**Pricing Analytics Project 2:**

**Kiwi Bubbles**

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**3. Logit model without segmentation**

**Answer to question 3-1:**

Call:

gmnl(formula = choice ~ price, data = mlogitdata, method = "nr")

Frequencies of categories:

0 KB KR MB

0.41564 0.18035 0.20039 0.20362

The estimation took: 0h:0m:0s

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 \*\*\*

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Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Optimization of log-likelihood by Newton-Raphson maximisation

Log Likelihood: -1909

Number of observations: 1547

Number of iterations: 4

Exit of MLE: gradient close to zero (gradtol)

The intercept for KB is 4.253, the intercept for KR is 4.362, and the intercept for MB is 4.204. The interpretation of those intercepts meanswhen price is not a factor, KR is most preferred option among consumers. The second is KB is slightly lower than KR, but still shows strong preferences among the consumers. MB has the least appeal compared to other two drinks.

The coefficient for Price is -3.738. This coefficient is negative, meaning that as the price increases, the probability of choosing KB, KR, or MB decreases relative to the reference category (not buying any product).

**Answer to question 3-2:**

Now let's compute the elasticity. For instance,

> #own-elasticity for KB is given by the following formula.

> eKB=-coef[4]\*meanPKB\*(1-demand(meanPKB,meanPKR,meanPMB,coef)[1])

> print(eKB)

price

4.257847

>

> # own-elasticity for MB

> eMB=-coef[4]\*meanPMB\*(1-demand(meanPKB,meanPKR,meanPMB,coef)[3])

> print(eMB)

price

4.069547

>

> # own-elasticity for KR

> eKR=-coef[4]\*meanPKR\*(1-demand(meanPKB,meanPKR,meanPMB,coef)[2])

> print(eKR)

price

4.13127

>

> #Cross-elasticity is as follow:

>

> # Cross-price elasticity of KB with respect to KR

> eKB\_KR = -coef[4] \* meanPKR \* (-demand(meanPKB, meanPKR, meanPMB, coef)[1])

> print(eKB\_KR)

price

-0.9033471

>

> # Cross-price elasticity of KB with respect to MB

> eKB\_MB = -coef[4] \* meanPMB \* (-demand(meanPKB, meanPKR, meanPMB, coef)[1])

> print(eKB\_MB)

price

-0.8820421

>

> # Cross-price elasticity of KR with respect to KB

> eKR\_KB = -coef[4] \* meanPKB \* (-demand(meanPKB, meanPKR, meanPMB, coef)[2])

> print(eKR\_KB)

price

-1.022324

>

> # Cross-price elasticity of KR with respect to MB

> eKR\_MB = -coef[4] \* meanPMB \* (-demand(meanPKB, meanPKR, meanPMB, coef)[2])

> print(eKR\_MB)

price

-0.9958681

>

> # Cross-price elasticity of MB with respect to KB

> eMB\_KB = -coef[4] \* meanPKB \* (-demand(meanPKB, meanPKR, meanPMB, coef)[3])

> print(eMB\_KB)

price

-0.9856638

>

> # Cross-price elasticity of MB with respect to KR

> eMB\_KR = -coef[4] \* meanPKR \* (-demand(meanPKB, meanPKR, meanPMB, coef)[3])

> print(eMB\_KR)

price

-0.9833483

Own-elasticity for three products are all relatively positive larger numbers, they are above 4. This pattern means the demand for each product is elastic and customers are highly price-sensitive. But the cross-elasticity among the different combinations are always less or equal to 1, which means the substitution effect is weak(customers don’t see KR, KB, MB as closely interchangeable options). We believe this pattern is not reasonable because when we compare the average prices for those three products, they are about the same, as the average price for KB is 1.38, the average price for KR is 1.37, and the average price for MB is 1.35. When the customers are highly price sensitive and price is similar, there should have relatively strong substitution effect among those three products.

**Answer to question 3-3:**

priceKB priceKR profitKB profitKR profitMB

1.16 1.16 185.9703 207.4379 90.96987

The optimal price is when both KB's and KR’s prices are equal to $1.16. At this time, the profit from KB is $185.9703, and the profit from KR is $207.4379, which is the maximizing point combined profit of KB and KR.

