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Analysis of the Avocado Industry

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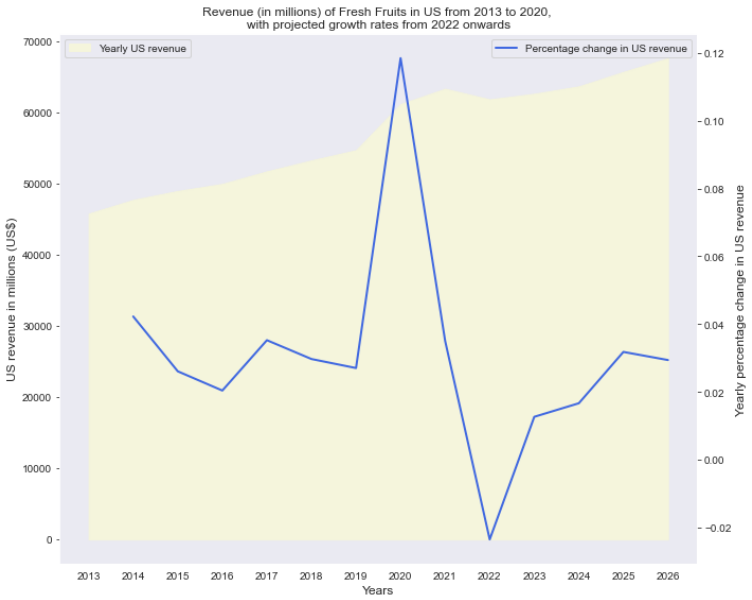
1. Introduction

1.1 Background Information

Covid-19 has resulted in the evolution of food behaviours, with an increasing trend in the consumption of fruits. This is evident through research conducted by IGD, with 51% of respondents claiming to have eaten more fruits and 85% actively trying to consume more fruits (Maynard, 2021).



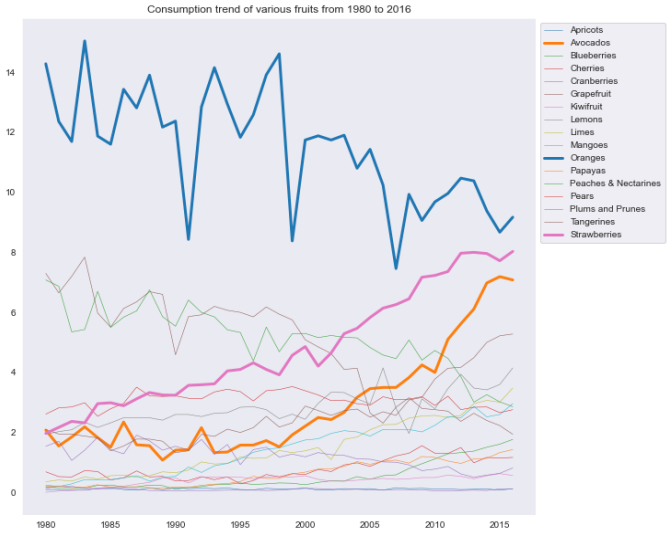
From Figure 1, we observe an increasing trend in the overall revenue gathered from the fruit industry between 2013 to 2020 and the projected revenue from 2021 to 2026. The projected revenue growth from fresh fruits, albeit witnessing a slight dip in 2022, displays a continual, gradual increase in the subsequent years. This elucidates potential prospects that the fresh fruit industry possesses.

Figure 1: Overall Trend of Average Yearly Revenue from 2015 to 2020

1.2 Problem Statement

GreenGrocer, a rapidly expanding fruit company that currently operates in the South-East Asian market, wants to capitalise on this opportunity by expanding into the US market. However, with limited resources, it is only feasible for GreenGrocer to expand into one fruit industry, thus, GreenGrocer has sought assistance from our consulting firm. With historical data on avocado prices and sales volume, we will perform data analysis to determine the **three regions** in which the company should set foot to garner the highest profits.

