Homework 1

BAX 442-01
Advanced Statistics
January 19, 2022
Group 6

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Introduction

Conjoint analysis is a technique that helps us understand how the customers value different features of a product or service. This technique allows us to determine the attribute importance, ideal product profiles, the price premium for brand names, and ultimately the optimal price in terms of profitability. This report will present the fundamental steps required to conduct this technique, followed by an actual illustration of the analysis done with our group members' data in assessing the importance of different features of a Flat-Panel TV. In this research, we have performed conjoint analysis using linear regression to estimate the importances of features. Our objective is to help with the design of a Flat-Panel TV based on the conjoint analysis results we obtain from our team members' data.

Methodology

The first step is to define the scope of the analysis. We need to consider essential attributes that are easy to describe and measure. The selected attributes are:

- Screen Size
- Screen Resolution
- Brand Name
- Price
- Attributes
- Willingness To Pay

The second step is to select the attribute levels we are interested in measuring. In a real-world scenario, the number of possible combinations is widely reduced by introducing only a couple of models that make sense for the business. In our report, we will consider the following levels:

- Screen Size: 85, 75, 65 inches
- Screen Resolution: 4k, 1k
- Brand Name: Sony, Sharp
- Price: Hi-Price ($2500), Lo-Price ($2000)

In total, we will measure 3 x 2 x 2 x 2 = 24 product profile combinations.

The third step is to collect preference data according to the profile combinations. In this report, each of our team members ranked different profiles from 24 to 1, where 24 is the most preferred, and 1 is the least preferred profile.

The following table shows the ranking results. On the left, we have the Design Matrix with all the different product profiles considered, and on the right, we have the preferences given by each of our

team members.

DESIGN MATRIX							RANKINGS				
Profile_num	Profiles	75 in	85 in	4K	Sony	High_price	Weishan	Gijeong	Claire	Minji	Joao
1	75, 1K, Sony, Lo Price	1	0	0	1	0	12	12	14	21	18
2	85, 1K, Sony, Lo Price	0	1	0	1	0	16	14	13	22	19
3	65, 1K, Sony, Lo Price	0	0	0	1	0	8	4	21	19	15
4	75, 4K, Sony, Lo Price	1	0	1	1	0	22	22	2	23	23
5	85, 4K, Sony, Lo Price	0	1	1	1	0	24	24	1	24	24
6	65, 4K, Sony, Lo Price	0	0	1	1	0	14	16	9	20	20
7	75, 1K, Sharp, Lo Price	1	0	0	0	0	11	11	16	15	14
8	85, 1K, Sharp, Lo Price	0	1	0	0	0	15	13	15	16	16
9	65, 1K, Sharp, Lo Price	0	0	0	0	0	7	3	22	13	13
10	75, 4K, Sharp, Lo Price	1	0	1	0	0	21	21	6	17	21
11	85, 4K, Sharp, Lo Price	0	1	1	0	0	23	23	5	18	22
12	65, 4K, Sharp, Lo Price	0	0	1	0	0	13	15	11	14	17
13	75, 1K, Sony, Hi Price	1	0	0	1	1	4	8	18	11	6
14	85, 1K, Sony, Hi Price	0	1	0	1	1	6	10	17	12	8
15	65, 1K, Sony, Hi Price	0	0	0	1	1	2	2	23	4	4
16	75, 4K, Sony, Hi Price	1	0	1	1	1	18	18	4	9	11
17	85, 4K, Sony, Hi Price	0	1	1	1	1	20	20	3	10	12
18	65, 4K, Sony, Hi Price	0	0	1	1	1	10	6	10	3	10
19	75, 1K, Sharp, Hi Price	1	0	0	0	1	3	7	20	5	2
20	85, 1K, Sharp, Hi Price	0	1	0	0	1	5	9	19	6	3
21	65, 1K, Sharp, Hi Price	0	0	0	0	1	1	1	24	1	1
22	75, 4K, Sharp, Hi Price	1	0	1	0	1	17	17	8	7	7
23	85, 4K, Sharp, Hi Price	0	1	1	0	1	19	19	7	8	9
24	65, 4K, Sharp, Hi Price	0	0	1	0	1	9	5	12	2	5

Design Matrix and Ranking Preferences

The last step is to analyze the collected data. We have several options to perform the analysis such as linear regression, maximum likelihood, or Bayesian methods. In this report, the chosen approach is linear regression.