**4. Logit model with segmentation**

**Answer to question 4-1：**

Number of consumers in each cluster

1 2 3 4 5 6 7 8 9

134 153 192 108 154 138 188 170 310

>print( coef.est)

segment intercept.KB intercept.KR intercept.MB price.coef

1 1 4.8086045 4.606528 5.6294806 -4.517302

2 2 7.6063946 6.661934 7.4775392 -5.897474

3 3 3.9972969 3.958938 3.8837551 -3.715366

4 4 0.9169255 1.673183 0.4573439 -1.251711

5 5 3.8689983 4.354056 4.0523865 -3.502896

6 6 7.3034174 7.138563 7.1181389 -5.793619

7 7 2.9694016 3.867674 2.7276100 -2.909001

8 8 2.3336806 3.112574 2.9252012 -2.896447

9 9 5.1174301 4.509340 4.5449628 -4.062526

> print(se.est)

segment intercept.KR intercept.KB intercept.MB price.coef

1 1 0.9757281 1.0153068 0.9859348 0.7443662

2 2 1.2997750 1.2672386 1.2056128 0.9153745

3 3 1.0251813 1.0418099 0.9768280 0.7396875

4 4 1.2602622 1.2613514 1.2294465 0.9010553

5 5 1.0160777 1.0089534 0.9522238 0.7287503

6 6 1.2588967 1.2601639 1.1690295 0.9026297

7 7 0.9978553 1.0097375 0.9613426 0.7205029

8 8 0.9960500 0.9800162 0.9709998 0.7182448

9 9 0.7629470 0.7523309 0.7194521 0.5451899

**Answer to question 4-2:**

Own price elasticity

> elasticity\_KB= -(meanPKB/ demand.agg(meanPKB,meanPKR,meanP​​MB,coef.est,segshare)[1])\*sum(segshare\*coef.est[,5]\*demand.seg(meanPKB, meanPKR, meanPMB, coef.est)[,1]\*(1-demand.seg(meanPKB, meanPKR, meanPMB, coef.est)[,1]))

> elasticity\_KB

[1] 4.378103

> #own price elasticity for KR

> elasticity\_KR= -(meanPKR/demand.agg(meanPKB,meanPKR,meanPMB,coef.est,segshare)[2])\*sum(segshare\*coef.est[,5]\*demand.seg(meanPKB, meanPKR, meanPMB, coef.est)[,2]\*(1-demand.seg(meanPKB, meanPKR, meanPMB, coef.est)[,2]))

> elasticity\_KR

[1] 3.634095

> #own price elasticity for MB

> elasticity\_MB= -(meanPMB/demand.agg(meanPKB,meanPKR,meanPMB,coef.est,segshare)[3])\*sum(segshare\*coef.est[,5]\*demand.seg(meanPKB, meanPKR, meanPMB, coef.est)[,3]\*(1-demand.seg(meanPKB, meanPKR, meanPMB, coef.est)[,3]))

> elasticity\_MB

[1] 4.278458

> elasticity\_KB\_KR = -(meanPKR / demand.agg(meanPKB, meanPKR, meanPMB, coef.est, segshare)[1]) \*

+ sum(segshare \* coef.est[,5] \* demand.seg(meanPKB, meanPKR, meanPMB, coef.est)[,1] \*

+ demand.seg(meanPKB, meanPKR, meanPMB, coef.est)[,2])

> elasticity\_KB\_KR

[1] 0.9130573

>

> # Cross-price elasticity of KB with respect to MB

> elasticity\_KB\_MB = -(meanPMB / demand.agg(meanPKB, meanPKR, meanPMB, coef.est, segshare)[1]) \*

+ sum(segshare \* coef.est[,5] \* demand.seg(meanPKB, meanPKR, meanPMB, coef.est)[,1] \*

+ demand.seg(meanPKB, meanPKR, meanPMB, coef.est)[,3])

> elasticity\_KB\_MB

[1] 1.075592

>

> # Cross-price elasticity of KR with respect to KB

> elasticity\_KR\_KB = -(meanPKB / demand.agg(meanPKB, meanPKR, meanPMB, coef.est, segshare)[2]) \*

