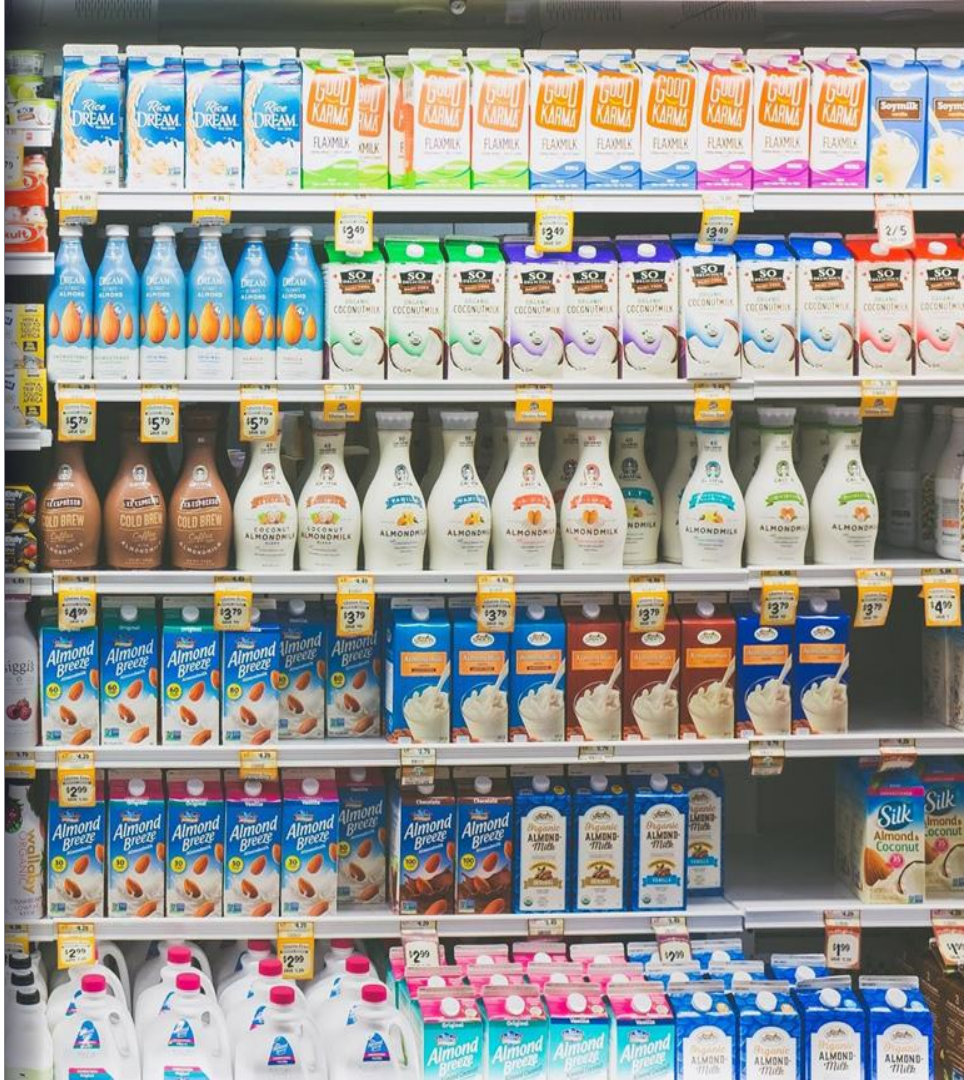
Retail

Inventory, Stockouts & ML

21/Jan/2018



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- *Using ML for Inventory decisions using time Series Sales forecasting*
- *Provide “In-Stock” updates to consumers*