Outputs and Interpretations

1. Partworths

Partworths	Coefficients				
	Weishan	Gijeong	Claire	Joao	Minji
Intercept	5.5	3.7	2.5	12.4	12.8
Screen 75 inch	5.5	8.0	5.5	2.1	4.0
Screen 85 inch	8.0	10.0	6.5	3.5	5.0
Resolution (4K=1)	10.0	9.3	12.0	5.2	0.8

Brand (Sony=1)	1.0	1.0	2.5	3.3	4.7
Price (low=0, high=1)	-6.0	-4.7	-2.5	-12.0	-12.0

Interpretation

Partworth is a numerical score that measures how much each attribute/feature influences the customer's decision to select an alternative. Partworths are the coefficients of the product features in our linear regression model, which tell us how the ranking/preference is related to a certain attribute.

1) **Weishan**

   In Weishan's case, 4K resolution is the most influential feature as having 4K resolution would make the ranking of the product go up by 10, keeping all the other attributes constant.

2) **Gijeong**

   In Gijeong's case, having an 85 inch screen seems to be the most influential feature as having an 85 inch screen would make the ranking of the product go up by 10, keeping all the other attributes constant. The next important feature would be 4K resolution, given the coefficient of 9.3.

3) **Claire**

   In Claire's case, 4K resolution is the most influential feature, followed by an 85 inch screen. Having 4K resolution would make the ranking of the product go up by 12, keeping all the other attributes the same.

4) **Joao**

   In Joao's case, low price was the most influential feature as the coefficient of -12 for price (low = 0, high = 1) shows that having high price would make the ranking of the product go down by 12, keeping all the other attributes the same.

5) **Minji**

   For Minji, the most influential feature seems to be the same as Joao. Low price was the most influential feature as the coefficient of -12 for price (low = 0, high = 1) shows that having high price would make the ranking of the product go down by 12, keeping all the other attributes the same. Unlike Joao whose second important feature is 4K resolution, for Minji, 85 inch screen seems to be the second important feature after low price as it has the coefficient of 5, meaning having 85 inch screen would make the ranking of the product go up by 5, keeping all the other attributes constant.

2. Attribute Importance

Attributes	Importance				
	Weishan	Gijeong	Claire	Joao	Minji
Screen Size	0.32	0.40	0.28	0.15	0.22
Resolution	0.40	0.37	0.51	0.22	0.04
Brand	0.04	0.04	0.11	0.14	0.21
Price	0.24	0.19	0.11	0.50	0.53

Interpretation

As the relative importance of each attribute, the attribute importance shows which attributes of a product are more or less important when we make a purchase.

1) **Weishan**

   Based on the value of importance, the most important attribute is resolution (40%) and the least important attribute is brand (4%).

2) **Gijeong**

   The most important attribute is screen size (40%) and the least important attribute is brand (4%).

3) **Claire**

   The most important attribute is resolution (51%) and the least important attributes are brand and price (both 11%).

4) **Joao**

   The most important attribute is price (50%) and the least important attribute is brand (14%).

5) **Minji**

   The most important attribute is price (53%) and the least important attribute is resolution (4%).

3. Willingness to Pay

Attributes	Willingness To Pay				
	Weishan	Gijeong	Claire	Joao	Minji
Screen 75 inch	458.33	857.14	1100.00	88.54	166.67
Screen 85 inch	666.67	1071.43	1300.00	145.83	208.33
Resolution (4K=1)	833.33	1000.00	2400.00	215.28	34.72
Brand (Sony=1)	83.33	107.14	500.00	138.89	194.44

Interpretation

Willingness to pay is defined as the maximum price that a customer is willing to pay for a product or service. This customer demand related indicator helps us to set the price point for the product.

1) **Weishan**

   Weishan would like to pay $458.33 more for TV with 75 inch screen, $666.67 more for TV with 85 inch screen than for TV with 65 inch screen, $833.33 more for TV with 4K resolution than for the ones with 1K resolution, and $83.33 more for TV with Sony brand than for Sharp TV.

