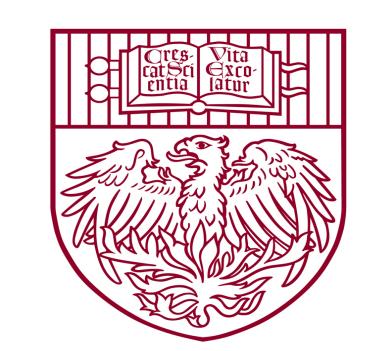


Insight into the Impact of Marketing Activities on Sales Using Marketing Mix Modeling



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Research Purpose

The purpose of this research is to help HAVI Global Solutions' client estimate the impact of historical marketing and pricing activities and then forecast the impact of future activities through the use of predictive statistical models. These models can provide the client with insight into where and how to apply marketing investment dollars more effectively. The marketing mix model developed for this research will do the following:

- Correctly identify the cannibalization effect of promotions across different products;
- Minimize data collinearity risks of independent variables (such as different types of promotions);
- Contain a model validation process that efficiently validates models related to large numbers of products,
- Allow for scalability into more markets.

Research Questions

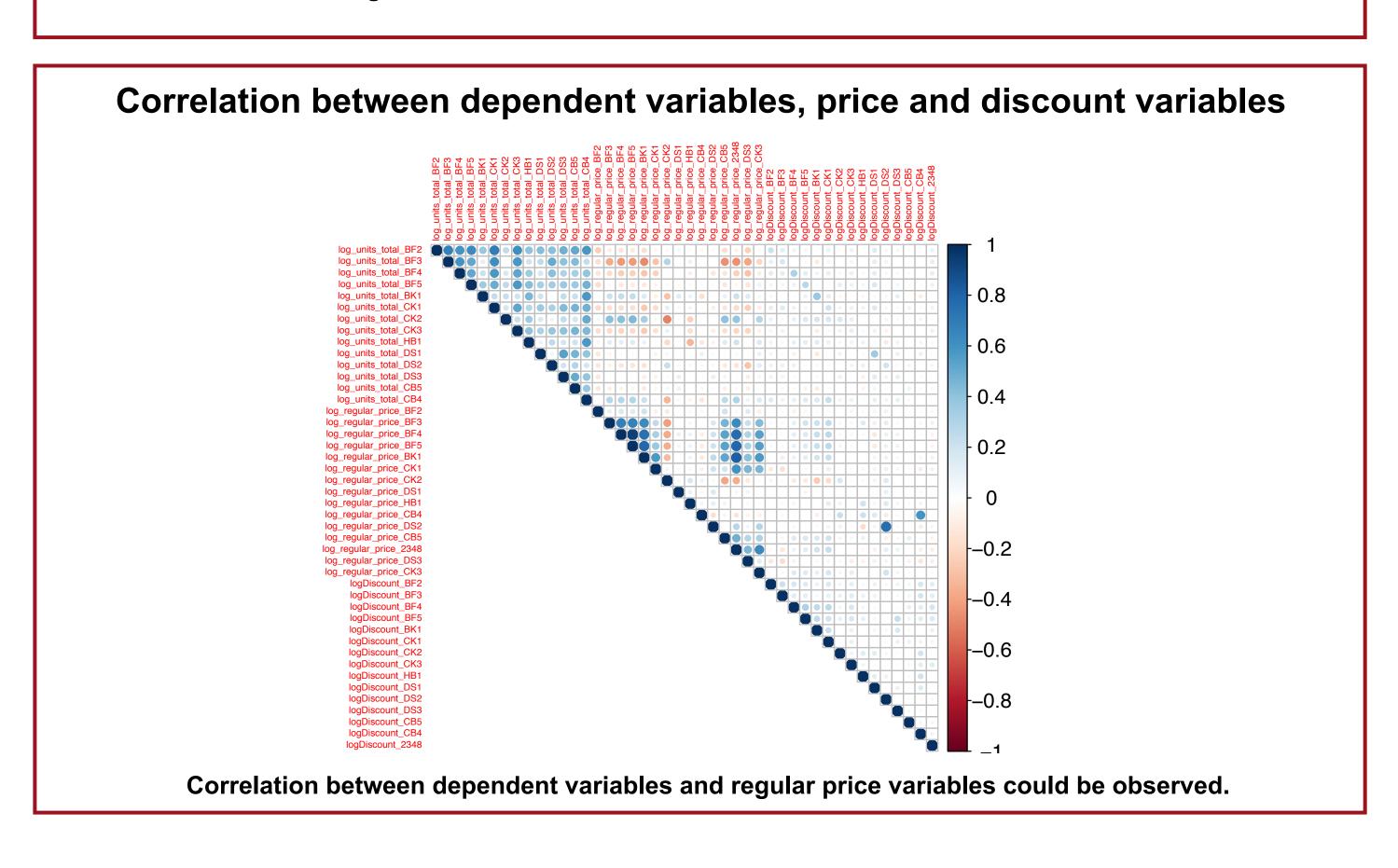
- What is the effect of different marketing and promotion activities on the total sales and the sales of other items?
- Are there opportunities to further optimize promotion strategies across products?