- *Not going to talk about factors influencing ‘Consumer Demand’*

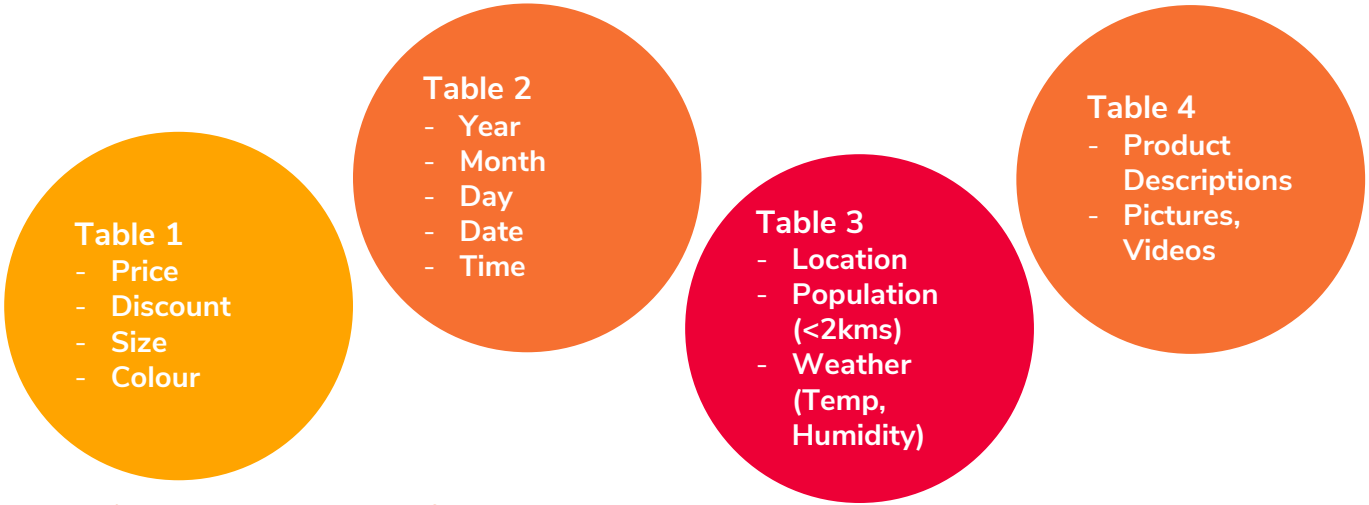
Modern history of Sales Forecasting

- **Xia & team (2012)** – Extreme learning algorithm (ELM) with adaptive metrics of inputs
- **Wong & team (2010)** - ELM for medium-term fashion sales forecasting
- **Chen & team (2011)** - Sales forecasting system based on Gray Extreme Learning Machine. GELM outperformed several methods based on back-propagation NN.
- Sales forecasting along with **Bass Model**
- **Ehrenthal & team (2013)** - Causes of retail stockouts are specfic to the retailer, store, category and product – **No Model fits all**

(The above list is focussed only on Learning algorithms/models and does not include other research)

Data Collection & Processing

- ***Step 1:**** *Select the articles to track.* ***15 articles across 3 product categories*** *(Fashion, Personal Care & Cosmetics).*
  - ***Why?*** *– Personal Care does have 'Continuity products', while Fashion & Cosmetics don't. Personal Care focussed only on Male products while Cosmetics focussed only on Female range.*
- ***Step 2:*** *Data collection*



(Table 4 contained more information about the product and was not used in detail during this process)

**(Across 20 stores; Mid-size; Using a PoS & Credit card system)*

Model Used

ARIMA - Autoregressive Integrated Moving Average model.

ARIMA (p, d, q) Model:

- *p – Order of autoregressive part*
- *d – degree of differencing involved*
- *q – Order of moving average part*

(Values of p = 3, d = 1 & q = 2)

Mathematically,

- $y(t) = c + \emptyset_1 y_{(t-1)} + ... + \emptyset_p y_{(t-p)} + ... + \theta_1 e_{(t-1)} + ... + \theta_q e_{(t-q)} + e_t$

What is happening at this moment?

- Collecting data for the last 2 months. We have about **1000 data points for each product**.
- All shops are in Mumbai/Pune.
- We have built a box that collects the data and shares it with our cloud system.
- Currently the model does not account for size & colour of article & location of the shop.
- Does account for all other factors including population around the location.

Expected Output

- Match the Actual & Forecasted Sales data for the last few months
- Provide ‘stock forecast’ information
- Identify the top 2 or 3 variables that drive sales of an article

Typical Process

Bit of mathematics to ponder

- **Time series models should be Stationary**
- Auto-Regression
- Moving average
- Differencing
- Standard Deviation

Some References

- https://www.mckinsey.com/industries/retail/our-insights/the-secret-to-smarter-fresh-food-replenishment-machine-learning
- https://www.researchgate.net/publication/4747825_Opportunities_for_active_stock-out_management_in_online_stores_The_impact_of_the_stock-out_policy_on_online_stock-out_reactions
- Dynamics in Consumer Response to product Unavailability - https://www.sciencedirect.com/science/article/pii/S0148296302004861
- Fashion Retailing forecasting based on ML - https://www.sciencedirect.com/science/article/pii/S0950705112001906
- An examination of causes of retail stock out - http://www.emeraldinsight.com/doi/abs/10.1108/09600031311293255

Thank you very much for your time