

Group Number: Team 2

Assignment Title: Assignment 4

Course Code: RSM8423

Instructor Name: Andre Cire

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Seizelt! Pricing Strategy

ASSIGNMENT 4

TEAM 2

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Executive Summary

Seizelt! is a platform that provides online activities for customers to learn new skills, cooking recipes and experiencing other types of entertainment. It has grown quickly during the pandemic, however, is currently experiencing difficulty in establishing an optimal pricing strategy. In this report, the most suitable pricing policy for it is explored based on visualization, global optimization, segmenting optimization as well as online voucher strategy.

For the basic pricing portion, two approaches are used to determine the optimal price. One is through graphing and visualization, from which a pattern that older people are willing to spend more is captured. The other approach is through fitting a demand curve that represents the relationship between demand v.s. price and then maximize the total revenue using the `scipy.optimize` package. A similar pattern and result are obtained from these two methods with the optimal single price being about \$28.5, which would give us the highest potential revenue of \$28509.7. On top of a single optimal pricing strategy, we explored that if charging customers based on segment, specifically, having a low price for younger age groups whereas a higher price for older age groups, an even higher revenue around \$31542.5 can be generated. Therefore, a more flexible pricing strategy based on the characteristics of the customer segments would be more beneficial for Seizelt! in terms of revenue maximization and thus should be considered to replace the current policy of \$45 across all products.

In addition to the basic pricing analysis, the team also explored the viability of offering online vouchers with a certain discount to selected customers. Specifically, there are two types of vouchers, one occurring on a daily basis, and the other occurring during summer and winter sales. For the voucher strategy, a single optimal price was used instead of the flexible price strategy, due to some age groups having an optimal price of \$20 and not being able to accept any vouchers. The total revenue is calculated as the total revenue from three different price settings. Based on the result, the optimal total revenue will be \$129,582. Since our optimal price is 28.47, the strategy used by the model is offering a lower price for higher demand.

Introduction

SeizeIt! is an online service provider that offers various quick online pocket experiences for customers to learn a new topic of interest like cooking and music. Despite the firm's quick growth since the pandemic, their current ad-hoc pricing methods have been very inefficient with a lack of analysis. This following report outlines a more systematic and efficient pricing strategy that could be used in SeizeIt!'s future operations.

Key Considerations

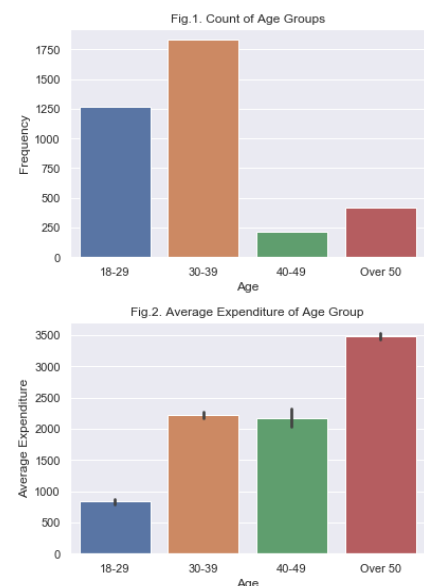
With SeizeIt!'s core principles in simplicity and streamlined choice, the following assumptions are considered in this report's analysis as stated in the case:

- 2 to 4 activities available at a time (each week)
- All activities offered in a given a week are priced equally
- Customers pays per activity
- Each activity is priced between \$20-\$60 CAD
- A given customer only purchase one activity per week
- There is no seasonality and trend

A. Understanding Current Customers

As seen in **Figure 1**, also presented on the right, also presented with detailed numbers in **Appendix A-1**, we observe that in the representative week, age group 18-39 represents 83% of the total customers where 18-29 represents 34% (1266) 30-39 is 49% (1830), out of a total of 3731 customers.

In comparison to the high rate of percentage of current customers in the younger groups, we see in **Figure 2** that on average, the older groups tend to spend more on similar services. In particular, the Over 50 group represents only 11% of current customers but their average expenditure on similar services is 36% higher than the most common age group, 30-39.