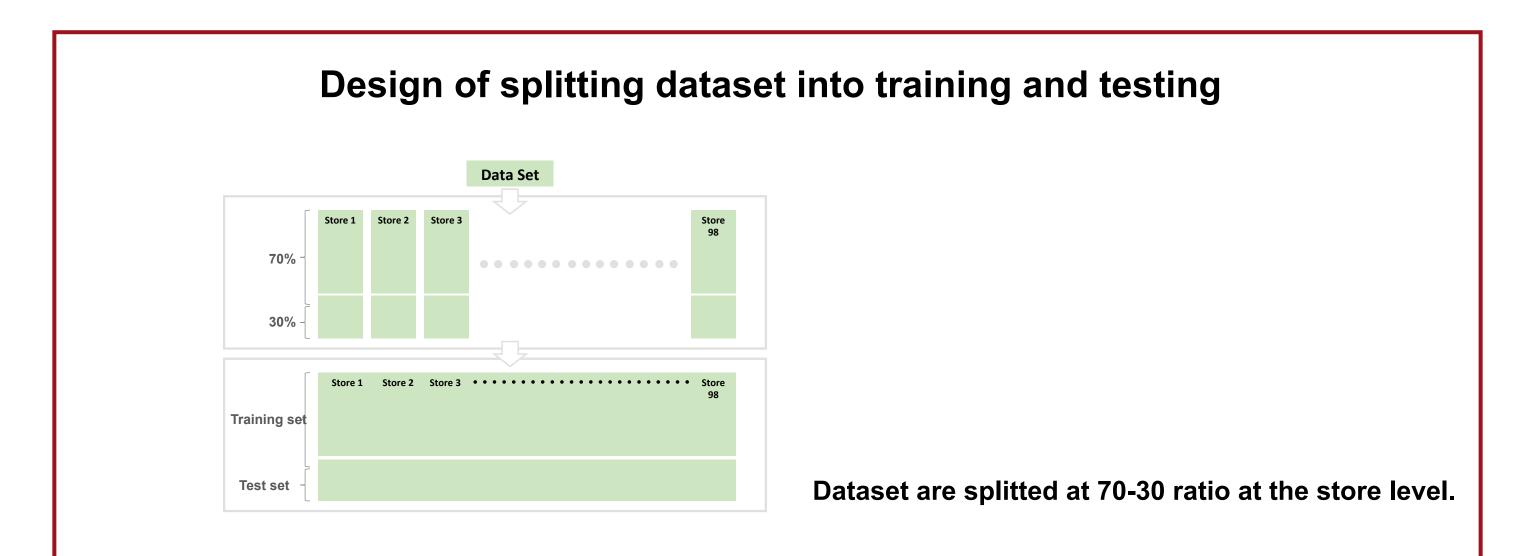
Research Hypothesis

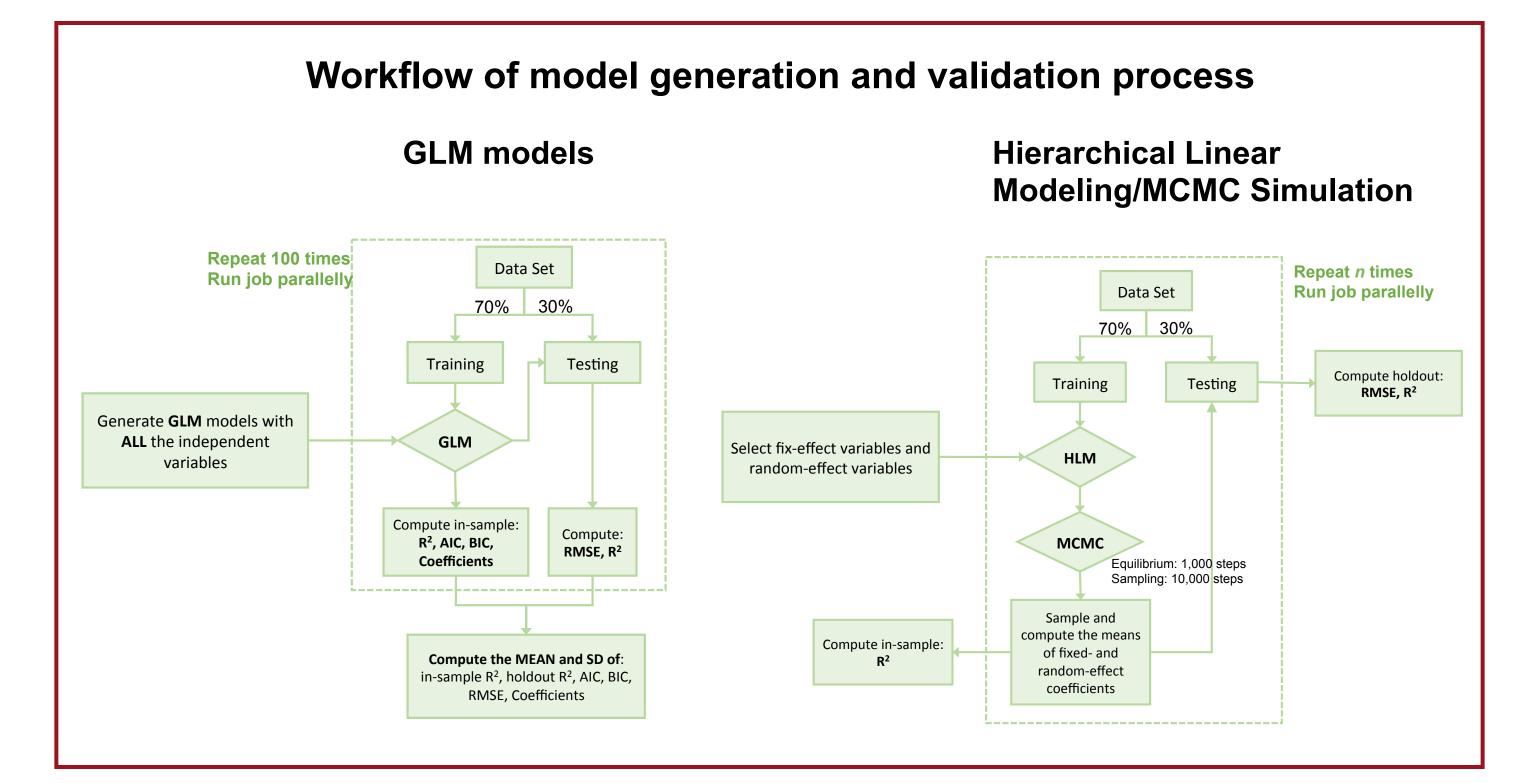
Changes in marketing and promotion activities within one Co-op impact sales differently across products.

Dataset Independent Variables Dependent Variables Total (4 variables) Weather (52 variables) Daily total sales (\$) Weather 07-JAN-2010, Weather 29-JAN-2010, Weather 30-Daily total transections JAN-2010, Weather 06-FEB-2010, Weather 08-FEB-2010 ... DrivThru daily total sales (\$) Day of week and holidays (114 variables) DrivThru daily total transections Sunday, Monday, Tuesday, Wednesday, Thursday, Dummy Coding Items (28 variables) Friday, Saturday New Years Day(Sunday), New Years Day(Tuesday), New units_total_BF1, units_total_BF2, **Dummy Coding** units_combo_BF2, units_total_BF3 Years Day(Wednesday), New Years Day(Friday), New Years Day(Saturday) units_total_BF4, units_combo_BF4, units_total_BF5, units_combo_BF5 **Dummy Coding** National promotions (24 variables) units_total_BK1, units_combo_BK1, units_total_CK1, units_combo_CK1 Local promotions (40 variables) **Dummy Coding** units_total_CK2, units_combo_CK2, Price reduction promotions (15 variables) units_total_DS1, units_total_HB1 Numeric units_total_CB1, units_total_CB2, Price Discount for different item Calculated as log(promoted price / regular price) units_total_CB3, units_total_CB4 units_total_DS2, units_total_CB5, Regular Price of items at store level (15 variables) Numeric units_total_DS3, units_total_CK3 units_combo_CK3, units_total_SI1, Promotion Price of items at store level (15 variables) Numeric units_total_SI2, units_total_SI3

Among 28 items, only 14 products have complete price information and were further used as dependent variables in the modeling.



