University of Rochester – Simon Business School

Spring A Semester

MKT 440 Pricing Analytics

Project 2

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1. Introduction

In this project, we are supposed to do the profit maximization with multi-segment and multi-product for the sake of analyzing the best pricing strategy for the new product “Kiwi Bubbles”. Under the assumption that the unit costs are all \$0.5 and market size is 1000 consumers, the data set we had records the choices of soft drink of 359 consumers over the course of 3 years. More details about how we manipulated the logit model are as follows.

2. Logit model without segmentation

When we assume that β_0^j and β_1 are common across consumers. In this case, the model collapses to a simple multinomial logit model and the code output is shown as below:

```
Coefficients:
                Estimate Std. Error z-value  Pr(>|z|)
KB:(intercept)  4.25316    0.32821  12.959 < 2.2e-16 ***
KR:(intercept)  4.36240    0.32945  13.241 < 2.2e-16 ***
MB:(intercept)  4.20440    0.31331  13.419 < 2.2e-16 ***
price          -3.73793    0.23671 -15.791 < 2.2e-16 ***
---
```

Next, the choice probability of each product is generated:

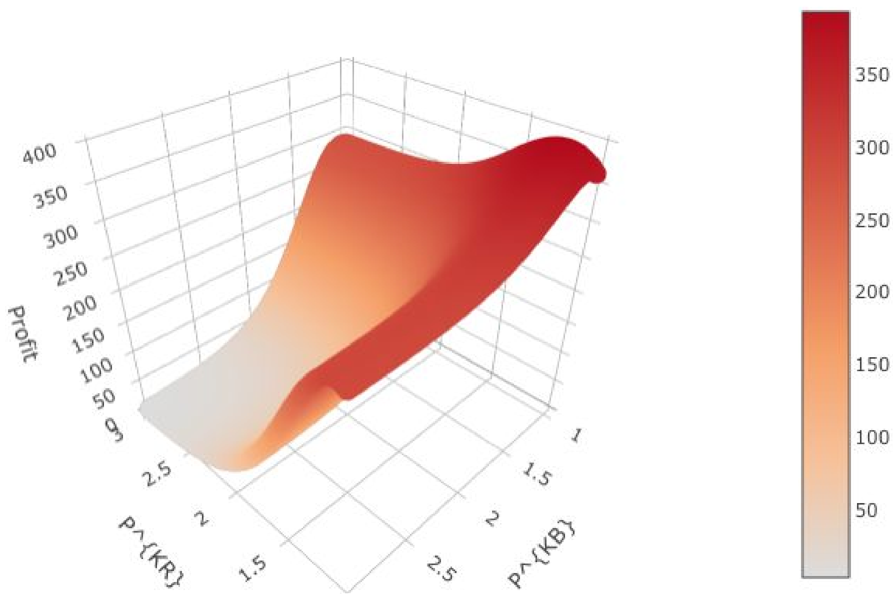
```
  prob_KB   prob_KR   prob_MB
0.1753666 0.1979974 0.1908972
```

We then can calculate own- elasticity of each product and cross-price elasticity for different combinations of products. For own- elasticity, Kiwi Bubbles(KB) has 4.25784, Kiwi Regular(KR) has 4.13126, and Mango Bubble(MB) has 4.06954. This means that one percent change in price will result in 4.25784% changes in the probability of purchase on Kiwi Bubbles, 4.13126% changes on KR and 4.06954% on MB. On the other hand, KB’s cross-price elasticity is 0.905474, KR’s is 1.019923 and 0.960156 for

MB, which means when price of KB moves by 1 percent, the percent change in choice probability of KR/MB is 0.905474%. Same applies to KR and MB.