1.3 Preliminary Analysis



From Figure 2, there are 3 budding fruit industries that GreenGrocer could potentially venture into – oranges (blue), strawberries (pink), and avocados (orange). Despite the high overall consumption of oranges, its downward consumption trend does not seem optimistic. However, the growth prospects of strawberries and avocados seem more promising with an upward trend. The strawberry industry is projected to hit $23.12 million market share in 2027 (Industry Research, 2021), while the avocado industry is expected to attain a market share of **US$21.56 billion** in 2027 (Research, 2018). Analyzing these two fruit industries, the prospective market share of the avocado industry significantly triumphs the strawberry industry over an **astounding scale of 1000**.

Figure 2: Consumption trends of 16 different potential fruit industries from 1980 to 2019 in the US

1.4 Assumptions

We assumed that the cost involved in the harvesting, and delivery of avocados is constant regardless of the region selected or seasons as the whole process of procuring avocados is performed within the country itself. Thus, **higher revenue translates to higher profitability.**

In addition, it is assumed that the demand for avocados is equal to the number of avocados sold for every region.

2. Main Analysis

According to Hass Avocado Board (HAB), the global demand for Hass, the most popular variety of avocados, is projected to grow at an annual rate of almost 5% through 2025, topping **US$8 billion (S$10.7 billion)** globally (The Straits Times, 2020). This supports the conclusion from our preliminary analysis that the avocado industry would be the most profitable to venture into. Hence, we seek to provide GreenGrocer with guidance on setting up avocado-related businesses in the United States.

2.1 Data Sources

1. **Kaggle**
   The dataset used, “avocado-updated-2020.csv” was acquired from Kaggle. “Avocado-updated-2020.csv” consists of historical data from 4 January 2015 up to 17 May 2020 which features avocado prices, sales volume, type of avocado in multiple cities, states, and regions of the US.
2. **Statista**
   The dataset of revenue from the fresh fruit industry between 2013 to 2026 (projected) was obtained from Statista, which contains the projected revenue of the fresh fruit industry for 150 countries.

2.2 Data Cleaning

The data set originally contained 33,045 data listings. We first began with an empty cell check, to minimize any subsequent issues due to possible errors in the data entry process. Thereafter, we removed any duplicate data present which will cause the analysis to be skewed. After we cleaned the data to increase accuracy, we obtained a total of 11,273 listings to be used for further analysis.

2.3 Terminologies

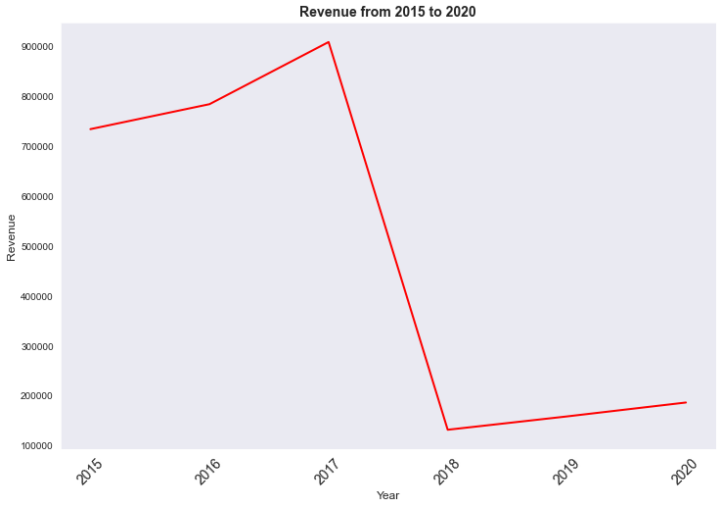
Avocado Grades	According to Love One Today (LOT), an official subsidiary under the Hass Avocado Board (HAB), there are 3 main grades of avocados, #4046, #4225, #4770 (Appendix 9.1).
Avocado Type	In this dataset, there are 2 types of avocados namely, conventional and organic.
Regions	According to HAB, the states in the US have been classified into 8 regions such as Plains, Southeast (SE), Southcentral (SC), Northeast (NE), West, Midsouth (MS), California (Cali), Great Lakes (GL) (Appendix 9.2).
Season	There are 4 seasons in a year, namely Winter, Spring, Summer, and Autumn (Appendix 9.3).
Average Price	In this dataset, the average price refers to the average price of a single avocado in that week according to the respective locations.
Total Volume	Total number of avocados sold

3. Business Question/Hypotheses

We aim to determine **which region(s) in the US is/are the most profitable**; how sales are affected by **regions, seasons, grade, and type of avocados**. We also want to determine whether there are any **price trends** and how the **average prices of avocados have an impact on its sales**. We would also be analyzing the **average revenue generated** to determine profitability.