We see a similar finding in the current operations as seen in **Appendix A-2**. While the purchase activities for 18-49 is majorly under \$45 with a clear right-skewed price distribution, Over 50 customers are less sensitive to price and have relatively uniform distribution across different prices. It comprises the majority of customers that select higher priced (\$50-60) activities with an average price of activities purchased of \$39 vs. \$28-30 for the other groups. We also note that overall, the average price purchased increases with age (\$28 for ages 18-29 vs. \$31 for age group 40-49).

Thus we have the following key findings which we consider as we strategize for pricing:

- Younger age groups (18-39) make up the majority of SeizeIt!'s current customers
- The older the age groups, less price sensitive and higher average price of activities
- The Over 50 group is least price sensitive to prices in comparison to other age groups
- The Over 50 group has the greatest profit potential with the average expenditure on similar products and the average price of purchased activities being much higher than other groups. Outside the context of this report which is focused on pricing, it is recommended for Seizeit! to strategize their marketing efforts to attract more customers from this group.

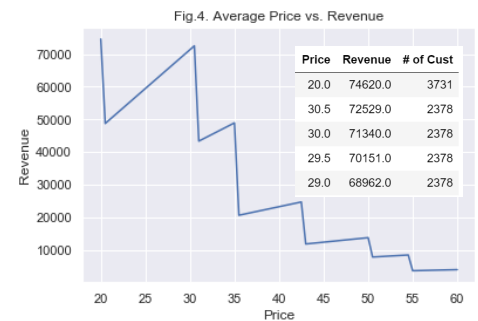
B. Basic Pricing

B1 - Graphing & Visualization

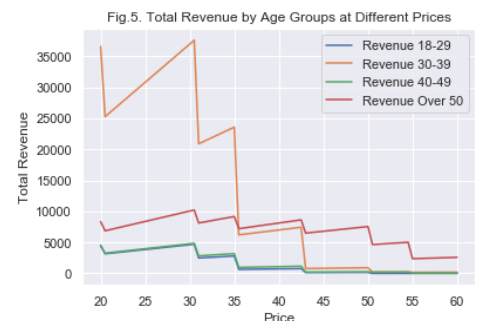
As outlined in the previous Key Considerations section, we follow the assumption that we still maintain a fixed price for all activities provided in a given week (i.e. in the representative week in the given data), between the price range of \$20 to \$60.

Assume that the prices discovered in the represented data for each customer represent the willingness to pay such that if activities are priced above the price in the data, they will not purchase the activity. Thus, there is a tradeoff between higher price charged vs. number of customers that will be making the purchase.

As seen in **Figure 4** on the right, under the current pricing scheme where all activities in the given week are priced the same for all customers, it shows that the highest revenue is found when the price is set to \$20, resulting in revenue of **\$74,620** (3731 customers x \$20) where all customers makes a purchase. The second highest revenue of \$72,525 is driven at a price of \$30.5 where 2378 (64% of all customers) are willing to make the purchase. At their current average price of \$45, we see that only 275 customers will make a purchase of the activity, with revenue of just \$12,375, which is 83% lower than the revenue at a price of \$20.



We clearly see from the previous section that different age groups have different price sensitivity and willingness to pay. Moreover, we saw that it was the older aged groups with higher willingness to pay, with younger groups with lower willingness to pay. Thus, if we had the flexibility to charge different prices per consumer, we expect the revenue to increase. To test this, we find the optimal price per age group as presented in **Appendix B-1**. The results are summarized in **Figure 5** on the right, where the optimal price (for the highest revenue) for the age group 18-29 is \$20, while for all others it is \$30.5. Moreover, we segregate the 18-29



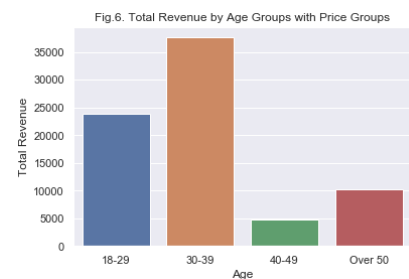
age group further to see at what age, the optimal price changes to \$30.5. As seen in **Appendix B-2** we see that starting from age 27, the optimal price is \$30.5 - Optimal price 18-26 is \$20, for 27 and up is \$30.5.