2) **Gijeong**

   Gijeong would like to pay $857.14 more for TV with 75 inch screen, $1071.43 more for TV with 85 inch screen than for TV with 65 inch screen, $1000 more for TV with 4K resolution than for the ones with 1K resolution, and $107.14 more for TV with Sony brand than for Sharp TV.

3) **Claire**

   Claire would like to pay $1100 more for TV with 75 inch screen, $1300 more for TV with 85 inch screen than for TV with 65 inch screen, $2400 more for TV with 4K resolution than for the ones with 1K resolution, and $500 more for TV with Sony brand than for Sharp TV.

4) **Joao**

   Joao would like to pay $88.54 more for TV with 75 inch screen, $145.83 more for TV with 85 inch screen than for TV with 65 inch screen, $215.28 more for TV with 4K resolution than for the ones with 1K resolution, and $138.89 more for TV with Sony brand than for Sharp TV.

5) **Minji**

   Minji would like to pay $166.67 more for TV with 75 inch screen, $208.33 more for TV with 85 inch screen than for TV with 65 inch screen, $34.72 more for TV with 4K resolution than for the ones with 1K resolution, and $194.44 more for TV with Sony brand than for Sharp TV.

4. Optimal Price and Maximum Profit

1) Weishan

price <dbl>	utility_mydesign <dbl>	market_share <dbl>	sales <dbl>	margin <dbl>	profit <dbl>
1500	19.5	1.797645e-02	1.797645e+00	-500	-8.988223e+02
1600	18.3	5.483283e-03	5.483283e-01	-400	-2.193313e+02
1700	17.1	1.657886e-03	1.657886e-01	-300	-4.973657e+01
1800	15.9	4.999247e-04	4.999247e-02	-200	-9.998495e+00
1900	14.7	1.506271e-04	1.506271e-02	-100	-1.506271e+00
2000	13.5	4.537277e-05	4.537277e-03	0	0.000000e+00
2100	12.3	1.366645e-05	1.366645e-03	100	1.366645e-01
2200	11.1	4.116295e-06	4.116295e-04	200	8.232590e-02
2300	9.9	1.239808e-06	1.239808e-04	300	3.719423e-02
2400	8.7	3.734233e-07	3.734233e-05	400	1.493693e-02

The optimal price of "my design" is $2100, the price that would generate the most profit. The maximum profit is 0.1367 which can be achieved if we set the price of "my design" at $2100.

2) Gijeong

price <dbl>	utility_mydesign <dbl>	market_share <dbl>	sales <dbl>	margin <dbl>	profit <dbl>
1500	18.333333	9.284141e-03	9.284141e-01	-500	-464.20706007
1600	17.400000	3.671585e-03	3.671585e-01	-400	-146.86341182
1700	16.466667	1.447041e-03	1.447041e-01	-300	-43.41121559
1800	15.533333	5.695353e-04	5.695353e-02	-200	-11.39070624
1900	14.600000	2.240419e-04	2.240419e-02	-100	-2.24041899
2000	13.666667	8.811438e-05	8.811438e-03	0	0.00000000
2100	12.733333	3.465201e-05	3.465201e-03	100	0.34652013
2200	11.800000	1.362687e-05	1.362687e-03	200	0.27253738
2300	10.866667	5.358684e-06	5.358684e-04	300	0.16076053
2400	9.933333	2.107260e-06	2.107260e-04	400	0.08429039

The optimal price of "my design" is $2100, the price that would generate the most profit. The maximum profit is 0.3465 which can be achieved if we set the price of "my design" at $2100.

3) Claire

price <dbl>	utility_mydesign <dbl>	market_share <dbl>	sales <dbl>	margin <dbl>	profit <dbl>
1500	11.5	5.471808e-05	5.471808e-03	-500	-2.73590391
1600	11.0	3.318891e-05	3.318891e-03	-400	-1.32755626
1700	10.5	2.013035e-05	2.013035e-03	-300	-0.60391057
1800	10.0	1.220977e-05	1.220977e-03	-200	-0.24419545
1900	9.5	7.405637e-06	7.405637e-04	-100	-0.07405637
2000	9.0	4.491759e-06	4.491759e-04	0	0.00000000
2100	8.5	2.724394e-06	2.724394e-04	100	0.02724394
2200	8.0	1.652430e-06	1.652430e-04	200	0.03304861
2300	7.5	1.002250e-06	1.002250e-04	300	0.03006751
2400	7.0	6.078958e-07	6.078958e-05	400	0.02431583

The optimal price of "my design" is $2200, the price that would generate the most profit. The maximum profit is 0.0330 which can be achieved if we set the price of "my design" at $2200.

