Project#3

Evaluating Sales Promotion Effects Using Scanner Panel Data

Team InSights

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Honor Pledge:
We pledge on our honor that we have not given or received any unauthorized assistance on this assignment.

Executive Summary

Short-term incentives such as sales promotions are easily implemented and provide CPG companies with a quick sales boost. This project tests the individual and combined effects of different promotion vehicles on detergent sales to optimize promotion strategy. The analysis reveals that consumers are highly price sensitive in their category purchase incidence and advertising elements such as in-store display and feature affect consumers' purchase decision as well as brand choice significantly. Purchase quantity decisions, on the contrary, are governed more by usage rather than price or promotions. Combined effect of sales promotions is higher than their individual effects, as seen in case of the Wisk brand. Promoting multiple brands increases purchase incidence and category sales, but with diminishing returns. Therefore, Retailers need to weigh costs against benefits before increasing the number of brands on promotion and in case they do, the brands Tide and All should take precedence for maximum benefit to category sales.

Introduction and Background

Retailers often execute short-term sales promotions in the form of temporary price reductions, coupons, in-store displays, feature advertising etc. to attract new consumers by brand switching and encourage existing customers to purchase more, resulting in higher product sales. Today, CPG companies are spending more on sales promotions than media advertising due to easy execution and faster results. Therefore, it is critical to analyze the sales impact of these promotions to improve promotion strategy.

This project uses household-level scanner panel data of a liquid laundry detergent category to analyze the effectiveness of sales promotions on consumers' purchase behavior. The main objective of this study is to analyze the individual versus combined effects of sales promotions on consumers' purchase incidence, brand choice and purchase quantity decisions.

Data and Methodology

Store-week level scanner panel data of liquid laundry detergents purchased by 178 households was used for the analysis. Unilever's detergent brands Wisk & All and P&G's Tide & Cheer were studied.

A Binary Logit Model was fitted to gauge the impact of price reduction, in-store displays and feature advertisements on consumers' purchase incidence for the detergent category. The effect of a household's previous category purchase on promotion and average purchase quantity were tested in the model to assess their impact.

Next, a Multinomial Logit Model was fitted to analyze the impact of promotions on consumers' brand choice. Specifically, effects of various pricing variables such as regular weekly prices, absolute price cuts and percentage price reductions were tested along with other promotions to find the best fit model.

Finally, Semi-Log Regression Models were fitted to tease out the impact of different factors on conditional purchase quantities for each brand. The models assessed the impact of a household's average purchase quantity (usage) versus that of sales promotions on the purchase quantity of each brand.

SAS was used for executing the study, including data cleaning, preparation and analysis. Results from all models were used to analyze the total effect of sales promotions on the effective purchase quantity, which is *Pr(Incidence)*Pr(Brand Choice)*Conditional Purchase Quantity*. *(Refer to Table 1 in Appendix for the functional forms of the models)*

Key Findings

The results of the Binary Logit Model, Multinomial Logit Model and Semi-Log Regression Models for category incidence, brand choice and conditional purchase quantity respectively are summarized below. *(Refer to Tables 2-7 in Appendix for model findings)*

- A 1 cent/oz increase in regular price decreases the odds of purchase incidence by 54%. A price discount of 1 cent/oz increases odds of purchase by as much as 191%. While promoting the detergent category using in-store displays increases the odds of purchase by 63.4%, feature ad promotions increase the odds of purchase by 74.5%. Lastly, if a customer has made his previous purchase on promotion then the odds of purchase incidence decreases by 39%.
- When there are no promotions, there is no preference to choosing All over Cheer or vice-versa, but the odds of Wisk being chosen over Cheer decreases by 32% and the odds of Tide being chosen over Cheer increases by 65%. Even in the absence of promotions, Tide enjoys the highest customer loyalty as compared to other brands.
- Running a display promotion increases the odds of a brand being chosen by 266%. Running a feature promotion increases the odds of a brand being chosen by 45%. Increasing price discount by 1% of regular price increases the odds of a brand being chosen by 5%.
- Price cuts have a negligible impact on purchase quantity compared to a household's average purchase quantity, implying that purchase quantities are driven by usage rather than price.
- Running an in-store display ad, which is not necessarily coupled with price cuts as seen in the data, could increase Wisk's sales by 16%. Similarly, a feature promotion (not necessarily coupled with price cuts) could increase Tide's sales by 6.4%.

