



ISB

Forecasting



Forecasting Project Group 8

Yash, Vivek, Shilpi, Sudhanshu, Basu



21 January 2013

- Business Goals & Forecasting Approach
- Assumptions
- Data Visualization
- Forecasting Fresh Milk Sales (SKU: Amul Taaza)
- Forecasting Dahi and Yoghurt Sales (SKU: Saras Dahi & Yakult)
- Conclusions & Recommendations

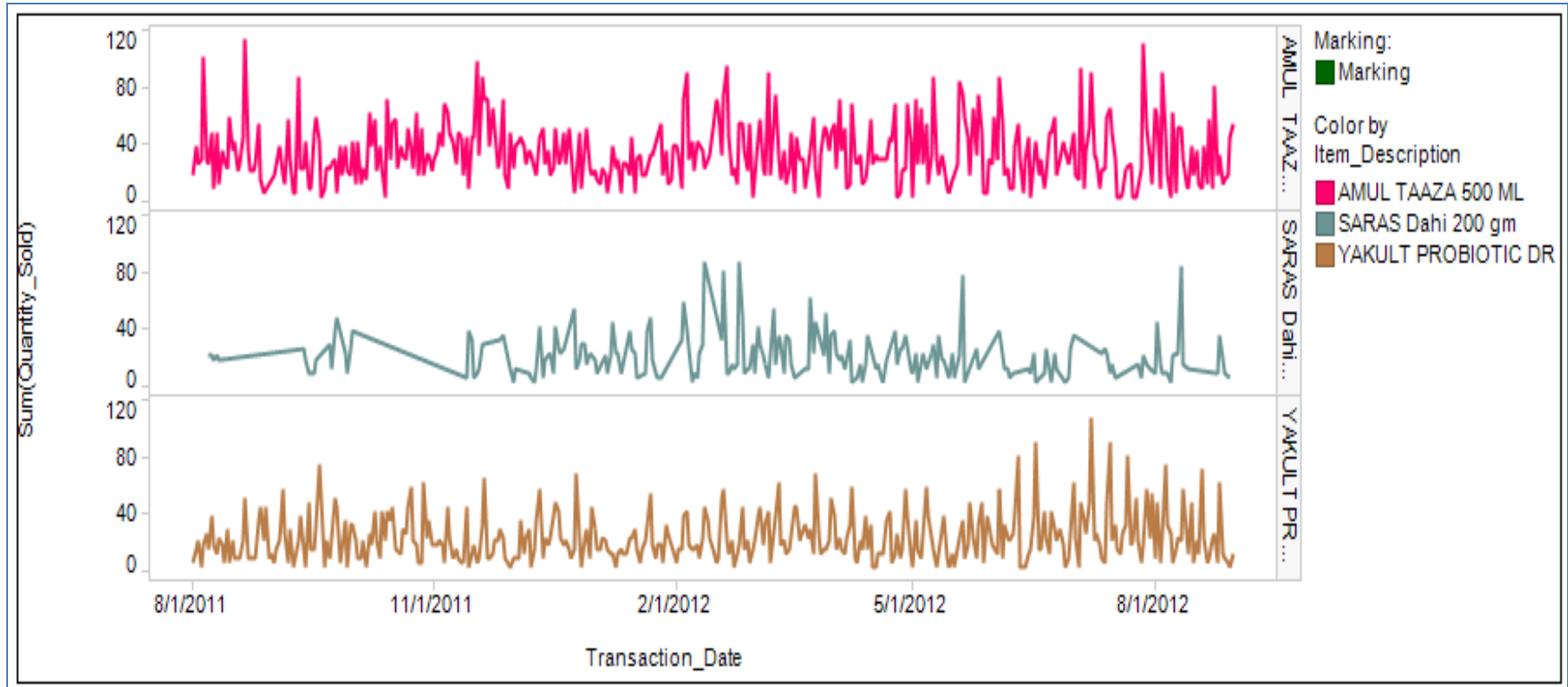
Business Goal

Reduce wastage of perishable classes - DAHI & YOUGURT and FRESH MILK which have short shelf life and high variability of demand

- ✓ Prevent wastage of the products by reducing inventory level
- ✓ Maintain optimum inventory level to prevent stock out
- ✓ Improve forecasting accuracy to improve service levels