4) Joao

price <dbl>	utility_mydesign <dbl>	market_share <dbl>	sales <dbl>	margin <dbl>	profit <dbl>
1500	27.875	9.989239e-01	9.989239e+01	-500	-4.994619e+04
1600	25.475	9.882640e-01	9.882640e+01	-400	-3.953056e+04
1700	23.075	8.842482e-01	8.842482e+01	-300	-2.652745e+04
1800	20.675	4.093362e-01	4.093362e+01	-200	-8.186724e+03
1900	18.275	5.914983e-02	5.914983e+00	-100	-5.914983e+02
2000	15.875	5.670957e-03	5.670957e-01	0	0.000000e+00
2100	13.475	5.171242e-04	5.171242e-02	100	5.171242e+00
2200	11.075	4.693452e-05	4.693452e-03	200	9.386904e-01
2300	8.675	4.257985e-06	4.257985e-04	300	1.277396e-01
2400	6.275	3.862772e-07	3.862772e-05	400	1.545109e-02

The optimal price of "my design" is $2100, the price that would generate the most profit. The maximum profit is 5.1712 which can be achieved if we set the price of "my design" at $2100.

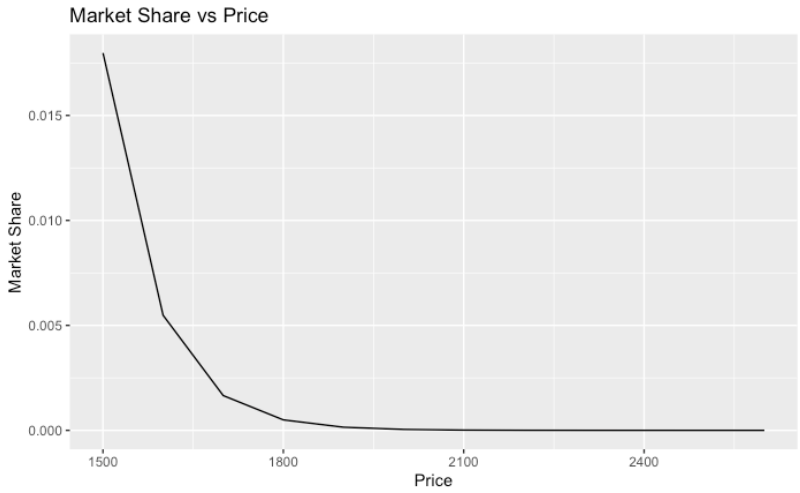
5) Minji

price <dbl>	utility_mydesign <dbl>	market_share <dbl>	sales <dbl>	margin <dbl>	profit <dbl>
1500	29.75	9.999859e-01	9.999859e+01	-500	-4.999929e+04
1600	27.35	9.998441e-01	9.998441e+01	-400	-3.999377e+04
1700	24.95	9.982847e-01	9.982847e+01	-300	-2.994854e+04
1800	22.55	9.814111e-01	9.814111e+01	-200	-1.962822e+04
1900	20.15	8.272736e-01	8.272736e+01	-100	-8.272736e+03
2000	17.75	3.028900e-01	3.028900e+01	0	0.000000e+00
2100	15.35	3.792165e-02	3.792165e+00	100	3.792165e+02
2200	12.95	3.563033e-03	3.563033e-01	200	7.126066e+01
2300	10.55	3.242817e-04	3.242817e-02	300	9.728451e+00
2400	8.15	2.942685e-05	2.942685e-03	400	1.177074e+00