In aggregate, when we separate the customer based on age less than 27 and over 27 accordingly and apply \$20 to under 27, and \$30.5 to ages 27 and older. The results are outlined in **Appendix B-3** where we arrive at a total revenue of **\$78,150.5** where \$20K (27%) is driven from 18-26, around 73% from ages 27 and older. This is **4.7%** (\$3530.5) higher than the consistent price of \$20 for all consumer groups. Given that this is a weekly incremental revenue, at a yearly level this equates to around \$183.6K (\$3.5K x 52 weeks) of increased annual revenue which is a significant amount.

We also note that in the previous method, we served all 3731 customers. Under this method, we cater to a total of 2929 (78%) of customers.

- All customers in 18-26 (1039) served
- 68% (154 out of 227) of 27-29
- 67% (1233 out of 1830) of 30-39
- 73% (159 out of 218) of 40-49
- 80% (335 out of 417) of the Over 50 group.

The breakdown of the revenues as seen in **Figure 6**, which resembles the summarized graph of count of customers per age group seen in Part A.



Many users with ages between 18-26 may be enrolled in post-secondary education. From this analysis, we advise SeizeIt! to price their weekly activities with a consistent price but with student/youth discounts targeting the 18-26 group. Based on the presented representative week, we:

- Offer a 'student' or 'youth' discount tailored to age groups 18-26 giving them the opportunity to try the services at the cost of \$20
- Provide a consistent price of \$30.5 for ages 27 and up

This way, we will be able to keep the simplicity of having a 'consistent price' for all activities while being able to differentiate price for the youngest group in a way that does not feel 'unfair' to others (i.e. consumers tend to not view student-discounts as an unfair advantage given to a particular group).

B2 - Optimization

In addition to the graphing visualization approach, the team has also attempted to fit a function for demand v.s. price ($d(p)$) using the `scipy.optimize` package, and then finding the corresponding price (p) that maximize the total revenue ($d(p)*p$). Two types of functions are examined to model the relationship between demand and price: linear **Figure 7** and constant elasticity **Figure 8**.

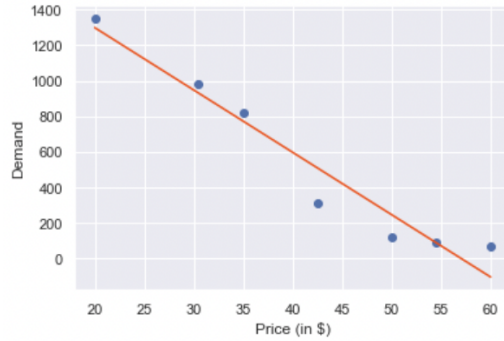


Figure 7: Linear

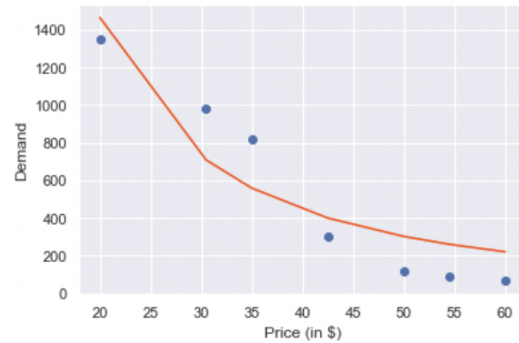


Figure 8: Constant Elasticity

Based on observing the plots, the linear relationship is chosen as it seems to be a relatively better fit since the distances between the observation points to the fit line are shorter. Then, by solving the revenue maximization function, the optimal price obtained is around \$28.5 and the corresponding total revenue is about \$28509.7. Compared to the expected revenue when charging \$45, which would only generate roughly \$18897.8, the new pricing strategy \$28.5 seems to be a better choice for Seizelt! in the aspect of revenue maximization.