4. Data Visualization

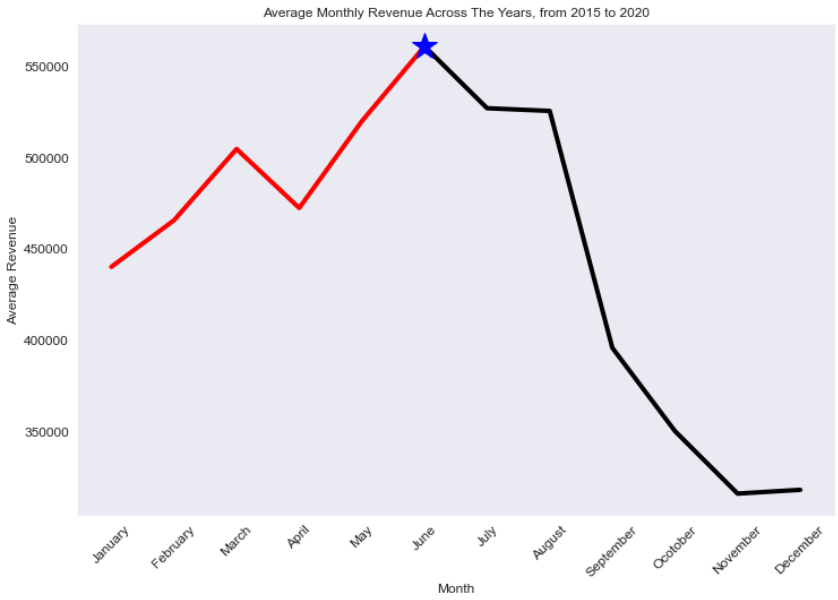
4.1 Revenue vs Year



In our preliminary analysis, the timeframe for the consumption of various trends was only up to 2020. Thus, to validate that the avocado industry is a lucrative one to enter, a trendline showing the average yearly revenue generated from avocados in the US from 2015 to 2020 is plotted. However, as seen in Figure 3, there was a drop in revenue in 2017 which may be due to a slowdown in the harvest pace in Mexico (Crane, 2017). Given that its valuation is expected to reach US $21.56 billion in 2027, it can be expected that the growth in revenue for the avocado industry will be increasing exponentially from 2018 onwards, despite the drop in 2017.

Figure 3: Overall Trend of Average Yearly Revenue from 2015 to 2020

4.2 Revenue vs Month



In determining which month generated the greatest revenue, the average monthly revenue from 2015 to 2020 was calculated and plotted on the line chart in Figure 4. From the figure, there is a steady growth in revenue in the first 6 months of the year, with June generating the highest revenue, followed by a downward trend thereafter. While avocados are available year-round, the initial half of the year (denoted by the red line) has proven to be the best time for flavor (Twesten, 2018) due to the optimal growing conditions.

Figure 4: Overall Trend of Average Monthly Revenue Across The Years, from 2015 to 2020

Since total revenue is affected by both the total volume and the average price of avocados sold, we analyzed the trends of these variables across the months as well. From Figure 5, the monthly average volume follows a downward trend over the months, with the earlier half of the year to have a higher monthly average volume sold compared to the later half of the year from 2015 to 2017. After the huge plunge in the total volume of avocados sold in August 2017, the monthly average total volume starts to stagnate and does not follow any significant trend. In spite of that, we observe from figure 6 that the monthly average prices of avocados do not adhere to any consistent trend and fluctuate throughout the months. Nonetheless, it is notable that the average prices in the second half of the year are generally higher than the average prices in the first half of the year. Despite this phenomenon, the average revenue for the first half of the year is substantially higher than the second half of the year.

Hence, we can conclude that the impact of the total volume of avocados sold on total revenue outweighs that of their average prices, and the dwindling revenue after June is particularly attributable to the decline in total volume.