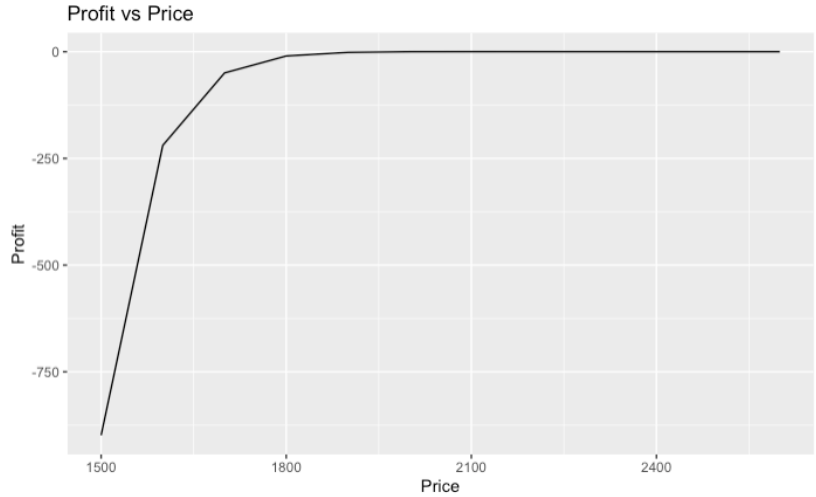
The optimal price of "my design" is $2100, the price that would generate the most profit. The maximum profit is 379.2165 which can be achieved if we set the price of "my design" at $2100. This is the highest profit when compared to the rest of the teammates'.

5. Market Shares (as function of Price) and Profit (as function of Price)

1) Weishan

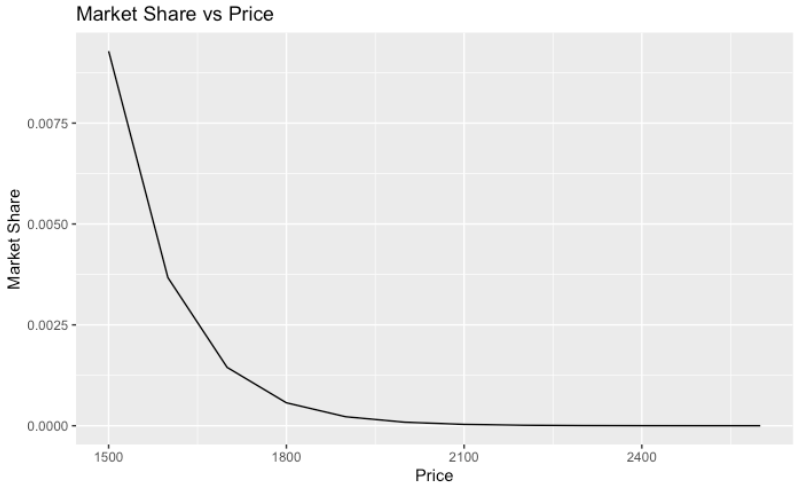


As we increase the prices, market share decreases. This is as expected since consumers are generally price-motivated, the higher the price, the lower the demand. The market share is a mere 1.366645e-05 at our optimal price point.

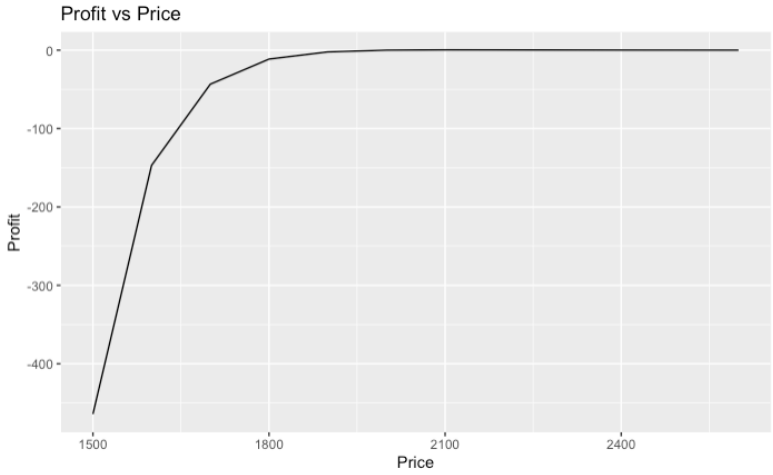


The plot shows the profit generated at each price point - we break even at $2000 and can generate the most profit at $2100 (although profit is minimal).

