Exam Marketing Strategy Modeling – June 2010

Question 1

Problem statement

Sales promotions are an important marketing tool to stimulate product sales. For manufacturers as well as retailers, they may generate a substantial increase in revenues and profit. While the increase in category sales constitutes a major point of concern from the retailer's point of view, brand switching effects are the main driver behind the manufacturer's sales and revenue increase.

To assess the profitability of sales promotions, the impact on sales revenues as well as costs has to be taken into account. The effect may differ depending on the type of consumer group that is attracted. When promotions especially appeal to *loyal buyers* of the brand, the increase in brand sales may predominantly be due to purchase acceleration (loyal consumers buying sooner or more of the brand) and to a lesser extent to brand switching. The small increase in additional sales (stockpiling by loyal consumers without increase in consumption, small number of new buyers) may not compensate for the high promotion costs (lower price and profit margin when a price discount is offered, and/or advertising costs of features and displays). *Deal-prone* consumers tend to buy on deal and often delay their purchases until a price reduction is offered. Sales promotions may have a strong immediate impact on their brand choice decisions, yet the positive effect tends to disappear after the promotion is retracted. For *other* consumers, sales promotions may have a positive and possibly longer lasting effect on brand choice decisions. In addition to their overall promotion response, these consumer groups may differ in their sensitivity to specific promotion instruments. While deal-prone consumers tend to be especially attracted by price discounts and to consult store flyers to collect promotion information, brand loyals may be price sensitive but less likely to consult store flyers. In-store displays that attract customer attention in the store, may be especially effective to reach new or irregular buyers of the brand.

The objective of this research is to define consumer segments that differ in promotion sensitivity and to derive guidelines for a differentiated sales promotion approach, aimed at selecting the right promotion instruments to target specific consumer segments.

Data

The examined product category is a frequently purchased consumer good (ketchup), that is frequently promoted by price discounts, features and displays. Scanner panel data of 945 households and a two year period are available for the analysis, accounting for 7575 purchases of the six major product items (choice alternatives, defined by brand and package size). The six brand-sizes in the market consist of Heinz (28 oz., 32.oz, 40 oz., and 64 oz.), Hunt's (32 oz.) and Del Monte (32 oz.). Descriptives for the products and household sample are provided in Table 1. Of the 945 households, 709 (accounting for 5611

purchases) are used for purposes of model estimation, and the remaining 236 households constitute the validation sample.

For each of the brand-sizes, information is available on:

- the product price, Price_{jt}, expressed in ¢/oz., which mainly captures the effect of promotional price reductions since regular prices tend to be stable over time
- features, Feature_{jt}, a dummy variable equal to 1 when product j is advertised in the store flyer in period t, and 0 otherwise
- in-store displays, Display_{jt}, a dummy variable equal to 1 when product j is on display in t, and 0 otherwise

In addition, the data set contains information on three socio-demographic characteristics of the panel members that can be used to characterize different consumer segments: household income (Income_i), household size (hhsize_i), and age of the head of the household (Age_i) (see Table 1).

Model and estimation procedure

To examine the effect of promotions on brand choice decisions, a conditional multinomial logit model is estimated:

$$P_{ijt}^{s} = P_{ijt}|i \in s = \frac{\exp\left(\alpha_j^s + \beta_1^s \ \text{Price}_{jt} + \beta_2^s \ \text{Display}_{jt} + \beta_3^s \ \text{Feature}_{jt}\right)}{\sum_l \exp\left(\alpha_l^s + \beta_1^s \ \text{Price}_{lt} + \beta_2^s \ \text{Display}_{lt} + \beta_3^s \ \text{Feature}_{lt}\right)}$$

With P_{ijt}^{s}= probability that household i (belonging to segment s) will select brand-size j on purchase occasion t.

Latent class estimation is applied to identify different consumer segments and characterize their buying behavior. Two different latent class models are examined: (1) a model without any explanatory variables for segment membership and (2) a model in which demographic variables are included as explanatory variables for segment membership probability.

(1) $$P(i \in s) = \frac{\exp\left(\gamma_s\right)}{\sum_r \exp\left(\gamma_r\right)}$$

(2) $$P(i \in s) = \frac{\exp\left(\gamma_s + \delta_{1s} \, Income_i + \delta_{2s} \, hhsize_i + \delta_{3s} \, Age_i\right)}{\sum_r \exp\left(\gamma_r + \delta_{1r} \, Income_i + \delta_{2r} \, hhsize_i + \delta_{3r} \, Age_i\right)}$$

With $P(i \in s)$= probability that household i is a member of segment s.

Based on the following goodness-of-fit statistics, a three-segment solution was selected:

Nr of segm's	**(1) without demograph.**			(2) **with demographics**		
	LL	BIC	CAIC	LL	BIC	CAIC
1	-5770	11609	11617	-5770	11609	11617
2	-5710	11567	11584	-5690	11527	11544
3	-5669	11562	11588	-5630	11484	11510
4	-5635	11572	11607	-5610	11522	11557

The estimation results for the three-segment solution – with and without demographic variables - are reported in Table 2.

Q.1-A. Model selection and specification: In the ketchup market, there are three major brands and four different package sizes. One of the brands – Heinz – clearly takes in a dominant market position and controls over 80% of the market. It is also the only brand for which different package sizes are available. Hence, as an alternative model specification, a nested logit model could be used, with brand choice decisions at the higher level and package size decisions at the lower model level. Compare both model specifications and discuss the *major* advantages and disadvantages of the multinomial logit model and nested logit model, *taking the research objective into account* (i.e., do not try to give a complete overview of each model's characteristics, but concentrate on the aspects that are most relevant for the problem concerned). Are there any other model improvements that could be made to obtain a better insight into the differences in sales promotion effectiveness across consumer segments?