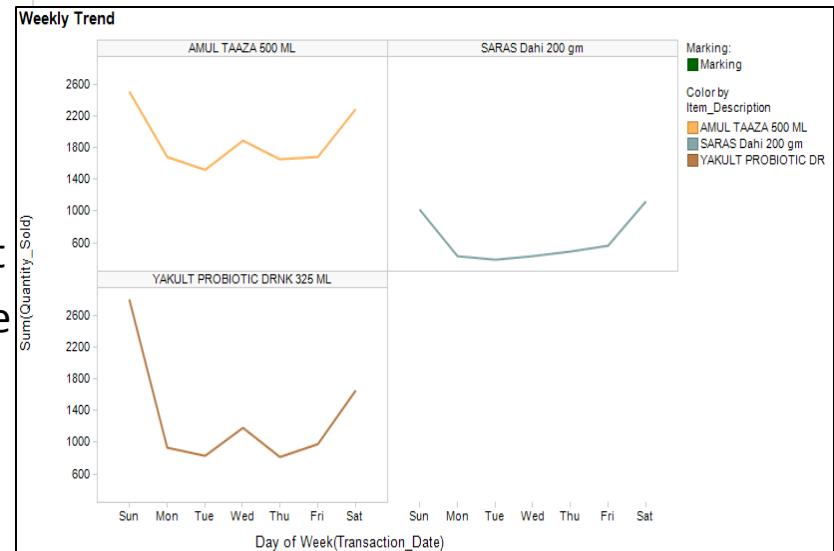
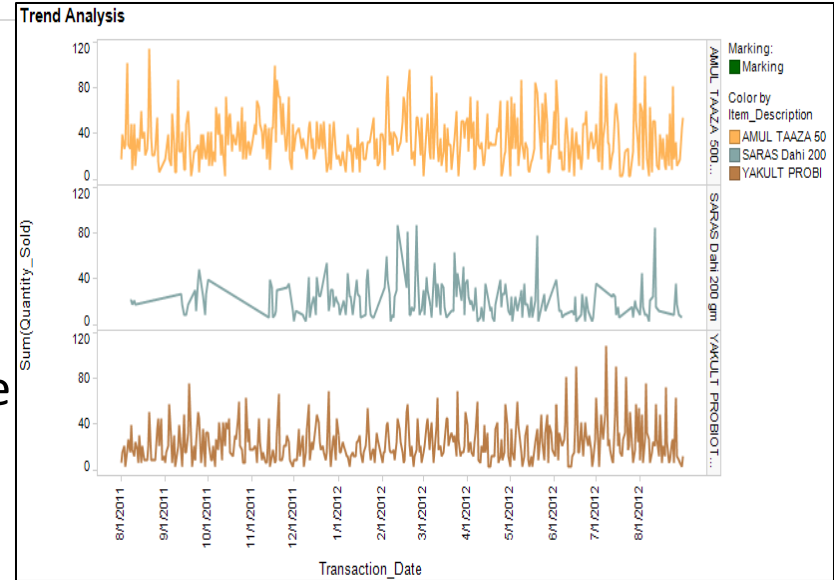
Forecasting Approach

- ✓ Forecast demand on the two selected classes - Fresh Milk and Dahi & Yoghurt
- ✓ Forecasting to be done at a daily level
- ✓ Training data set taken from Aug'11 to July'12, validation data of 1 month



- Data aggregated and filtered for classes DAHI & YOGURT and FRESH MILK
- No Trend in the data
- Data contains outliers and anomalies which needed to be addressed