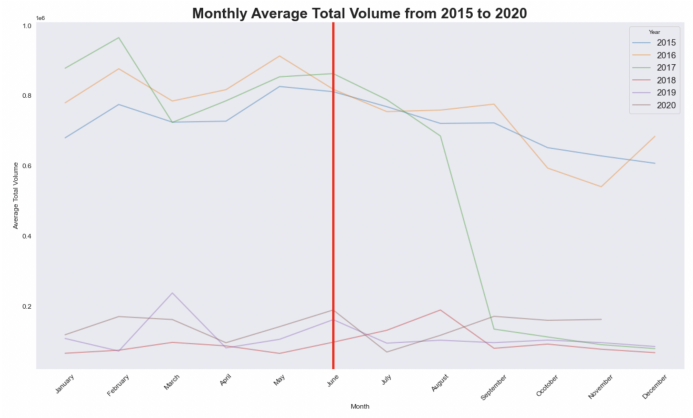


Figure 5: Overall Trend of Monthly Average Total Volume from 2015 to 2020

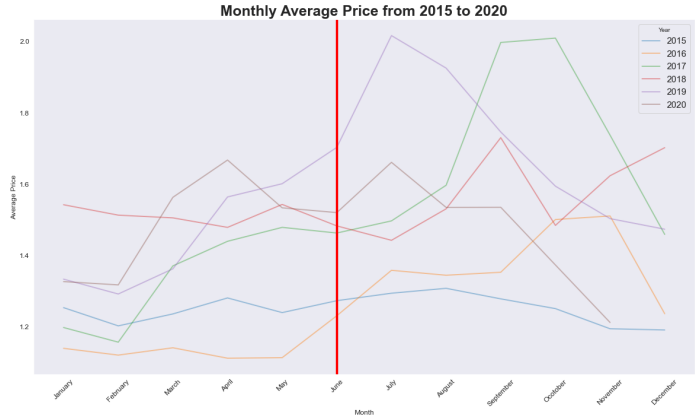
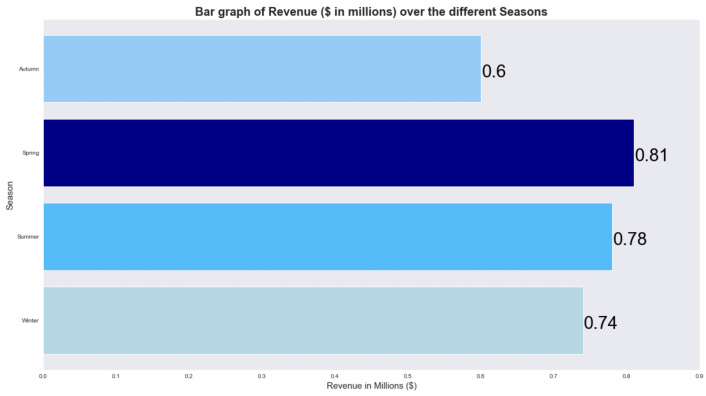


Figure 6: Overall Trend of Monthly Average Price from 2015 to 2020

4.3 Revenue vs Season



To determine which season is the most lucrative for the avocado business, we plotted a bar graph to analyze the revenue earned across each season for easy comparison. As defined above in terminologies, we split the year into 4 seasons and found the average revenue for each. Therefore, to milk the highest revenue possible, it is recommended that the business strengthen its sales during spring followed by summer, winter, then autumn.

Figure 7: Bar graph depicting average revenue earned for each season across the years