+ sum(segshare \* coef.est[,5] \* demand.seg(meanPKB, meanPKR, meanPMB, coef.est)[,2] \*

+ demand.seg(meanPKB, meanPKR, meanPMB, coef.est)[,1])

> elasticity\_KR\_KB

[1] 0.8129505

>

> # Cross-price elasticity of KR with respect to MB

> elasticity\_KR\_MB = -(meanPMB / demand.agg(meanPKB, meanPKR, meanPMB, coef.est, segshare)[2]) \*

+ sum(segshare \* coef.est[,5] \* demand.seg(meanPKB, meanPKR, meanPMB, coef.est)[,2] \*

+ demand.seg(meanPKB, meanPKR, meanPMB, coef.est)[,3])

> elasticity\_KR\_MB

[1] 0.8283068

>

> # Cross-price elasticity of MB with respect to KB

> elasticity\_MB\_KB = -(meanPKB / demand.agg(meanPKB, meanPKR, meanPMB, coef.est, segshare)[3]) \*

+ sum(segshare \* coef.est[,5] \* demand.seg(meanPKB, meanPKR, meanPMB, coef.est)[,3] \*

+ demand.seg(meanPKB, meanPKR, meanPMB, coef.est)[,1])

> elasticity\_MB\_KB

[1] 1.039614

>

> # Cross-price elasticity of MB with respect to KR

> elasticity\_MB\_KR = -(meanPKR / demand.agg(meanPKB, meanPKR, meanPMB, coef.est, segshare)[3]) \*

+ sum(segshare \* coef.est[,5] \* demand.seg(meanPKB, meanPKR, meanPMB, coef.est)[,3] \*

+ demand.seg(meanPKB, meanPKR, meanPMB, coef.est)[,2])

> elasticity\_MB\_KR

[1] 0.8991862

As all the own price of elasticity greater than 1, indicating that the demand for the products is elastic. In the segmentation case, the own price elasticity increases for KB and MB, and decreases for KR. KB and MB have become more price-sensitive in the segmentation model, suggesting that their customers are more responsive to price changes. At the same time, KR has become less elastic, meaning customers are less likely to switch away from KR when its price increases. This suggests stronger brand differentiation or loyalty for KR after segmentation.

When comparing the cross elasticity, we found:

1.KR has become more differentiated – Before segmentation, KR had a higher cross-elasticity with KB and MB, meaning it was seen as a strong substitute. After segmentation, its cross-elasticity decreased, suggesting consumers see it as a distinct product with reduced competition from KB and MB.

2.KB and MB have a stronger relationship – Their cross-elasticity has increased, meaning they now influence each other’s demand more than before. This could indicate that segmentation has positioned them as closer substitutes.

3. Cross-elasticities flipped from negative to positive in many cases, meaning that products that were once direct substitutes may now have more complementary demand dynamics or independent demand structures.

4.KR is now less affected by price changes of KB and MB, meaning it might cater to a more loyal or niche market post-segmentation.

KB and MB are now closer substitutes than in the no-segmentation case, as their cross-price elasticity increased and was greater than 1 in the segmentation case. As the cross elasticity decreases for KR with other two products, KR has become less of a direct substitute for KB and MB, meaning segmentation has effectively differentiated KR from the rest of the market.

**Answer to question 4-3:**

#### Among all segments, segments 2, 6, and 9 prefer KB over KR since they have a higher intercept for KB. Segments 4, 5, 7, and 8 prefer KR over KB and MB is most preferred in segments 1, 2, and 6.

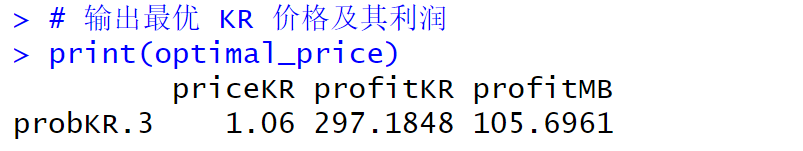
The Most price-sensitive segments are Segments 2 and 6 because they have the highest price coefficients. Moderately price-sensitive: Segments 1, 5, and 9. And the least price-sensitive segment is Segment 4, suggesting they prioritize quality or brand loyalty.