Q.1-B. Estimation results: Discuss the estimation results. Which latent class approach would you prefer (with or without demographics included) and why?

Q.1-C. Managerial implications: The major objective of the analysis is to identify segments of consumers that differ in promotion reactions, and to derive implications for a differentiated sales promotion strategy. Suppose you are the marketing manager of Heinz; what are the major conclusions that can be derived from the model results and that may help to support future promotion decisions? Can the model be used to support market segmentation and targeting decisions? Illustrate with an example.

Question 2: Discuss the following statement:

"*To the extent that market shares are used as market performance indices, it is clearly desirable for the individuals concerned to have thorough knowledge of the processes which generate market-share figures and to be able to analyze the impact of their own actions on market share. Lacking such knowledge, one might be tempted to oversimplify the cause-and-effect relationships between market shares and marketing variables and fall into deadly traps of blindly competing for market shares for their own sake.*"

Do you agree with this statement? Indicate why (not). Using your knowledge on market-share analysis, explain why information on market share indices and their evolution over time (i.e. data on own and competitors' market shares in the present and previous periods) is (not) enough to assess a brand's market position and develop strategic marketing plans. Limit your answer to the (max.) 5 most important arguments, and *briefly* (in one or two sentences) explain why they are important.

Table 1
DESCRIPTIVE STATISTICS FOR CATSUP DATA

1a Brand Data

Brand	Share (%)	Average Price (¢/oz.)	Display[a]	Feature[b]
Heinz 64 oz.	3.9	4.59	.7	2.1
Heinz 40 oz.	7.6	4.80	2.5	2.2
Heinz 32 oz.	43.6	3.33	5.9	10.7
Heinz 28 oz.	25.6	4.50	6.1	7.2
Hunts 32 oz.	13.8	3.47	5.6	5.6
Del Monte 32 oz.	5.5	3.49	4.3	5.6

1b Demographic Data[c]

Variable	Estimation Sample Mean	Validation Sample Mean
Income	6.59	6.71
Household size	3.16	3.23
Average age of heads of household	48.06	48.68
Number of households	709	236

[a,b]Percentage of purchases made on Display and Feature respectively.
[c]Income is coded as 1 = less than $5,000; 2 = $5,000–$10,000; 3 = $10,000–$15,000, and so on.

Table 2a
PARAMETER ESTIMATES AND (*t*-RATIOS)
THREE-SEGMENT SOLUTION[a]

	Without Demographics			With Demographics		
Variable	Segment 1	Segment 2	Segment 3	Segment 1	Segment 2	Segment 3
Heinz 64	−.403	6.570	.797	−.394	6.522	.759
	(−1.345)	(6.414)	(1.468)	(−1.320)	(6.398)	(1.344)
Heinz 40	1.877	5.877	4.395	1.861	5.830	4.386
	(12.406)	(5.681)	(13.427)	(12.183)	(5.663)	(13.481)
Heinz 32	2.380	4.567	2.654	2.377	4.558	2.647
	(30.164)	(4.541)	(8.711)	(30.079)	(4.536)	(8.705)
Heinz 28	2.709	4.948	5.377	2.714	4.924	5.363
	(22.639)	(4.825)	(16.559)	(22.547)	(4.821)	(16.680)
Hunts 32	.964	2.705	2.231	.957	2.659	2.256
	(10.593)	(2.622)	(7.084)	(10.254)	(2.571)	(7.147)
Price	−1.898	−1.057	−1.242	−1.899	−1.043	−1.231
	(−31.465)	(−6.461)	(−11.300)	(−31.856)	(−6.453)	(−11.375)
Display	1.062	.831	1.027	1.068	.843	1.043
	(9.489)	(2.900)	(5.792)	(9.564)	(2.929)	(5.906)
Feature	1.171	.588	.425	1.165	.607	.434
	(13.494)	(2.469)	(2.475)	(13.353)	(2.559)	(2.558)
Segment size	.653	.080	.267	.621	.135	.244
−LL		5649			5630	
ρ^2		.438			.440	
$\bar{\rho}^2$		.440			.443	
Number of parameters		26			32	
Likelihood ratio statistic					38[b]	

[a]Del Monte 32 was treated as the base brand.
[b]χ^2-value significant at the 5% level of significance.

ρ^2 = Pseudo $R^2 = 1 - LL(\beta)/LL(\beta_0)$; with $LL(\beta)$=LL for model with explanatory variables, $LL(\beta_0)$=LL for model with constants only

Table 2b

PARAMETER ESTIMATES AND (*t*-RATIOS)
EFECTS OF DEMOGRAPHIC VARIABLES ON SEGMENT MEMBERSHIP PROBABILITIES[a]

	Without Demographics		*With Demographics*	
Variable	*Segment 1*	*Segment 2*	*Segment 1*	*Segment 2*
Intercept	.893[b]	−1.214[b]	.886	−1.070
	(6.514)	(−6.525)	(1.400)	(−.984)
Income			−.168[b]	−.082
			(−4.535)	(−1.328)
Household size			.167[c]	.356[b]
			(1.810)	(2.530)
Age			.014	−.016
			(1.482)	(−.933)

[a]Segment 3 is treated as the "base" segment.
[b]Significant at the 5% level of significance.
[c]Significant at the 10% level of significance.

Predictive validity, based on holdout sample of households:

	Without demographics	With demographics
LL	-1953.55	-1950.26
ρ^2	.445	.446
Hit rate (% correct prediction)	62%	62%