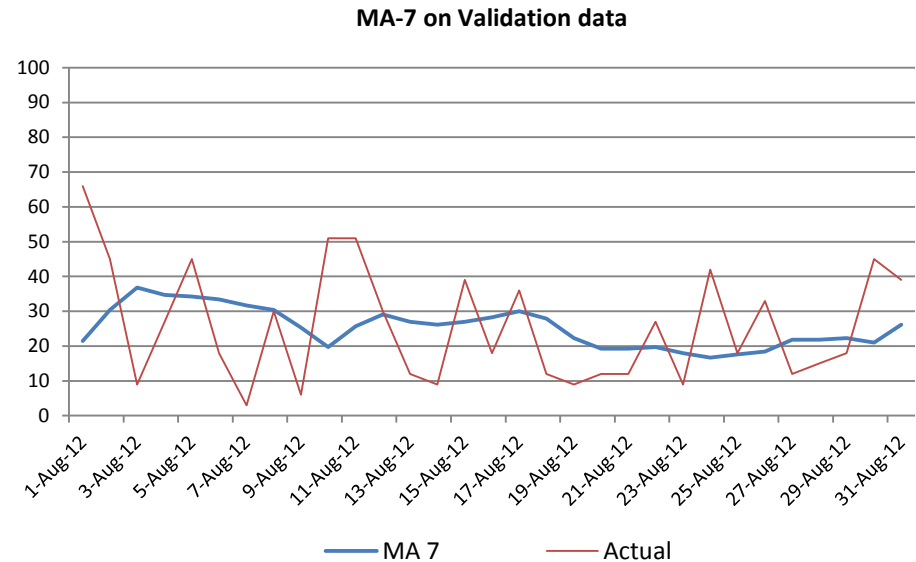
- Data for each SKU in “Dahi and Youghurt” class were aggregated separately:
 - ✓ SKU 1 - Yakult Probiotic drink 325 ml
 - ✓ SKU 2 - Saras Dahi 200gm
- Data for the SKU in “Fresh Milk” class were aggregated
 - ✓ *Amul Taaza 500 ml*
- Aggregation was done at a daily, weekly and monthly level to visualize trends
 - Plot on the right shows visible seasonality in quantity sold for SKU’s in Dahi & Yoghurt
 - Daily sales increase over the weekends due to increased footfalls. Sales increase on Wednesdays



- Historical purchase pattern and consumer preferences would be similar in the future without any major economic/environmental changes
- Product attributes will not change. Correspondingly, the correlation between sales of Saras Dahi and Yakult would continue to exist in future
- The forecasting model is based on daily sales which are assumed to represent demand of the products and does not consider the possibility of stock-outs that might have happened over the sales period.

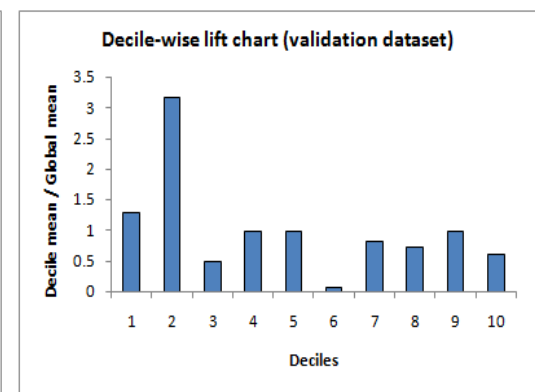
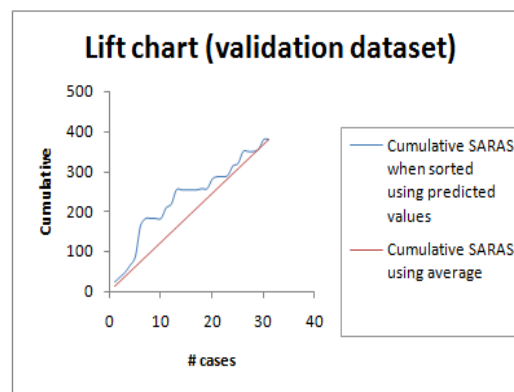
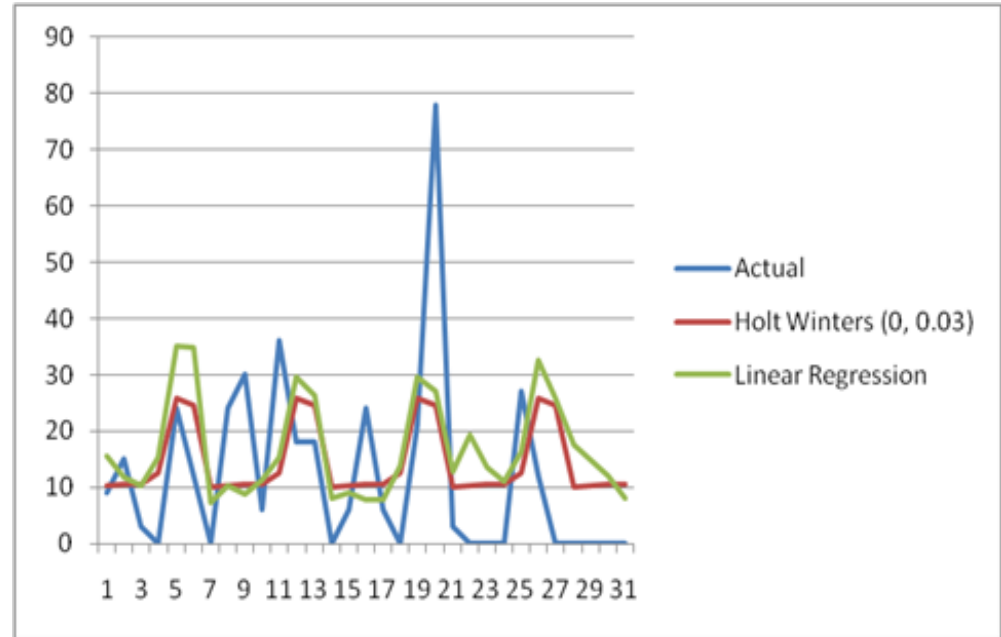
- Amul Taaza: training data from 1-Aug-2011 to 30-Jul-2012 and validation on Aug 2012 data

