Overview: Kamakura, Russell. A Probabilistic Choice Model for Market Segmentation and Elasticity Structure. 1989, JMR.

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Major contributions

- A landmark paper that performs preference-based segmentation using purchase history data for four brands/groups of brands, at the household level. 1290 citations – in various works on customer and brand equity, customer heterogeneity, market structure identification, etc.

- The model is a discrete choice 'latent-class' model, where heterogeneity is attributed to individuals' membership in different segments. Individuals are assumed to be homogenous (shared price sensitivity and brand utility) within a segment. [Eq. 4, 7, 6]

$$(4) \quad P_j(\mathbf{u}_i, \beta_i, \mathbf{X}_{kt}) = \exp(u_{ji} + \beta_i X_{jkt}) \bigg/ \sum_{j'} \exp(u_{j'i} + \beta_i X_{j'kt}).$$

$$(7) \qquad L(H_k|i) = \prod_t P_{c(t)}(\mathbf{u}_i, \beta_i, \mathbf{X}_{kt}).$$

$$(6) \qquad L(H_k) = \sum_i \left[\exp(\lambda_i) L(H_k|i) \bigg/ \sum_{i'} \exp(\lambda_{i'}) \right]$$

(i – segment; k – individual; t – time; j – brand; u – brand utility; β – price coefficient.; λ – segment membership parameter)

- Paper shows how price elasticity within and between segments [Eq. 9-12], elasticity-based measures (competitive clout, vulnerability – p. 386), and segment membership metrics capture rich information about the structure of the market, demand, and brand's position. (η_{ji} – elasticity, % change in j's share with 1% change in i's price)

Competitive clout – scale of market share brand i takes away from competitors by changing own price. *Vulnerability* – how much other brands steal from i by changing their prices.

$$\text{Competitive Clout}_i = \sum_{j \neq i} \eta_{ji}^2 \qquad \text{Vulnerability}_i = \sum_{j \neq i} \eta_{ij}^2$$

Note: In elasticity calculation, a special correction is used – to account for the fact that individuals within segments are not completely homogenous. The correction has the same effect as if the elasticity values were aggregated across individuals. However, it is only valid under a restrictive assumption discussed in Weaknesses section.

Strengths

- Model strikes a balance between the need to capture heterogeneity and simplicity, producing a few easy-to-analyze homogenous segments, which are different between each other. (Number of segments selected based on AIC).
- Validity heuristic: estimated choice shares correspond to actual market shares [p. 386].
- Model is easy to estimate using gradient descent methods. [Appendix A]

Weaknesses

- Not clear how reliable the elasticity estimates are, given that customers are not completely homogenous within segments – even after a correction.
- Heterogeneity correction assumes, within a segment, independence between individual's price sensitivity and his preference for a brand, which is not very realistic. [Eq. 13-16, Appendix B]
- Model assumes independence of errors over time. Trend enters only through exogenous price.
- "Loyal" segments manually identified and excluded from model estimation.
- Model only includes price as an exogenous factor.

Possible improvements, future work

- Explicitly model time-dependence.
- More directly incorporate heterogeneity within segments.
- Use more covariates, beyond price.
- No custom filtering out of users without switching behavior?
- Explore segment-specific brand utility u_{ij} in descriptive analysis, by expressing and estimating it as a function of segment specific tastes.
- Get sales elasticity (vs. choice share elasticity, as currently done)

Table 2
PARAMETER ESTIMATES FOR FIVE-SEGMENT SOLUTION[a]

	Segment 1	Segment 2	Segment 3	Segment 4	Segment 5
Intrinsic brand utilities					
A	4.153	2.182	1.605	3.811	.035[b]
	(.419)	(.293)	(.243)	(.430)	(.320)
B	.562	2.185	−.198	.651	.856
	(.271)	(.213)	(.090)	(.160)	(.230)
C	0	0	0	0	0
	Fixed	Fixed	Fixed	Fixed	Fixed
P	−.825	−1.171	−2.963	−1.356	1.055
	(.343)	(.362)	(.189)	(.258)	(.217)
Price sensitivity					
β	−1.874	−1.436	−3.065	−5.424	.366[b]
	(.355)	(.223)	(.238)	(.446)	(.213)
Segment size					
λ	−1.019	−.975	0	−.452[b]	−1.247
	(.221)	(.229)	Fixed	(.293)	(.249)

[a]Standard errors are in parentheses. Parameters constrained to zero are denoted as "fixed." Segment size is defined relative to all switching segments.
[b]Parameter statistically *insignificant* at the .05 level.

Figure 2
COMPETITIVE CLOUT VERSUS VULNERABILITY FOR TOTAL MARKET
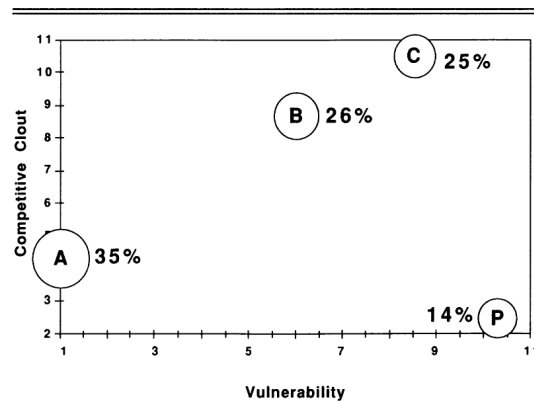
Table 3
PREFERENCE SEGMENTATION AND PRICE SENSITIVITY

	Loyal segments				Switching segments[a]				
	A	B	C	P	1	2	3	4	5
Choice probabilities									
A	1				.790	.219	.152	.095	.192
B		1			.089	.646	.259	.238	.332
C			1		.069	.092	.520	.301	.133
P				1	.052	.043	.065	.367	.343
Segment size (% of all households)									
	19.0	5.8	3.9	2.7	9.3	9.7	25.8	16.4	7.4
Price sensitivity									
β					−1.87	−1.44	−3.07	−5.42	.37[b]

[a]For switching segments 1 through 4, purchase probabilities greater than .10 are underlined.
[b]Price coefficient statistically *insignificant* at the .05 level.