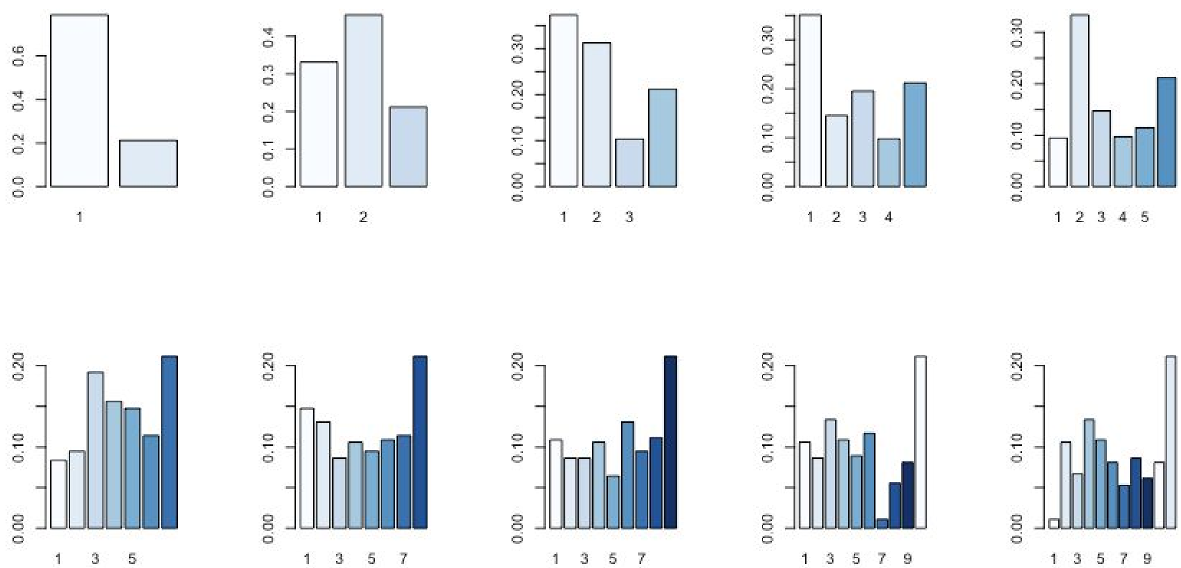
The obvious pattern in this case is that these elasticities are all positive, indicating that these products are substitutes for each other. The highest cross elasticity comes from KR on MB/KB, meaning that consumers prefer bubbles over regular drinks. On the contrary, consumers favor KB over MB/KR because cross elasticity of KB to KR/MB is the lowest.

We can also plot the company's profit distribution over KR and KB's prices and then find the spot where the profit is maximized. That is, when KR and KB are both priced at $1.16, the profit is maximized at $393.4082.



3. Logit model with segmentation

Now, consumers are heterogeneous with different demographics, so we estimate multinomial logit models separately for each segment of consumers. After using a for loop testing the segment shares all plotted in one figure, we observe that having more than 9 segments will lead to a great segment shares imbalance. So we end up having 8 clusters and 9 segments.



Moreover, we merge the sales data with clustered segmentation ID and use multinomial logit model to calculate coefficients for each segment. Afterward, we generate the WTP of each product as well as the consumers' preference in each segmentation.

segment	intercept.KB	intercept.KR	intercept.MB	price.coef	WTP.KB	WTP.KR	WTP.MB	preference
1	2.3336806	3.112574	2.9252012	-2.896447	0.8057045	1.074618	1.009927	KR
2	2.9694016	3.867674	2.7276100	-2.909001	1.0207634	1.329554	0.937645	KR
3	7.6063946	6.661934	7.4775392	-5.897474	1.2897715	1.129625	1.267922	KB
4	7.3034174	7.138563	7.1181389	-5.793619	1.2605969	1.232142	1.228617	KB
5	3.9972969	3.958938	3.8837551	-3.715366	1.0758823	1.065558	1.045322	KB
6	3.8689983	4.354056	4.0523865	-3.502896	1.1045141	1.242987	1.156867	KR
7	4.8086045	4.606528	5.6294806	-4.517302	1.0644860	1.019752	1.246204	MB
8	0.9169255	1.673183	0.4573439	-1.251711	0.7325376	1.336716	0.365375	KR
9	5.1174301	4.509340	4.5449628	-4.062526	1.2596670	1.109984	1.118753	KB