Since we observe there are some differences in spending patterns across age groups, the approach of an optimal price for each age group is also explored. For the price discrimination strategy, we use different functions to represent an age group's demand elasticity on price. The functions for each age group are shown in the figures below:

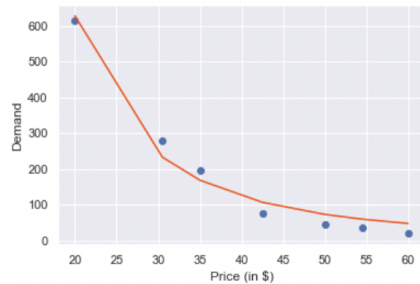


Figure 9: 18-29 Demand curve

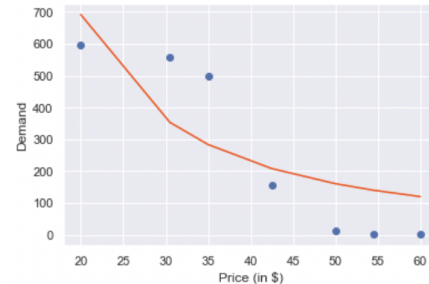


Figure 10: 30-39 Demand curve

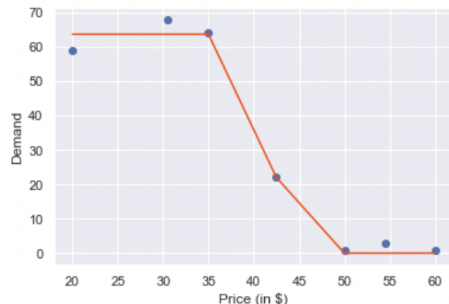


Figure 11: 40-49 Demand curve

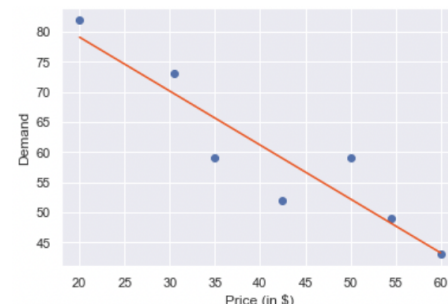


Figure 12: 50 & older Demand curve

For age group 18-29 (**Figure 9**), the demand function is $c * (\text{price} ** d)$, based on observations available, parameters c and d are estimated to be 717966.255 and -2.35

respectively. The objective function is set to maximize the revenue, which is $(\text{price} * 7.179 * (\text{price} ** -2.35))$, the only constraint in this case is the price must be between \$20 and \$60. The optimal price for customer age between 18 and 29 is \$20, the expected revenue would be \$12540.

Age group 30-39 (**Figure 10**) used a similar demand function to age group 18 – 29, which is $(c * (\text{price} ** d))$. Based on observations available, the parameters c and d are estimated to be 81553 and -1.59 respectively. The larger parameter d compared to the previous age group suggests older people are less sensitive to price increases. The objective function is set to maximize the revenue, which is $(\text{price} * 81553.7 * (\text{price} ** -1.59))$, the only constraint in this case is the price must be between \$20 and \$60. The optimal price for customer age between 30 and 39 is \$20, the expected revenue would be \$13839.

For age group 40-49 (**Figure 11**), the demand function is $(c * \exp(-(a + b * \text{price})) / (1 + \exp(-(a + b * \text{price})))$. Based on observations available, the parameters a , b and c are estimated to be 63.667, -98.83 and 2.341 respectively. The objective function is set to maximize the revenue, which is $(\text{price} * (2.341 * \exp(-(63.667 - 98.83 * \text{price})) / (1 + \exp(-(63.667 - 98.83 * \text{price}))))$, the only constraint in this case is the price must be between \$20 and \$60. The optimal price for customer age between 40 and 49 is \$40.29, the expected revenue would be \$2537. The price increase for this age group is due to customers in this group having lower demand elasticity, which is reasonable, people in age 40 – 49 generally should have higher disposable income than younger folks.

For age group 50 and older (**Figure 12**), the demand function is $a - b * \text{price}$, as the data points suggest the demand decreases linearly as the price increases. Based on observations available, the parameters a and b are estimated to be 96.98 and 0.89 respectively. The objective function is set to maximize the revenue, which is $(\text{price} * (96.98 - 0.89 * \text{price}))$, the only constraint in this case is the price must be between \$20 and \$60. The optimal price for customers older than 50 is \$54.167, the expected revenue would be \$2626.45.