KB and MB became stronger substitutes as we found that they have a higher cross-elasticity, meaning price-sensitive consumers switch between them. The underlying segment explanations are that the KB and MB preferences in segments 2, 6, and 9 are close, and they are also price sensitive (the coefficient for price is bigger than 4), so they can switch between KB and MB when those two products have some price changes.

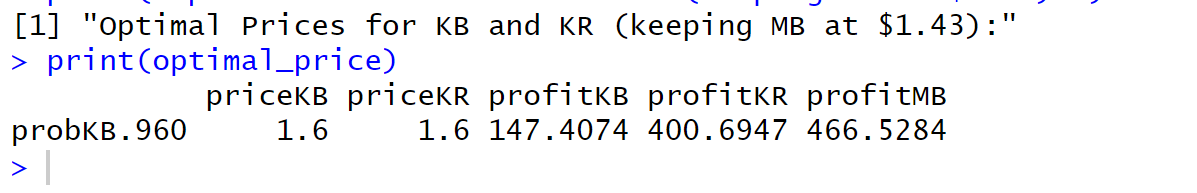
We believe KB should be positioned in Segments 2, 6, and 9 (high KB preference, high price sensitivity). They can Compete on price and promotions to capture price-sensitive consumers.

Based on the analysis, segments 2, 6, 1, and 9 are highly price-sensitive, meaning they are more likely to switch products when prices change. Segments 2 and 9 have a strong preference for Kiwi Bubbles (KB) over Kiwi Regular (KR), suggesting a loyal customer base for KB. In contrast, segments 1 and 6, despite being price-sensitive, do not show as strong a preference for KB, making them more likely to switch if KB becomes too expensive. To effectively position KB, the brand should focus on segments 2 and 9, as they are already inclined to choose KB, ensuring strong retention. Meanwhile, for price-sensitive groups like 1 and 6, KB should maintain competitive pricing to prevent switching to alternatives. Additionally, less price-sensitive segments (such as segment 7) could be targeted with a premium positioning strategy to further enhance KB’s market reach. In conclusion, KB should be positioned to attract its most loyal customers while balancing pricing strategies to retain price-sensitive consumers and maximize profitability.

**Answer to question 4-4:**

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The optimal price for Kiwi Regular (KR) is $1.06, maximizing its profit to $297.18.



Launching Kiwi Bubbles (KB) at $1.60, while Kiwi Regular (KR) at $1.60 increases total Kiwi profit by $250.92 and Mango Bubbles (MB) profit by $360.83. The results support the previous positioning strategy, confirming that segments 2 and 9, as loyal KB customers, are willing to pay a premium, while segments 1 and 6 may require competitive pricing or promotions to prevent switching. Additionally, segment 7 can be targeted with a premium strategy. However, MB’s unexpectedly high profit surge suggests stronger synergies with KB than initially assumed, requiring a reassessment of MB’s role. While KB's launch supports the original strategy, pricing adjustments may be needed to maximize profitability across all consumer segments.

**5. Understanding Strategic Responses**

**Answer to question 5-1:**

**> cat("Mango's optimal price for MB:", optimal\_price\_MB, "\n")**

**Mango's optimal price for MB: 1**

**The optimal price of MB, , given KB’s prices of $1.15 and KR’s price of $1.17 is $1. It means MB setting the price to $1 to maximize the profit.**

**Answer to question 5-2:**

**> cat("Optimal price for Kiwi Bubbles (KB):", optimal\_KB, "\n")**

**Optimal price for Kiwi Bubbles (KB): 1.04**

**> cat("Optimal price for Kiwi Regular (KR):", optimal\_KR, "\n")**

**Optimal price for Kiwi Regular (KR): 1.08**

**In response to Mango’s new price, the price for KB is $1.04, KR is $1.08. These prices let Kiwi stay competitive while maximizing its profit given Mango’s pricing strategy.**

**Answer to question 5-3:**

**Answer to question 5-4:**