Point of Sale Data (POS) in Demand Forecasting

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Agenda

- Introduction
- Uses of POS data
- Empirical analyses and indexation
- Future research directions?
Why POS Data Is Important In The Supply Chain

“The old techniques for meeting customer and market demand—forecasting from historical data and holding inventory—are no longer effective for consumer goods manufacturers dealing with increasingly high customer service expectations. Traditional forecasting processes not only tie up capital but are riddled with errors when applied to short-term demand and supply issues like shelf replenishment.”

There’s Power in POS Data-Not Just for Retailers, but for Suppliers Too,
Mohan Balachandrand and Jim Morganstern
Consumer Goods Technology

“From a forecasting perspective, POS data give advance warning to enable response to change sooner. The data have been used on an ad hoc basis in operational planning, but that’s beginning to change.”

Larry Lapide
Demand Management Solutions Group at the MIT Center for Transportation and Logistics
Using POS Data to Drive Supply Chain Efficiency

Walgreens has selected Retail Solutions’ Demand Signal Management (DSM) solution to share operational supply chain data (POS, Inventory, etc.) with authorized suppliers:

- Mechanism through which Walgreens will share its data at a near real-time (day/store/item) level.
- Presents suppliers with
  - An intuitive web-based solution providing reporting and advanced analytics tools
  - A data structuring service
- Through extensive validation and cleansing, transactional data can be put into a standard format such that raw POS data becomes more immediately actionable
- Users can either run reports on the data from the on-demand web report builder tool, or schedule reports to automatically deploy via email.

**Benefit:** Enables users to gain consumer demand insights for operational business effectiveness

Walgreens

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Data Sources In The Retail Industry

Retailer Data Sources

• Point of Sale (POS) Scan Data *- Store and DC’s – Inventories
• Planograms
• Store Clusters
• Retail Item Hierarchies
• Events

Internal Data Sources

• Sales
• Promotions
• Events
• Item Hierarchies and Attributes
• Store/Location Hierarchies
• Forecasts
• Shipments

Third-Party Data Sources

• Syndicated Data – Nielsen*, IRI*, NPD
• Weather Data
• Map/Spatial Data

* Represents POS data sources

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# POS Data References In The Forecasting Literature

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Empirical Views Of POS Data

• Seasonality – Time Characteristics
• Seasonality – Spatial Characteristics
• Periodicity Characteristics
• Indexation Approach – non-scalar view
## Seasonality – Time Characteristics

Align Quarters to Calculate Seasonal Indexes within 13 week quarter

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Align Quarters

Quarter 2

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Seasonality in WEEKLY Within QUARTER

- Quickly Determine Seasonality
- Four Week Effect
- End of Quarter Effect
- Weeks add to Months
- Weeks add to 4-5-4
- Weeks add to Quarters
Seasonality - Geographic Characteristics

POS movement with Weather - White PE

- Seasonal Indexes
- Average Monthly Temperature

Graph showing the relationship between POS movement and weather with lines for South Monthly POS, East Monthly POS, South Average Monthly Temperature, and East Average Monthly Temperature.
Time Periodicity

Need to match periodicity of Point Of Sales data to Order data

Weekly POS data

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Time Periodicity (continued)

Need to match periodicity of Point Of Sales data to Order data

Weekly POS converted to Monthly data

Quote: “Although nearly all consumer products manufacturers have used POS data for monthly category management, the new shelf-centric reality requires seeing more granular data on a daily basis.” Lora Cecere, AMR Research

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Relationship Between POS Data And Order Data

But is it useful in forecasting demand?

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An “Indexation” Approach

Search for a POS / Order relationship to understanding POS data and the POS / Order data relationship

A POS series:

\[ X(1), \ X(2), \ X(3) \ldots \ X(n) \]

Define an index by:

\[ \frac{X(1)}{X(1)}, \ \frac{X(2)}{X(1)}, \ \frac{X(3)}{X(1)}, \ldots, \ \frac{X(n)}{X(1)} \]
The “indexed” data has all the characteristics of the nominal data including Seasonality and Trend.
A typical Consumer Packaged Goods (CPG) company has thousands to hundreds of thousands of stock-keeping units (SKUs)
POS Data Patterns Across SKUs

“indexation” helps unclutter a graphical view of multiple POS data streams
“Indexing” POS / Order Relationship

Create Index

(1) Create an index for both POS data and Order data

(2) Divide the Order data index by the POS data index:

Observe

- If this series has an increasing trend - retail inventory is relatively decreasing

- If this series has a decreasing trend - retail inventory is relatively increasing
POS Index Versus Order Index

POS Index vs Order Index [scaled * 9]

Monthly Period

Index Value

ORDER
POS

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Relative Growth Rates

Relative Index : Order index / POS Index

Monthly Period

Index Value Order and POS Index

ORDER
POS
ORDER/POS

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Trends In Order / POS Index
Relative Growth Rates

Positive linear trend suggests slight inventory build

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The order [and POS data] trend is down. The order/pos index trend is up. Indicates slight build in inventory.
Reversion to the mean indicates systematic correction processing is occurring. Negative serial correlation around the 3-month moving average?

Three Month Moving Average in the Order Index / POS Index series

Reversion to the mean in Relative Index: Order index / POS Index

Three Month Moving Average in the Order Index / POS Index series

Reversion to the mean indicates systematic correction processing is occurring. Negative serial correlation around the 3-month moving average?

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Experience has shown that using POS data collaboratively can lead to reductions in biased views by decision-makers. It tends to reduce order oscillations ("bull-whip" effect) at higher levels of the supply chain by allowing collaborating partners to better interpret the internal orders they receive.

Future research could examine the robustness of POS to Order relationships at different nodes in the supply chain (retail, distributor, warehouse, manufacturer, supplier) to improve collaborative forecasting among its partners.

Croson, Rachel and Donohue Karen,

"Impact of POS Data Sharing on Supply Chain Management: An Experimental Study", Production and Operations Management, April 2003

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