4.4 Revenue vs Type

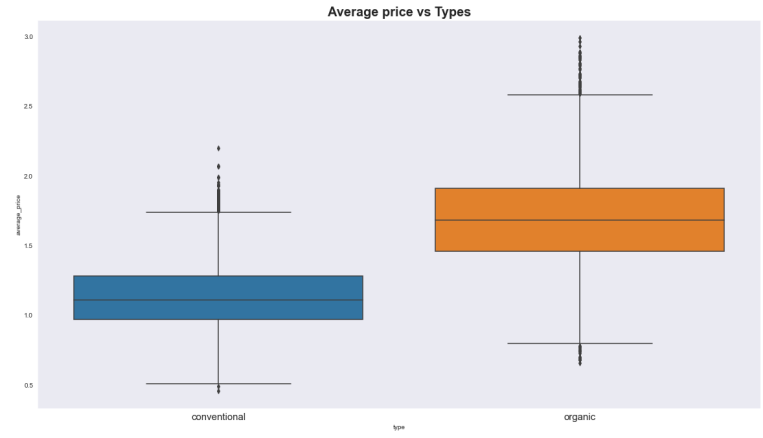


Figure 8: Relationship between Average Price and Type

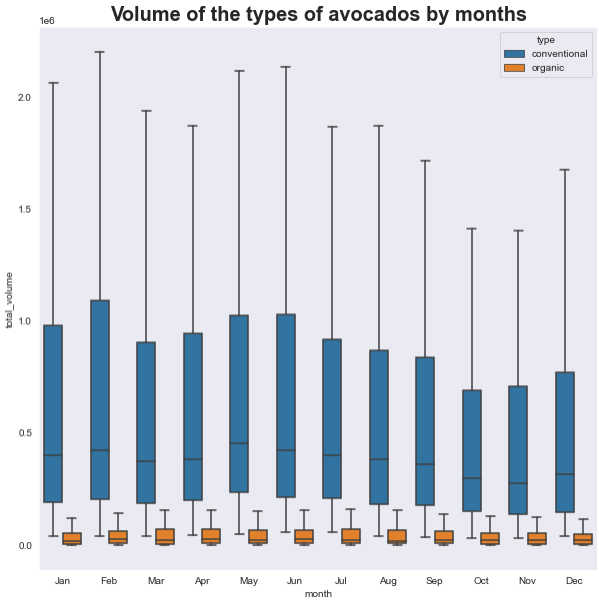


Figure 9: Relationship between Volume and Type throughout the months

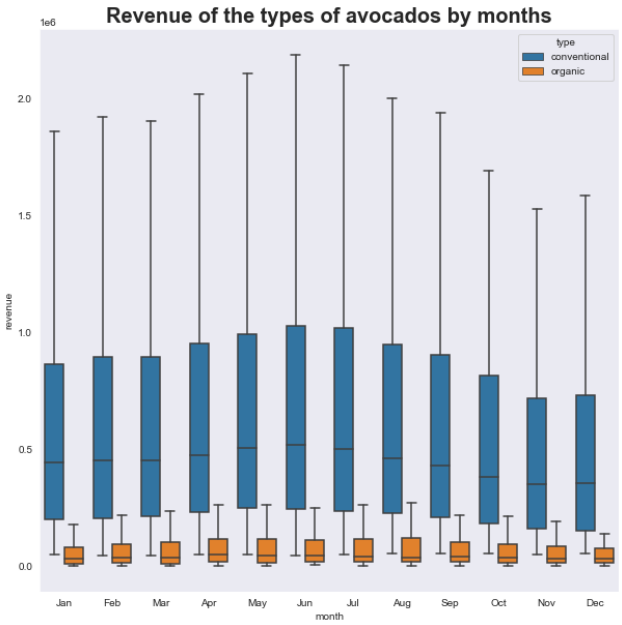


Figure 10: Relationship between Revenue and Type throughout the months

Based on the boxplot of two different types, namely, conventional and organic, it is clear that organic ones are generally sold at a higher price (Figure 8). This may be attributed to greater labor input (Soni, 2019), as well as the low supply that could drive these high prices (Hirsh, 2019). The relatively higher price of organic avocados may result in the limited demand from customers according to the law of demand and thus, the total volume of conventional avocados completely outnumbered the organic ones (Figure 9).

Despite the relatively lower price for conventional avocados, when analysing the total revenue sold, the conventional avocado dominates the market instead (Figure 10). The revenue range for conventional avocados sold is significantly, and consistently larger than that of the organic avocados. This may be attributed to the target customers of organic avocados being in the upper class, whereas conventional avocados have a wider range of customers from the lower to middle classes; therefore, creating such a huge disparity in revenue.

