst
• Calculate Forecast Value Added response variable
• Create predictor variables
• Use classification techniques to predict FVA or NVA
  • Classification Tree, Random Forest, Boosted Tree, Logistic Regression
Dispersion-Scaled Overrides (DSO)

- Use Seasonal-Trend decomposition to extract residuals
- Calculate dispersion statistics on the residuals
  - Standard Deviation
  - Mean Absolute % Error
  - Median Absolute % Error
- Divide overrides by dispersion measures to create DSOs

Displacement-Scaled Override$_t$ = \( \frac{\text{Override}_t}{\sigma_{\text{residuals}}} \)

Displacement-Scaled Override$_t$ = \( \frac{\text{Override}_t}{\text{MAD}_{\text{residuals}}} \)

Displacement-Scaled Override$_t$ = \( \frac{\text{Override}_t}{\text{MdAD}_{\text{residuals}}} \)

Forecast Scaled Override$_t$ = \( \frac{\text{Override}_t}{\text{Statistical Forecast}_t} \)
<table>
<thead>
<tr>
<th>Category</th>
<th>Element</th>
</tr>
</thead>
<tbody>
<tr>
<td>Response Variable</td>
<td>Forecast Value Add. Set to “1” if FVA exceeds 5%, otherwise set to “0”</td>
</tr>
<tr>
<td>Predictor Variables: Dispersion-Scaled Overrides</td>
<td>Dispersion-Scaled Override, Root Mean Square Error</td>
</tr>
<tr>
<td></td>
<td>Dispersion-Scaled Override, Mean Absolute Error</td>
</tr>
<tr>
<td></td>
<td>Dispersion-Scaled Override, Median Absolute Error</td>
</tr>
<tr>
<td></td>
<td>Forecast Scaled Override</td>
</tr>
<tr>
<td>Predictor Variables: Opportunity Indicators</td>
<td>Root Mean Square % Error (RMSPE) of Statistical</td>
</tr>
<tr>
<td></td>
<td>Mean Absolute % Error (MAPE) of Statistical forecast</td>
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<tr>
<td></td>
<td>Median Absolute % Error (MdAPE) of Statistical</td>
</tr>
<tr>
<td></td>
<td>Ljung-Box test for Autocorrelation</td>
</tr>
</tbody>
</table>

- **Classification Tree**
  - Visual, explainable
- **Random Forest**
  - Ensemble technique, black box
  - Variable importance plot
- **Boosted Tree**
  - Over-samples mis-classified records; black-box
- **Logistic Regression**
  - Probability values for variables
Classification Tree
Random Forest, Logistic Regression
Results and Implications

- Results
- Implications
- Future work

<table>
<thead>
<tr>
<th>Technique</th>
<th>Accuracy</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>Precision</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classification Tree</td>
<td>80.1 %</td>
<td>85.7 %</td>
<td>69.7 %</td>
<td>83.9 %</td>
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<tr>
<td>Random Forest</td>
<td>81.9 %</td>
<td>86.8 %</td>
<td>71.4 %</td>
<td>86.4 %</td>
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<tr>
<td>Boosted Tree</td>
<td>80.8 %</td>
<td>90.1 %</td>
<td>63.6 %</td>
<td>82.0 %</td>
</tr>
<tr>
<td>Logistic Regression</td>
<td>81.5 %</td>
<td>97.8 %</td>
<td>45.1 %</td>
<td>78.8 %</td>
</tr>
</tbody>
</table>

Results and Implications

- Results
- Implications
- Future work

- Opportunity to create forecast value add.
- Small adjustments, indistinguishable from underlying variation.
- Low Statistical Forecast Error
- Document Assumptions
- Do Not Override
- Beware of optimism bias
- Opportunity to create forecast value add.

Dispersion-Scaled Override

Statistical Forecast Error
Questions?
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