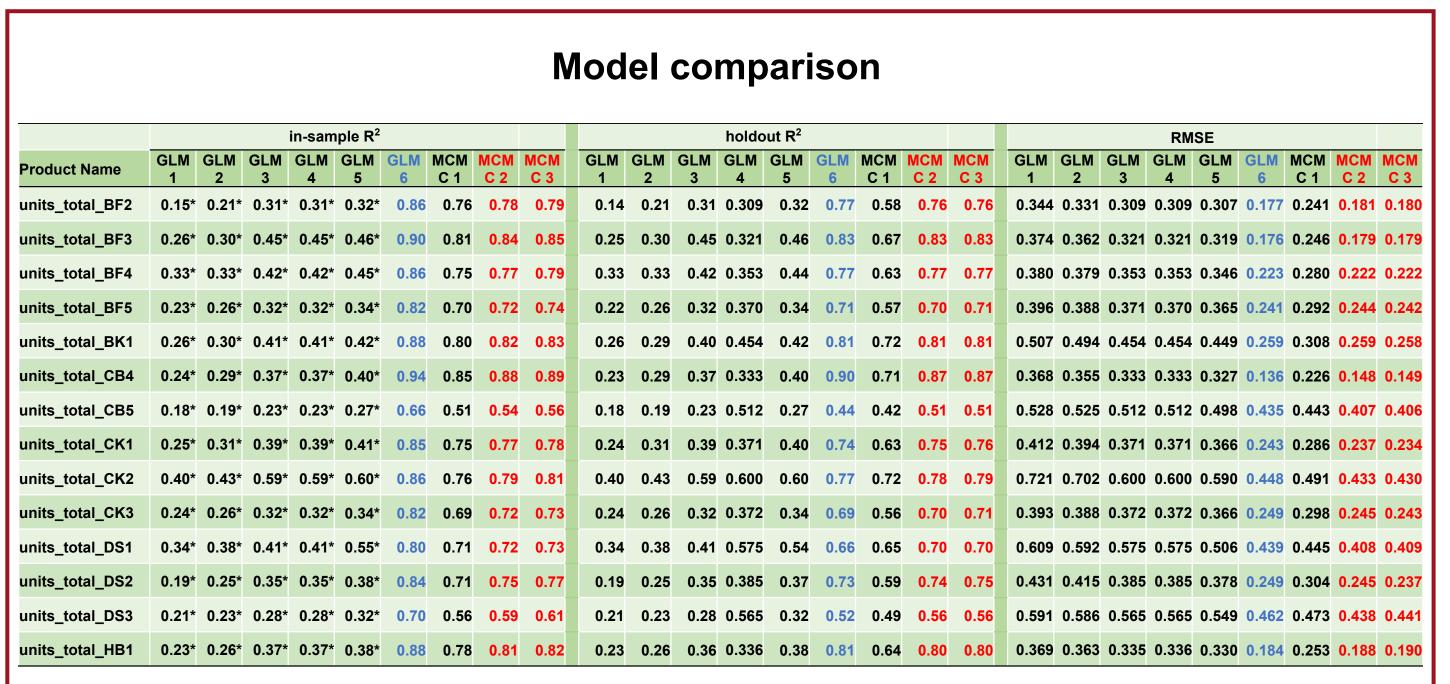




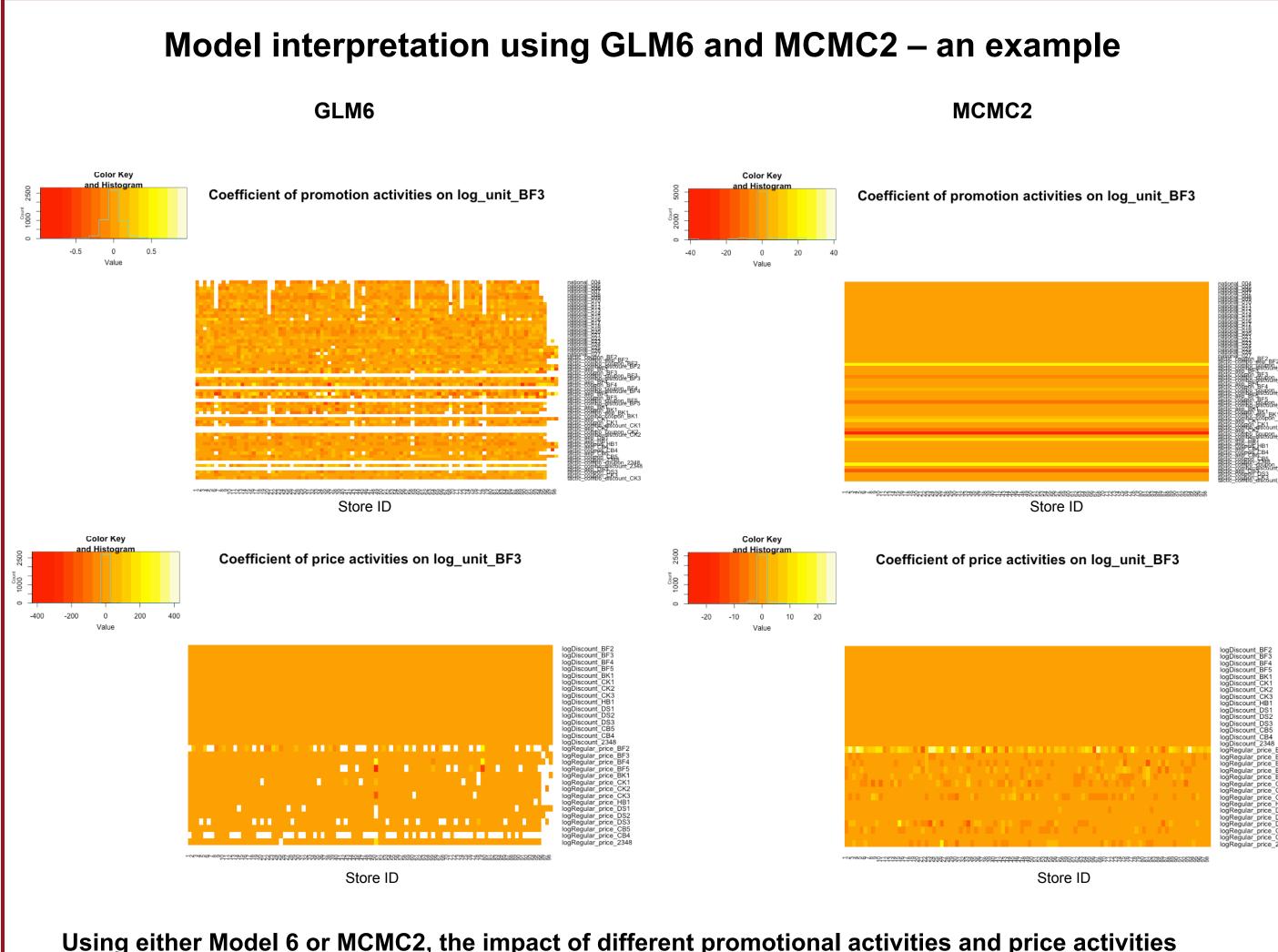
Models generated in this study

$=\beta_0 + \sum \beta_{1i}(day\ of\ week)_i + \sum \beta_{2j}(holiday)_j + \sum \beta_{3k}(weather)_k + \sum \beta_{4l}(national\ promotion)_l + \sum \beta_{5m}(tactic\ promotion)_m + \sum \beta_{6n}log\left(\frac{promo_price_n}{regular\ price_n}\right)$ GLM 1 GLM 2 $=\beta_0+\sum\beta_{1i}(\textit{day of week})_i+\sum\beta_{2j}(\textit{holiday})_j+\sum\beta_{3k}(\textit{weather})_k+\sum\beta_{4l}(\textit{national promotion})_l+\sum\beta_{5m}(\textit{tactic promotion})_m+\sum\beta_{6n}log\textit{Discount}_n$ GLM 3 $=\beta_0 + \sum_i \beta_{1i}(day\ of\ week)_i + \sum_i \beta_{2j}(holiday)_j + \sum_i \beta_{3k}(weather)_k + \sum_l \beta_{4l}(national\ promotion)_l + \sum_i \beta_{5m}(tactic\ promotion)_m + \sum_i \beta_{6n}logDiscount_n$ $+\sum_{l}\beta_{7o}logRegular_price_{o}$ $=\beta_0+\sum\beta_{1i}(day\ of\ week)_i+\sum\beta_{2j}(holiday)_j+\sum\beta_{3k}(weather)_k+\sum\beta_{4l}(national\ promotion)_l+\sum\beta_{5m}(tactic\ promotion)_m+\sum\beta_{6n}logDiscount_n$ $+\sum_{\sigma} \beta_{\sigma o} log Regular_price_o$ $=\beta_0 + \sum_i \beta_{1i}(day\ of\ week)_i + \sum_i \beta_{2j}(holiday)_j + \sum_k \beta_{3k}(weather)_k + \sum_l \beta_{4l}(national\ promotion)_l + \sum_m \beta_{5m}(tactic\ promotion)_m + \sum_k \beta_{6n}logDiscount_n$ GLM 5 $+\sum eta_{7o} log Regular_price_o + \sum eta_{8p} (week of