The total expected revenue by summing across all four age groups is about \$31542.5, which is higher than the revenue generated by charging a single price (\$28.5) for everyone. Thus, based on the findings, a more flexible pricing strategy that can be tailored for individuals' characteristics and needs would be the optimal policy for Seizelt! if aiming for revenue maximization.

C. Online Vouchers

Model Assumption

To simplify the modeling process, we decided to use the linear fit demand function for the global approach as segmentation would require much longer processing time. The current model takes 60-90 minutes to reach optimal status. \$28.47 is the optimal price to generate maximum revenue for the single price strategy. Additionally, as some of the optimal prices for our segmentation approach is \$20 we are not able to provide any vouchers at all for some customers if using flexible optimal pricing. Finally, to make the problem linear we decided to set the discount values of the normal online voucher and summer or winter voucher. A normal online voucher would be worth \$2.8, which is 10% of the regular price. A summer or winter voucher would be worth \$4.3, which is 15% of the regular price.

The company does not observe seasonality or trends that need to be accounted for in the model or demand function. Also people who reach the willingness to pay level will decide to pay within the week.

Model Parameters and Sets

Sets

- Number of Weeks
- Number of Customers

Parameters

- Optimal price from part 1
- Discount rate for vouchers
- Discount rate for summer and winter vouchers

Model Constraints

There are various constraints given in the model.

- The unit price after discount can not go below \$20.
- A customer can only receive, at most, one voucher per week
- In a given year, for a customer, no more than 24 vouchers must be given.
- Every customer should have received at least five vouchers
- Two consecutive vouchers for the same customer must be 3 weeks apart at least. This includes summer and winter vouchers as well
- All customers must receive a voucher for the summer sale and winter sale.
- The summer and winter sale occur June to August and December to February respectively.
- If a customer does not receive any vouchers or special sales, then they pay at the optimal price.

Model Variables

The various variables used in the linear programming model are listed below.

- $yvar(i,t)$: Binary variable to apply voucher discount or not for a customer i at week t

- $\text{svar}(i,t)$: Binary variable to apply summer or winter voucher discount or not for a customer i at week t
- $\text{xvar}(i,t)$: Binary variable to apply regular pricing or not for a customer i at week t

Model Objective Function

Every week, customers are randomly assigned into three groups: Regular Price group, Regular Voucher group and Seasonal Voucher group. Because of that, the total revenue could be estimated as the sum of revenue from each group. Assuming the population of customers is N , then the population of each group will be a proportion of N , denoted as pr_1, pr_2, pr_3 , where $pr_i = \frac{\text{Number of Customers in Group } i}{N}$. Because the customers are randomly assigned, we could assume that the demand function will not change in each group. Denote the price of each group as p_1, p_2, p_3 . Hence the demand of each group could be written as

$$R_i = pr_i \times D(p_i). \text{ Thus the total revenue} = \sum_i R_i = \sum_i pr_i \times D(p_i).$$

Model Result Analysis

The results and mathematical formulation of the model are shown in Appendix C below. Based on the result, the optimal total revenue will be \$129,582. The result is lower than expected mainly because the model tends to provide vouchers to customers if possible. As shown in figure 8, we already noticed that lower prices will generate higher demands at the low price range. Since our optimal price is 28.47, it is sensible that the model decides to trade off the price for the larger demand.

Sensitivity Analysis

We consider adding an extra 10% on top of the original voucher and summer/winter sale, making a regular voucher worth \$5.7, a seasonal voucher worth \$7.1, which is 25% of the regular price. Younger customers (18 to 39 years old) represent over 80% of the customer population, the demand elasticity for younger customers is non-linear, a smaller decrease in price might trigger a large increase in unit sold or revenue. Keeping all the constraints and the objective function unchanged. The new revenue would be \$136,391.48, which is higher than the 10% voucher scenario.