Conclusions and Recommendations
- Customers are found to be highly price sensitive while purchasing detergents, as seen by higher price cuts increasing the odds of purchase by an average of 190%. In addition to price cuts, retailers should also invest in in-store displays and feature ads periodically as they affect the odds of purchase incidence of detergents significantly.
- Customers tend to stock up on detergents when offered on promotion and thus the likelihood of purchase during the next shopping trip is less. Therefore, there is need to exercise caution while running promotions and it may not be a good idea to overdo them. While the intent may be to increase short term sales and attract new customers, the company may end up training customers to wait for promotions.
- All three promotion types affect brand choice but in-store displays and feature promotions play a bigger role. High purchase quantities are driven by usage rather than price due to lack of price incentive within brand, i.e. after choosing a brand only people who consume more buy more. So, price cuts should be supplemented with feature or display ads to push higher purchase quantity.
- When sales promotions are applied individually, in-store displays, feature ads and price cuts result in 375.7%, 130.1% and 77.3% increase in expected purchase quantity respectively for Wisk. Therefore, depending on cost constraints, in-store display ads (preferred) or feature ads should be executed whenever possible to maximize Wisk's sales.
- Supplementing Price reduction with in-store display and feature promotions is most effective, increasing Wisk's sales by 1312%. The next best combination is in-store display and feature ads, yielding a sales spike of 870%.
- As more brands are promoted, the purchase incidence and expected category sales increases but with diminishing returns. Promoting two, three and four brands respectively gives an average of 32%, 26% and 23% increase in sales. Therefore, the retailer needs to take a call regarding number of brands to be promoted considering the added cost of promoting each additional brand.
- Tide and All have high brand loyalty and therefore when any promotion is run on these brands the probability that other brands get chosen decreases significantly. Multiple brand promotions should definitely include Tide and All for maximum benefit to category sales.
  (Refer to Table 8 in Appendix for details of the above analyses)

Appendices

Table 1: Functional Forms of Models

Type of Model	Functional Form
Binary Logit Model for Incidence	$Pr[I_{i,t} = 1] = \dfrac{exp(V_{i,t})}{1 + exp(V_{i,t})}$ where $V_{i,t} = a + b_1 X_{1i,t} + b_2 X_{2i,t} + ...$.
Multinomial Logit Model for Brand Choice	$Pr[B_{i,k,t} = 1] = \dfrac{exp(U_{i,k,t})}{exp(U_{i,1,t}) + exp(U_{i,2,t}) + ... + exp(U_{i,K,t})}$ where $U_{i,k,t} = a + b_1 X_{1i,k,t} + b_2 X_{2i,k,t} + ...$, $k = 1... K$
Semi Log Regression Model for Conditional Purchase Quantity	$S_{i,k,t} = exp(a + b_1 X_{1i,k,t} + b_2 X_{2i,k,t} + ...), \ k = 1... K$

Table 2: Binary Logit Model Results for Incidence

Criteria For Assessing Goodness Of Fit			
Criterion	DF	Value	Value/DF
Log Likelihood		-3184.70	
Full Log Likelihood		-3184.70	
AIC (smaller is better)		6381.41	
AICC (smaller is better)		6381.41	
BIC (smaller is better)		6428.57	

