



# Loss Aversion Estimation in Brand Choice Using MCMC

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MACSS 2021', Social Science Division, University of Chicago



## Research Question

Does Loss Aversion exists in brand choice settings?

## Introduction

- Expected Utility Theorem: People's utility is based on the overall gain or loss.
- Prospect Theory: People make decisions based on gain or loss regarding a reference point, and loss always cause a stronger effect on the utility than gain(loss aversion).
- A main stream of literature are focusing on empirically finding the reference point(Homonoff, 2018; Pope & Schweitzer, 2011; Allen, Dechow, Pope, & Wu, 2017)
- Considering heterogeneity(individual differences) may lead to a totally different result, loss aversion may not exist at all, as shown in (Bell & Lattin, 2000)

## Heterogeneity Concerns - MCMC

- A more price-responsive consumer (with a steeper response function) tends to have a lower price level as a reference point. This consumer faces a larger proportion of prices above his reference point, thus the response curve is steeper in the domain of losses.
- Mixture of Normal Priors to run the MCMC sampler, where  $\theta_i = (\alpha_{ij}, \beta_{1i}, \beta_{2i}, \beta_{3i}, \beta_{4i})$  follows a multivariate normal distribution and the prior on  $V_\theta$  is inverted Wishart.

$$\theta \sim N(\theta, V_\theta)$$

$$V_\theta \sim IW(v, V)$$

## Multinomial Logit Model

$$V_{ijt} = \alpha_{ij} + \beta_{1i}Feat_{jt} + \beta_{2i}Disp_{jt} + \beta_{3i}GAIN_{ijt} + \beta_{4i}LOSS_{ijt}$$

- $\alpha_{ij}$  is the intercept for each brand, representing the initial value of brand j to individual i
- $\beta_{1i}, \beta_{2i}, \beta_{3i}, \beta_{4i}$  are the marginal utility of brand's feature, display, gain and loss.
- $\beta_{3i} < \beta_{4i}$  constitutes the evidence for loss aversion. GAIN and LOSS are the gain or the loss that consumers receive when the price is below or above the reference price.
- After the model is set up, I could use this model to represent the choice making process. Based on the multinomial logit choice model, the probability that consumer i choose brand j at time t can be represented by:

$$P_{it}(j) = \frac{e^{V_{ijt}}}{\sum_k e^{V_{ikt}}}$$

## Assuming homogeneity

Table 3: Cracker Market Estimation Results

	Null	Reference-Dependent Model	
		Memory-based	Stimulus-based
nabisco:(intercept)	1.962 (0.072)***	2.053 (0.074)***	1.681 (0.074)***
private:(intercept)	0.169 (0.117)	0.788 (0.117)***	0.397 (0.117)***
sunshine:(intercept)	-0.494 (0.101)***	-0.306 (0.102)**	-0.370 (0.101)***
price	-3.125 (0.209)***	-	-
disp	0.092 (0.062)	0.285 (0.071)***	0.277 (0.074)***
feat	0.496 (0.095)***	0.652 (0.112)***	0.679 (0.117)***
gain	-	-2.801 (0.279)***	-1.773 (0.270)***
loss	-	-6.585 (0.262)***	-8.078 (0.319)***
AIC	6707.427	5390.533	5024.146
Log Likelihood	-3347.713	-2688.267	-2505.073
Num. obs.	3292	3292	3292

\*\*\*p < 0.001, \*\*p < 0.01, \*p < 0.05

Table 4: Yogurt Market Estimation Results

	Null	Reference-Dependent Model	
		Memory-based	Stimulus-based
hiland:(intercept)	-3.716 (0.145)***	-3.414 (0.164)***	-2.713 (0.166)***
weight:(intercept)	-0.641 (0.054)***	-0.616 (0.055)***	-0.572 (0.056)***
yoplait:(intercept)	0.735 (0.081)***	1.246 (0.081)***	0.898 (0.088)***
price	-0.367 (0.024)***	-	-
feat	0.491 (0.120)***	0.606 (0.136)***	0.860 (0.149)***
gain	-	-0.158 (0.028)***	-0.266 (0.034)***
loss	-	-1.024 (0.037)***	-1.099 (0.045)***
AIC	5323.776	4230.342	3926.072
Log Likelihood	-2656.888	-2109.171	-1957.036
Num. obs.	2412	2412	2412

\*\*\*p < 0.001, \*\*p < 0.01, \*p < 0.05

## Assuming heterogeneity

Table 7: Correlation Matrix-Cracker Market (Memory-based)

	Std Dev	feature	display	gain	loss
feature	0.97	1.00	0.23	-0.38	0.40
display	1.12	0.23	1.00	-0.40	0.71
gain	4.55	-0.38	-0.40	1.00	-0.71
loss	6.28	0.40	0.71	-0.71	1.00

Table 9: Correlation Matrix-Yogurt Market (Memory-based)

	Std Dev	feature	gain	loss
feature	1.33	1.00	-0.27	0.047
gain	0.70	-0.272	1.00	0.388
loss	0.65	0.047	0.39	1.000

## Limitations & Future Research

- Data access is limited in the Yogurt and Cracker Market
- The reference point is limited in the price.
- Future research could detect the existence of loss version in other areas other than price(time, seat availability, review loss aversion)

## Conclusion

- Reference point and loss aversion would be shown empirically true using the multinomial logit choice model assuming all the people are the same.
- Taking heterogeneity concerns using MCMC Sampler with mixture normal setting would lead to a reduction or even disappear of the Loss Aversion.
- The promotion activities in the store could possibly make people less sensitive about the price change.

## References

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## Acknowledgement

I sincerely thank Dr. Rick Evans and all classmates of MACS 30250 for helpful comments and suggestions

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