Qualitative Problems

Beyond how vouchers will lead to different quantities of demand, the fact that vouchers are presented as discount codes for emails leads to qualitative costs that can't be easily quantified. For example, sending out too many emails to customers may be considered spam and would lead to customers having a negative view of SeizeIt!'s product. Additionally, the assumptions that everyone who gets a voucher will immediately make a purchase that week, which is not always true as customers may wait before using a voucher. SeizeIt! using other methods or channels to present vouchers may lead to more effective results, however in the case of the model this does not matter. Finally, in terms of

demographics, voucher effectiveness may vary based on the age of the customer. Older customers may be more price inelastic and the decrease would not matter, while younger customers may be more receptive. This difference can influence the effectiveness of the voucher program.

Conclusion

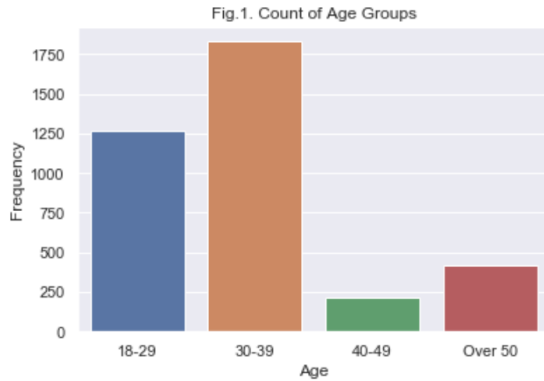
Based on our results from part 1, we have found that it is more beneficial to segment the customers by age group and then find the optimal price, versus having one general optimal price for all customers. Using both the optimization and graphical approach, demonstrates that this is a more beneficial approach. However, when it comes to the online voucher approach, a segmentation approach may not be as feasible due to computing power constraints and the fact that some segments optimal pricing is already at the lower bound of the companies pricing restriction.

In terms of limitations, as the problem is non-linear, finding a feasible solution can be difficult. Additionally, due to the sheer number of variables that need to be calculated in our model, the computing power and time needed is very long. If we had data on different types of vouchers available, then a more robust model could be created.

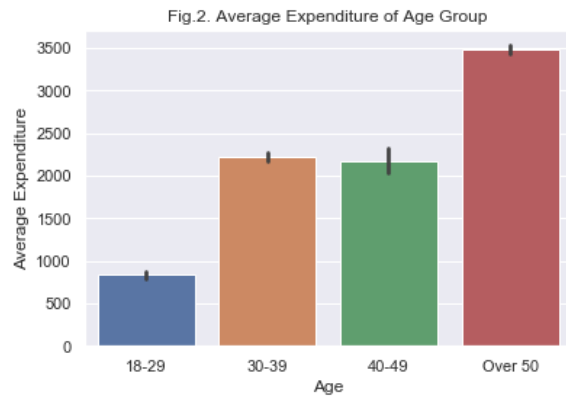
Appendix

Appendix A: Understanding Current Customers

A-1: Current Customers' Age Groups

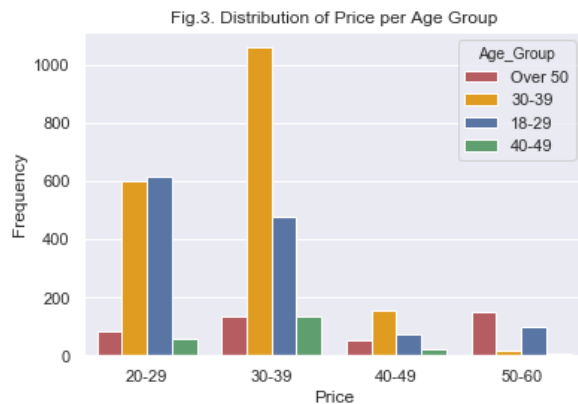


Total number of data: 3731
Number of Age_Group 18-29: 1266
Number of Age_Group 30-39: 1830
Number of Age_Group 40-49: 218
Number of Age_Group Over 50: 417



Average Expenditure: 1889.7278316805123
Number of Age_Group 18-29: 836.1176540284371
Number of Age_Group 30-39: 2221.2540655737703
Number of Age_Group 40-49: 2169.891238532111
Number of Age_Group Over 50: 3487.094388489207