4.5 Revenue vs Regions

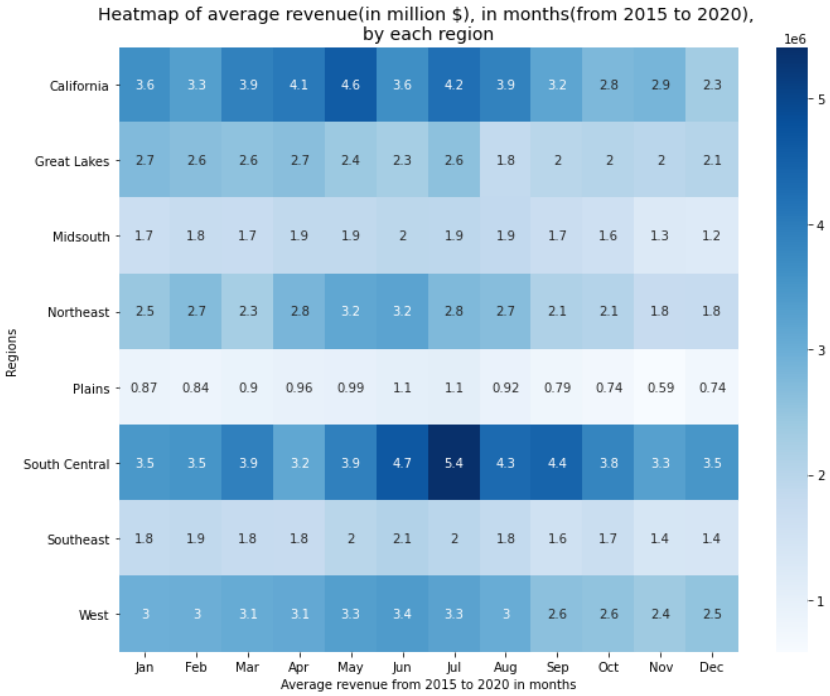


Figure 11: Relationship between Revenue and Regions, segmented into months

To establish which region GreenGrocer should enter to garner the most revenue, a heatmap of the average revenue earned in months, segmented based on each region was plotted. Analyzing Figure 11, we observe that the South Central region has been consistently gathering substantial revenue from 2015 to 2020 every month, followed by the California region.

In addition, the revenue for all regions follows a specific pattern every year – revenue increases from January till the middle of the year; and thereafter declines for the rest of the year. This is illustrated through the gradual change in color gradient of the heatmap. This distinctly shows that the surge in revenue is a result of increased sales across all regions, validating our analysis for revenue VS months (header 4.2). Thus, regardless of the region entered, GreenGrocer should capitalize on the increased sales during the middle of the year (May to July) by ramping up their production capacity.

5. Scoring System

5.1 Description of Scoring System

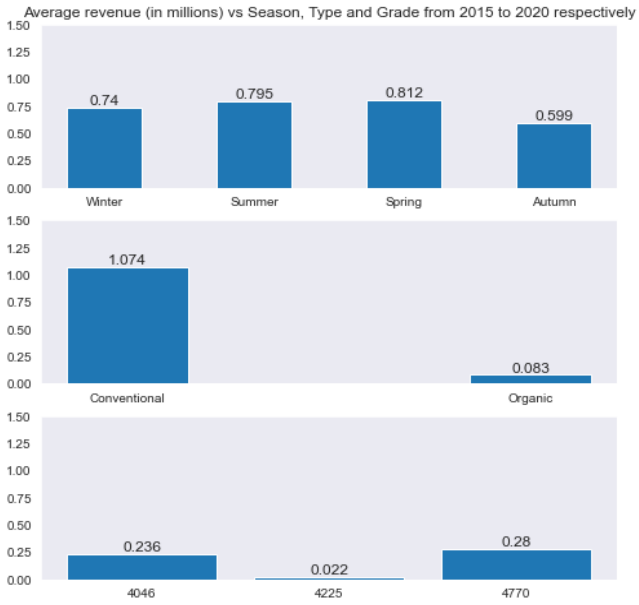


Figure 12: Average Revenue by Season, Type and Grade from 2015 to 2020

To assist GreenGrocer in finding out the best region to enter, we have devised a scoring system to evaluate each of the regions in the US based on three variables – seasons, type, and grade.

The scoring system follows a methodology where scores are assigned based on the revenue earned.

With reference to Figure 12, for seasons, since Spring has the highest average revenue, it will be allocated with 4 points, followed by Summer (3 points), Winter (2 points), and Autumn (1 point) (Figure 13). And for type, conventional avocados will be assigned with 2 points and organic with 1 point (Figure 14), and for the grade of avocados, “4770” will be given 3 points, “4046” with 2 points, and “4225” with 1 point (Figure 15).