- Outlier treatment – sales data more than 2 SDs over the mean were replaced by mean



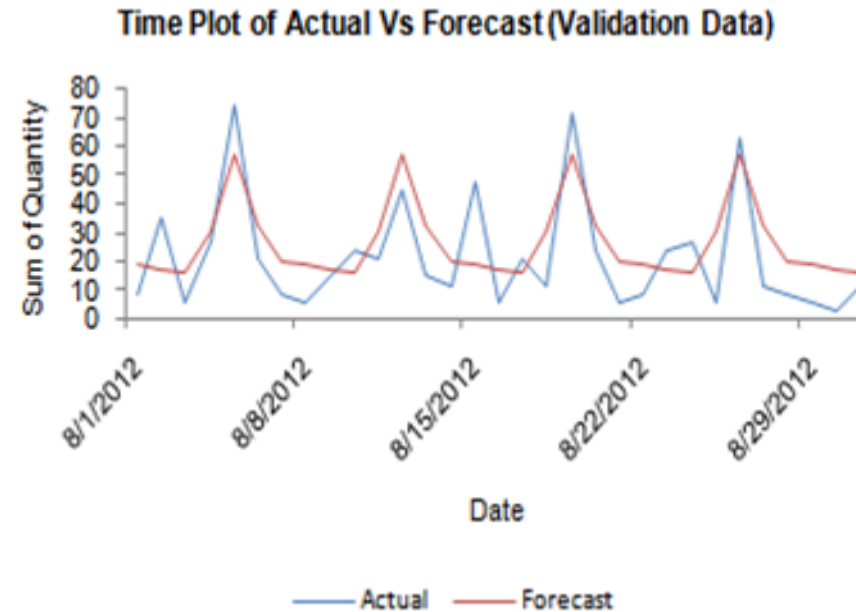
- Moving Average and Neural network models were tested on Amul Taaza data. The neural network model could not give any usable fit on the data, hence moving average was chosen and optimized further for best results
- Randomness in data best captured through Moving Average Smoothing method, as there is no trend or seasonality in the data
- MA(7) gave lowest error on both training and validation data - hence used for forecasting sales of Amul Taaza

- Long periods of zero sales observed in data, hence final training period selected from Dec '11 – Apr'12 and validation on May'12 data
- No trend but constant weekly seasonality with peaks over weekends
- Multiple linear regression (with days of week as dummy variables) and Holt Winters (no trend) considered
- Iterative process yielded Holt Winters (Alpha = 0, Gamma = 0.03, Season Length = 7) as best fit model with MSE = 222.66 vs. MSE of 270.44 from MLR model



- Linear Regression Model and Holt Winters No Trend considered
- Multiple Linear Regression Model
 - ✓ Seasonality captured through a categorical dummy variable for day of week
- Holt Winters Model
 - ✓ Considered as there is no trend in data
 - ✓ Optimum values for model are $\alpha = 0.2$, $\gamma = 0.09$
- MSE for Multiple Linear Regression better than that for Holt-Winter's on both training and validation datasets

Holt-Winters No Trend Model



	MSE	
	Training	Validation
Linear Regression	96.79	181.16
Holt Winters	140.65	185.93

Amul Taaza Fresh Milk

- Average sales over the previous week best predictor for daily sales
- Safety Stock a good idea to absorb unexpected increase in sales

Saras Dahi Yoghurt

- Occasional increase in sales should be captured when making safety inventory stocking decisions
- Refine forecasts using latest available data

Yakult Probiotic Drink

- Robust and accurate model for estimating daily sales
- Weekday/Weekend seasonality to drive inventory stocking decisions

Thanks!!!