Analysis Of Maximum Likelihood Parameter Estimates							
Parameter	DF	Estimate	Standard Error	Wald 95% Confidence Limits		Wald Chi-Square	Pr > ChiSq
Intercept	1	1.20	0.92	-0.61	3.01	1.69	0.19
avg_rp	1	-0.76	0.14	-1.04	-0.48	27.90	<.0001
avg_pc	1	1.06	0.37	0.34	1.79	8.21	0.00
cat_disp	1	0.49	0.14	0.21	0.76	12.21	0.00
cat_feat	1	0.56	0.10	0.35	0.76	28.04	<.0001
Lbpromot	1	-0.52	0.08	-0.69	-0.36	38.80	<.0001
Scale	0	1.00	0.00	1.00	1.00		

Table 3: Multinomial Logit Model Results for Brand Choice

Model Fit Summary	
Dependent Variable	decision
Number of Observations	781
Number of Cases	3124
Log Likelihood	-845.08
Log Likelihood Null (LogL(0))	-1083
Maximum Absolute Gradient	2.04046E-8
Number of Iterations	4
Optimization Method	Newton-Raphson
AIC	1702
Schwarz Criterion	1730

Conditional Logit Estimates

Parameter Estimates					
Parameter	DF	Estimate	Standard Error	t Value	Approx Pr > |t|
intcpt1	1	-0.38	0.14	-2.73	0.00
intcpt2	1	-0.13	0.13	-0.96	0.34
intcpt3	1	0.50	0.12	4.21	<.0001
pricimp	1	0.05	0.01	3.36	0.00
disp	1	1.30	0.12	10.75	<.0001
feat	1	0.38	0.11	3.38	0.00

Table 4: Semi Log Regression Model Results for Conditional Purchase Quantity for 'Wisk'

Parameter Estimates					
Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	3.78	0.10	35.17	<.0001
avol	1	0.007	0.00	7.43	<.0001
disp1	1	0.15	0.05	3.04	0.00

Table 5: Semi Log Regression Model Results for Conditional Purchase Quantity for 'All'

Parameter Estimates					
Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	3.86	0.08	46.09	<.0001
avol	1	0.007	0.0006	11.29	<.0001

Table 6: Semi Log Regression Model Results for Conditional Purchase Quantity for 'Tide'

Parameter Estimates					
Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	3.90	0.07	56.98	<.0001
avol	1	0.006	0.0005	11.90	<.0001
feat3	1	0.06	0.03	2.16	0.03

Table 7: Semi Log Regression Model Results for Conditional Purchase Quantity for 'Cheer'

Parameter Estimates					
Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	4.29	0.06	73.10	<.0001
Avol	1	0.003	0.0005	6.10	<.0001

Table 8: Analysis of Combinations of Sales Promotions

Number of Brands Promoted	Avg. Probability of Purchase Incidence	Avg. % Increase in Category Sales
1 brand	14%	230%
2 brands	16%	298%
3 brands	19%	375%
4 brands	23%	462%

Promotion Combination	Purchase Incidence Probability	% Increase in Category Sales
one brand promoted (Wisk)	13.2%	225%
one brand promoted (All)	13.6%	237%
one brand promoted (Tide)	14.1%	255%
one brand promoted (Cheer)	13.1%	202%
multiple brands promoted (Wisk & All)	16.0%	298%
multiple brands promoted (Wisk & Tide)	16.5%	317%
multiple brands promoted (All & Tide)	17.0%	327%
multiple brands promoted (Wisk & Cheer)	15.4%	265%
multiple brands promoted (All & Cheer)	15.8%	280%
multiple brands promoted (Tide & Cheer)	16.3%	300%
multiple brands promoted (Wisk, All, Tide)	19.8%	398%
multiple brands promoted (All, Tide, Cheer)	19.5%	383%
multiple brands promoted (Tide, Cheer, Wisk)	19.0%	370%
multiple brands promoted (Cheer, Wisk, All)	18.4%	348%
all four brands promoted	22.6%	462%