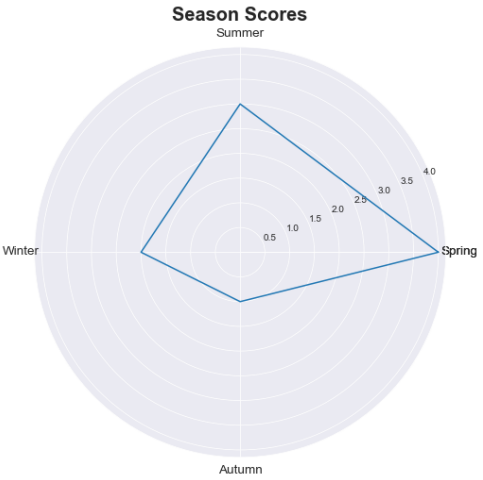


Figure 13: Assignment of Season scores

Figure 14: Assignment of Type scores

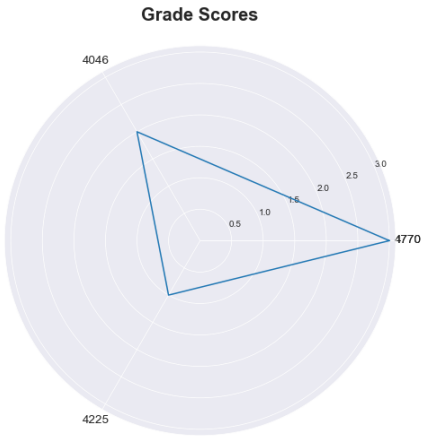


Figure 15: Assignment of Grade scores

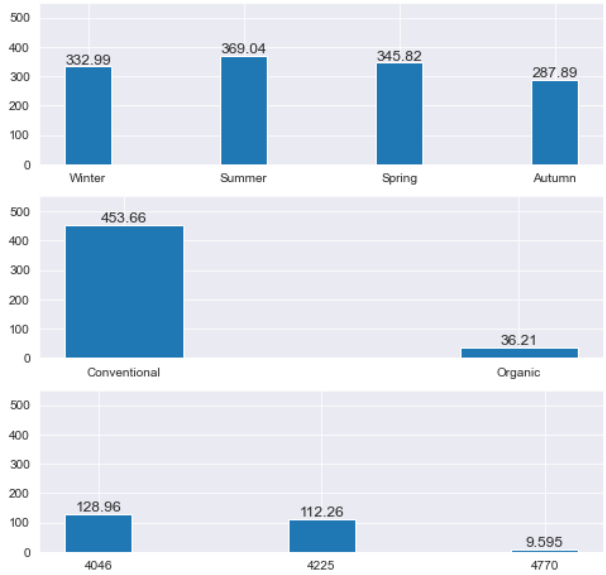
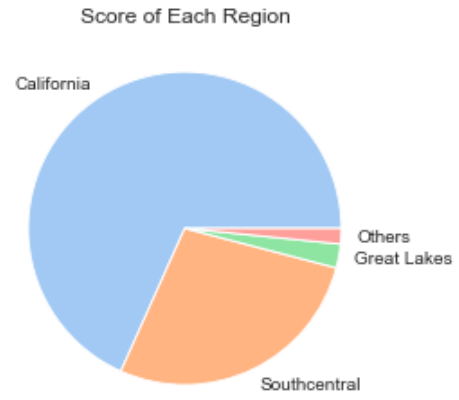


Figure 16: Values for the state California

After assigning the values for season, type and grade, we will then compute the score for each region. However, since each region has different land size, for better comparison, we decided to divide each of the revenue values for each region by their respective land area.