year)_p$ $=\beta_{0,storeID} + \sum_{i} \beta_{1i,storeID}(day\ of\ week)_{i,storeID} + \sum_{i} \beta_{2j,storeID}(holiday)_{j,storeID} + \sum_{k} \beta_{3k,storeID}(weather)_{k,storeID}$ GLM 6 $+\sum_{l}\beta_{4l,storeID}(national\ promotion)_{l,storeID} + \sum_{m}\beta_{5m,storeID}(tactic\ promotion)_{m,storeID} + \sum_{n}\beta_{6n,storeID}logDiscount_{n,storeID} +$ $+\sum_{a} \beta_{7o,storeID} logRegular_price_{o,storeID} + \sum_{p} \beta_{8p,storeID} (week of year)_{p,storeID}$ MCMC 1 $=\beta_0+\sum_i\beta_{1i}(day\ of\ week)_i+\sum_i\beta_{2j}(holiday)_j+\sum_k\beta_{3k}(weather)_k+\sum_l\beta_{4l}(national\ promotion)_l+\sum_m\beta_{5m}(tactic\ promotion)_m+\sum_n\beta_{6n}logDiscount_n$ (HLM/MCMC) $+\sum_{o} \beta_{7o} log Regular_price_o + \sum_{o,storelD} \alpha_{0p,storelD} + \sum_{o,storelD} \alpha_{1q} log Discount_{q,storelD}$ MCMC 2 $=\beta_0+\sum_i\beta_{1i}(day\ of\ week)_i+\sum_i\beta_{2j}(holiday)_j+\sum_k\beta_{3k}(weather)_k+\sum_l\beta_{4l}(national\ promotion)_l+\sum_m\beta_{5m}(tactic\ promotion)_m+\sum_n\beta_{6n}logDiscount_n$ (HLM/MCMC) $+\sum_{o}\beta_{7o}logRegular_price_{o} + \sum_{p}\beta_{8p}(week\ of\ year)_{p} + \sum_{p,storelD}\alpha_{0p,storelD} + \sum_{q,storelD}\alpha_{1q}logDiscount_{q,storelD} + \sum_{r,storelD}\alpha_{2r}logRegular_price_{r,storelD}$ $=\beta_0 + \sum_i \beta_{1i}(day\ of\ week)_i + \sum_i \beta_{2j}(holiday)_j + \sum_k \beta_{3k}(weather)_k + \sum_l \beta_{4l}(national\ promotion)_i + \sum_m \beta_{5m}(tacktic\ promotion)_m + \sum_n \beta_{6n}logDiscount_n$ MCMC 3 (HLM/MCMC) $+\sum_{o}\beta_{7o}(logRegular_price)_{o} + \sum_{p}\beta_{8p}(week\ of\ year)_{p} + \sum_{p,storeID}\alpha_{0p,storeID} + \sum_{q,storeID}\alpha_{1q,storeID}(logDiscount)_{q,storeID}$ $+\sum_{r} \alpha_{2r,storeID} (logRegular_price)_{r,storeID} + \sum_{s,storeID} \alpha_{3s,storeID} (tactic promotion)_{s,storeID}$

For each product, 9 models are generated as above.



Model 6 and MCMC2 are selected as final models for business interpretation.



Osing either Model 6 or MCMC2, the impact of different promotional activities and price activities on total sale units are different, which provide the potential way to optimize the market activities.

Conclusions

- 6 Linear models and 3 HLM/MCMC models are generated and effectively validated in this study.
- GLM6 and MCMC2 are selected for the business interpretation using the performance in the train and test.
 The effect of different marketing and promotion activities on the sales of products could be measured by
- these models, which provide a potential way to further optimize market activities.

Current and Future direction

- Residual diagnose and model improvement by eliminating seasonal pattern in dependent variables.
- Interpretation of price elasticities, price discount effect and promotional effect on total sales.

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