A-2: Current Price Distribution by Age Groups



Age_Group
18-29 28.637046
30-39 29.541803
40-49 30.745413
Over 50 39.189448

Appendix B: Basic Pricing

B-1: Top 5 Prices for max revenue per Age group

- Age 18-29:

Price	Revenue	# of Cust
20.0	25320.0	1266
30.5	19855.5	651
30.0	19530.0	651
29.5	19204.5	651
29.0	18879.0	651

- Age 30-39:

Price	Revenue	# of Cust
30.5	37606.5	1233
30.0	36990.0	1233
20.0	36600.0	1830
29.5	36373.5	1233
29.0	35757.0	1233

- Age 40-49:

Price	Revenue	# of Cust
30.5	4849.5	159
30.0	4770.0	159
29.5	4690.5	159
29.0	4611.0	159
28.5	4531.5	159

- Age Over 50:

Price	Revenue	# of Cust
30.5	10217.5	335
30.0	10050.0	335
29.5	9882.5	335
29.0	9715.0	335
28.5	9547.5	335

B-2: Total Revenue at Optimal Prices

- Age 27-29:

Price	Revenue	# of Cust
30.5	4697.0	154
30.0	4620.0	154
29.5	4543.0	154
20.0	4540.0	227
29.0	4466.0	154

B-3: Total Revenue at Optimal Prices

Total Revenue: \$78150.5

- Revenue 18-26 at \$20: \$20780

- Revenue 27 and Over at \$30.5: \$57370.5

Revenue of Age_Group 18-29: \$23860

Revenue of Age_Group 30-39: \$37606.5

Revenue of Age_Group 40-49: \$4849.5

Revenue of Age_Group Over 50: \$10217.5

Appendix C: Online Vouchers

C-1: Model Math

Maximize Total Revenue

$$\sum_{i=1}^n \sum_{t=1}^n ((yvar_{i,t} * d(p(1 - voucher)))/numcustomers) + \\ ((svar_{i,t} * d(p(1 - summer/winter)))/numcustomers) + \\ ((xvar_{i,t} * d(p))/numcustomers)$$

Subject to:

- $\sum_{i=1}^n svar_{i,t} == 2 \quad t = 1, \dots, n$
- $yvar_{i,t} + svar_{i,t} \leq 1 \quad i = 1, \dots, n, t = 1, \dots, n$
- $\sum_{i=1}^n \sum_{t=1}^n yvar_{i,t} + yvar_{i,t+1} + yvar_{i,t+2} + svar_{i,t} + svar_{i,t+1} + svar_{i,t+2} \leq 1 \quad i = 1, \dots, n, t = 1, \dots, n$
- $\sum_{i=1}^n \sum_{t=1}^n svar_{i,t} == 1 \quad i = 1, \dots, n, t = [1, \dots, 8], [48, \dots, 52], [24, \dots, 32]$
- $\sum_{i=1}^n \sum_{t=1}^n xvar_{i,t} == 1 ; \text{ if } svar_{i,t} \text{ AND } yvar_{i,t} == 0 \quad i = 1, \dots, n, t = 1, \dots, n$

- $5 \leq \sum_{i=1}^n \sum_{t=1}^n yvar_{i,t} + svar_{i,t} \leq 24 \quad i = 1, \dots, n, t = 1, \dots, n$