Then we compute the own- and cross price elasticity of these products. On the product level, we use the method of weighted average in our calculation. The own price elasticity of KB, KR and MB is displayed as following:

KB_seg_own	KR_seg_own	MB_seg_own
4.378103	3.634095	4.278458

When it turns to cross price elasticity:

	from KB	from KR	from MB
to KB	NA	0.9130573	1.0755919
to KR	0.8129505	NA	0.8283068
to MB	1.0396138	0.8991862	NA

There exists a great difference on own price elasticity, cross price elasticity, and consumers' willingness to pay between having segmentation or not. Without segmentation, we can see very little difference between each products' own elasticity. However, under segmentation, according to both own and cross product elasticity of each product, we can see that the rank of price sensitivity is clearly KB > MB > KR. Furthermore, after looking at the cross elasticity after segmentation, we can conclude that KB is a closer substitute of both MB and KR, and KB's closer substitute is MB.

Also, according to the willingness to pay value that we generated by dividing each product's coefficient by the price coefficient, we conclude that having segmentation can help us better understand consumers' preference. In our matrix, we can clearly see that segment 1,2,6,8 prefer KR, segment 3,4,5,9 prefer KB, and segment 7 prefer MB. From the substitution pattern and underlying segmentation, we believe that Kiwi Bubbles should be positioned in segment 3,4,5,9.

When Mango Bubbles is priced at $1.43 and does not react to Kiwi's pricing, on the condition that KB does not show on the market, then the optimal price of KR is $1.06

with maximum profit of $289.9052. Then, if we do launch Kiwi Bubbles, then the optimal price of KB is $1.15 and that of KR is $1.19, reaching a total profit of $395.3924. In addition, the profit for Mango company drops from $106.60 to $90.15 as a result of the launch. Clearly, the profit of Kiwi increases as the profit of Mango decreases after the launch of KB. Nevertheless, there comes a disadvantage of launching KB besides just increasing the profit. The cannibalization happens when the company sells two products concurrently, and this can be proved by that the market share of KR goes down after selling KB.

4. Understanding strategic responses

Given that the price of KB is $1.15 and that of KR is $1.19, if Mango reacts to Kiwi's pricing strategy, then it will set a new optimal price to make a greater profit. The methodology used here is the same as previous questions: finding a price that generates the highest profit in the profit function that is derived by using unit costs, market size and choice probability.

As for the result, Mango will price at $0.96 in a response to KB's $1.15 and KR's $1.19 unit price and obtain a higher profit of $180.4173. However, Kiwi will then again set a new optimal price corresponding to MB's, that is, KB at $1.02 and KR at $1.08. Repeatedly, Mango lowers its price to $0.92. Then, KB will lower its price to $1.01 and KR will lower its price to $1.07 in order to achieve the highest profit of $263.1639. Again, Mango further lowers its price to $0.91. Consequently, KB is $1 and KR is $1.07. Eventually, MB no longer lowers its price because it can still maximize its profit at MB = $0.91 with a profit of $143.3983. Therefore, this pricing war ends up with KB = $1, KR = $1.07, MB = $0.91 and Kiwi is making a profit of $259.7019 as Mango has a profit of $143.3983.

If Kiwi does not launch KB, in the ‘pricing war’ scenario, it will start at KR = $1.06 and MB priced at $0.98 as a reaction. Analogously to the above, this case will stop at MB = $0.96 with profit of $178.0638 and KR = $0.97 with profit of $190.4437.

From the profit aspect, it is fair to say that launching Kiwi Bubbles still plays a role as profit booster, where we can see from the pricing war scenario that the profit increases from $190.4437 to $259.7019, so KB’s strategic advantage keeps the same.