2) Gijeong

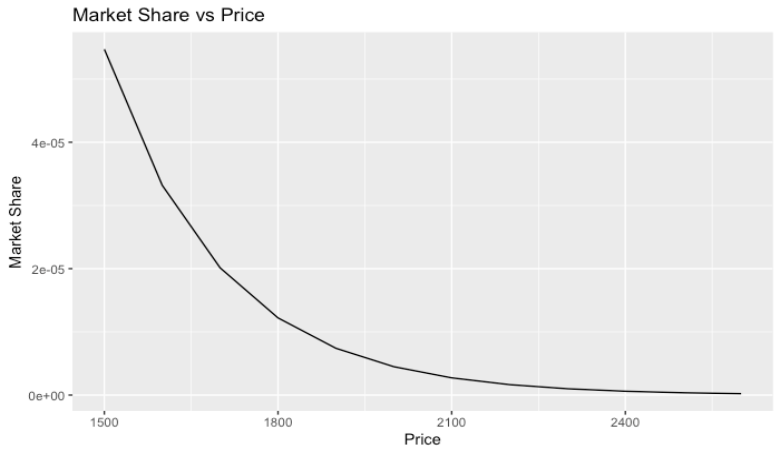


As we increase the prices, market share decreases. This is as expected since consumers are generally price-motivated, the higher the price, the lower the demand. The market share is a mere 3.465201e-05 at our optimal price point.

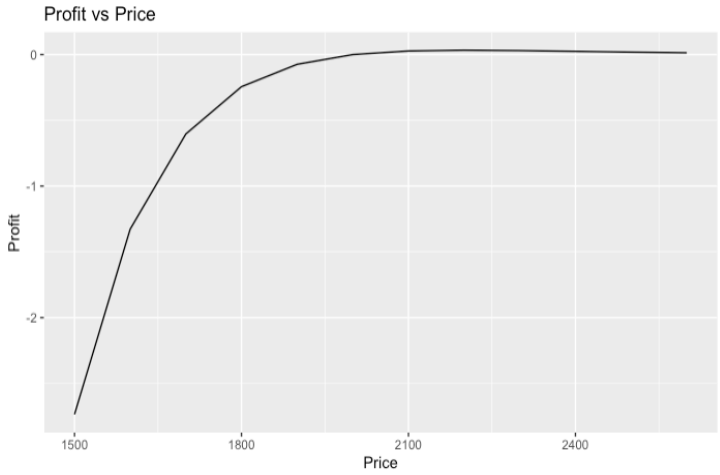


The plot shows the profit generated at each price point - we break even at $2000 and can generate the most profit at $2100 (although profit is minimal).

3) Claire

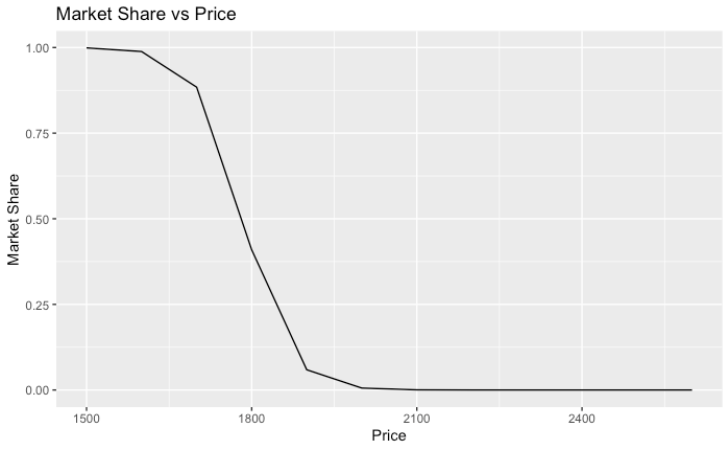


As we increase the prices, market share decreases. This is as expected since consumers are generally price-motivated, the higher the price, the lower the demand. The market share is a mere 1.652430e-06 at our optimal price point.