C-2: Model Results

Week 1

Voucher for 3706.0 customers
Summer/Winter voucher for 4.0 customers

Week 2

Voucher for 0.0 customers
Summer/Winter voucher for 1.0 customers

Week 3

Voucher for 20.0 customers
Summer/Winter voucher for 0.0 customers

Week 4

Voucher for 1429.0 customers
Summer/Winter voucher for 1249.0 customers

Week 5

Voucher for 561.0 customers
Summer/Winter voucher for 206.0 customers

Week 6

Voucher for 241.0 customers
Summer/Winter voucher for 45.0 customers

Week 7

Voucher for 1225.0 customers
Summer/Winter voucher for 950.0 customers

Week 8

Voucher for 601.0 customers
Summer/Winter voucher for 338.0 customers

Week 9

Voucher for 617.0 customers
Summer/Winter voucher for 0.0 customers

Week 10

Voucher for 1963.0 customers
Summer/Winter voucher for 0.0 customers

Week 11

Voucher for 1137.0 customers
Summer/Winter voucher for 0.0 customers

Week 12

Voucher for 631.0 customers
Summer/Winter voucher for 0.0 customers

Week 13

Voucher for 1792.0 customers
Summer/Winter voucher for 0.0 customers

Week 14

Voucher for 1301.0 customers
Summer/Winter voucher for 0.0 customers

Week 15

Voucher for 638.0 customers
Summer/Winter voucher for 0.0 customers
Week 16
Voucher for 1637.0 customers
Summer/Winter voucher for 0.0 customers
Week 17
Voucher for 1440.0 customers
Summer/Winter voucher for 0.0 customers
Week 18
Voucher for 654.0 customers
Summer/Winter voucher for 0.0 customers
Week 19
Voucher for 1505.0 customers
Summer/Winter voucher for 0.0 customers
Week 20
Voucher for 1554.0 customers
Summer/Winter voucher for 0.0 customers
Week 21
Voucher for 672.0 customers
Summer/Winter voucher for 0.0 customers
Week 22
Voucher for 1349.0 customers
Summer/Winter voucher for 0.0 customers
Week 23
Voucher for 1688.0 customers
Summer/Winter voucher for 0.0 customers
Week 24
Voucher for 478.0 customers
Summer/Winter voucher for 216.0 customers
Week 25
Voucher for 692.0 customers
Summer/Winter voucher for 427.0 customers
Week 26
Voucher for 943.0 customers
Summer/Winter voucher for 544.0 customers
Week 27
Voucher for 689.0 customers
Summer/Winter voucher for 436.0 customers
Week 28
Voucher for 555.0 customers
Summer/Winter voucher for 318.0 customers
Week 29
Voucher for 803.0 customers
Summer/Winter voucher for 499.0 customers

Week 30
 Voucher for 911.0 customers
 Summer/Winter voucher for 645.0 customers

Week 31
 Voucher for 457.0 customers
 Summer/Winter voucher for 170.0 customers

Week 32
 Voucher for 621.0 customers
 Summer/Winter voucher for 373.0 customers

Week 33
 Voucher for 2110.0 customers
 Summer/Winter voucher for 0.0 customers

Week 34
 Voucher for 523.0 customers
 Summer/Winter voucher for 0.0 customers

Week 35
 Voucher for 1077.0 customers
 Summer/Winter voucher for 0.0 customers

Week 36
 Voucher for 2131.0 customers
 Summer/Winter voucher for 0.0 customers

Week 37
 Voucher for 443.0 customers
 Summer/Winter voucher for 0.0 customers

Week 38
 Voucher for 1147.0 customers
 Summer/Winter voucher for 0.0 customers

Week 39
 Voucher for 2141.0 customers
 Summer/Winter voucher for 0.0 customers

Week 40
 Voucher for 375.0 customers
 Summer/Winter voucher for 0.0 customers

Week 41
 Voucher for 1193.0 customers
 Summer/Winter voucher for 0.0 customers

Week 42
 Voucher for 2163.0 customers
 Summer/Winter voucher for 0.0 customers

Week 43
 Voucher for 292.0 customers
 Summer/Winter voucher for 0.0 customers

Week 44
 Voucher for 1258.0 customers

Summer/Winter voucher for 0.0 customers
Week 45
Voucher for 2181.0 customers
Summer/Winter voucher for 0.0 customers
Week 46
Voucher for 201.0 customers
Summer/Winter voucher for 0.0 customers
Week 47
Voucher for 1318.0 customers
Summer/Winter voucher for 0.0 customers
Week 48
Voucher for 1174.0 customers
Summer/Winter voucher for 1038.0 customers
Week 49
Voucher for 18.0 customers
Summer/Winter voucher for 0.0 customers
Week 50
Voucher for 0.0 customers
Summer/Winter voucher for 0.0 customers
Week 51
Voucher for 3711.0 customers
Summer/Winter voucher for 2.0 customers
Week 52
Voucher for 3730.0 customers
Summer/Winter voucher for 1.0 customers