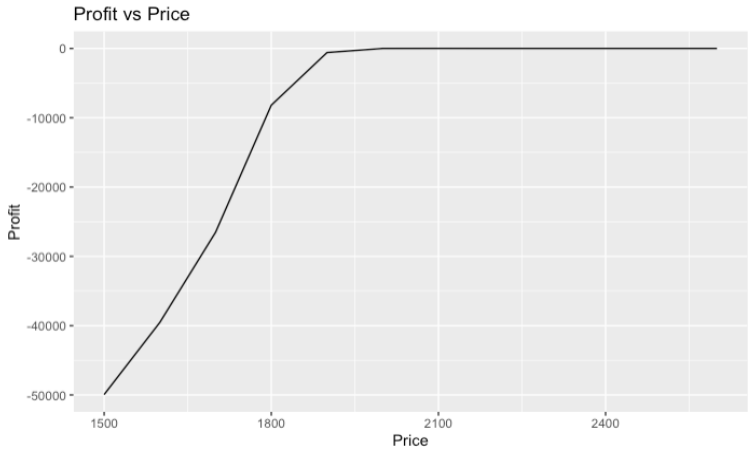


The plot shows the profit generated at each price point - we break even at $2000 and can generate the most profit at $2200 (although profit is minimal).

4) Joao

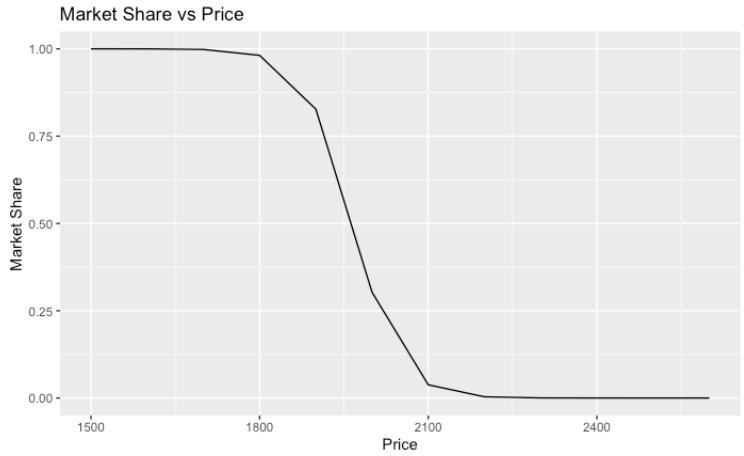


As we increase the prices, market share decreases. This is as expected since consumers are generally price-motivated, the higher the price, the lower the demand. The market share is a mere 5.171242e-04 at our optimal price point. Note that compared to previous plots, at lower prices, the market share does not decrease as drastically.

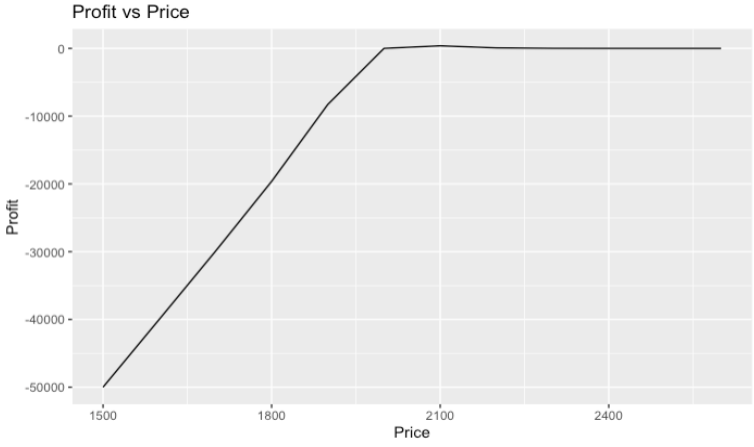


The plot shows the profit generated at each price point - we break even at $2000 and can generate the most profit at $2100 (although profit is minimal).

5) Minji



As we increase the prices, market share decreases. This is as expected since consumers are generally price-motivated, the higher the price, the lower the demand. The market share is a mere 3.792165e-02 at our optimal price point. Similar to Joao's plot, the market share does not decrease drastically in the lower price range.



The plot shows the profit generated at each price point - we break even at $2000 and can generate the most profit at $2100.