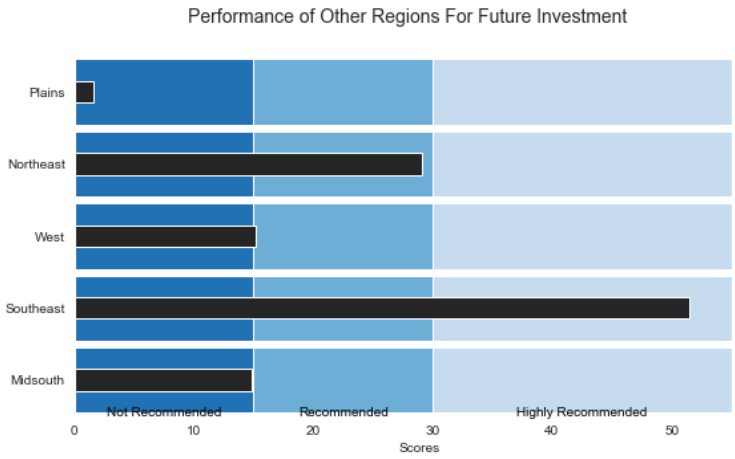
Using California as an example, the score for California can be derived from values for each category, according to the assigned score determined above. For example, for season, California will be awarded (332.99*2 + 369.04*3 + 345.82*4 + 287.89*1) points. This can then be repeated for type, grade and subsequently for all other regions in the US. The computations for all other regions are included in Appendix 9.6.

5.2 Scores of Each Region



From the pie chart in Figure 13, we observe that California has the highest score, followed by Southcentral and Great lakes. The five other regions that GreenGrocer can potentially venture into are classified under “Others”, due to its low proportion of scores. With these outstanding scores, GreenGrocer should penetrate into California, Southcentral, and Great Lakes.

Figure 13: Performance by the Different Regions



To analyse the five other regions on a deeper level, the standards, ‘Not Recommended’, ‘Recommended’ and ‘Highly Recommended’ have been determined through past experience with dealing with other fruit companies who have sought help from us regarding the same issue. From Figure 16, should GreenGrocer acquire more capital and be willing to set up more avocado shops in more regions other than the three identified above, they should target the Southeast and Northeast.

Figure 14: Performance of other regions for future investment

6. Limitations & Improvements

6.1 Limited Avocado Types

While there are many varieties of avocados, only the Hass avocados are explored and analyzed in our dataset. This may give a myopic view of the avocado industry as different varieties may have different revenue-generating trends. Therefore, we are unable to give the exact variety of avocados that will generate the most lucrative revenue. However, our analysis will still be useful in the case of our specific business problem since Hass variety is the most popular worldwide, accounting for 95% in the US and about 80% worldwide (Handwerk, 2017), and we would also be advising GreenGrocer to sell this particular variety based on our analysis.

6.2 Factors of Demand

The historical data only constitutes the quantity of avocados sold in the different regions and does not account for the demand of avocados. Demand and quantity sold are different since there may be times when there is a lack of avocado supply to meet the specified demand. Especially in regions where demand is higher than quantity sold, the potential revenue amassed may be high. However, due to supply constraints, the region is only able to provide the limited supply of avocados available. Hence, the revenue generated may be understated as reflected in the dataset when there is excess demand but insufficient supply and is not truly reflective of the revenue that can be earned from the region.

6.3 Inability to Capture Certain Regions

The dataset used might not capture all regions in the US since there are 50 states in the US (World Population Review, n.d.) but not all may be reflected equally in the dataset. Therefore, there is a possibility of missing out on a state that can generate higher profits than the one we concluded on, resulting in possibly an inaccurate and incorrect market-entry strategy for GreenGrocer.

6.4 Different Number of Avocado Sellers In Each State

The data we have is an aggregate sum of all avocados sold by all existing sellers within each region. The dataset does not reflect how many sellers there are and is unable to reflect the general trend of each seller. Utilizing the lump volume of avocados sold by all the sellers, we are unable to see if there are different trends by each seller. Therefore, we are unable to estimate what the actual volume sold from each store is. However, since a general trend is observed, we believe that the analysis is reliable enough for GreenGrocer.

7. Conclusion

In conclusion, we would advise GreenGrocer to expand its business into California, Southcentral and Great Lakes. In terms of the type, conventional avocados would be more profitable than organic ones. Avocados of grade #4770 should also be prioritized as it is the most profitable. Additionally, GreenGrocer can consider pricing their avocados higher during Spring, especially in June, as it is the most lucrative season out of the four. They can do so by slowly increasing the prices from January to June, due to higher demand. They can also consider lowering their prices after June to entice more customers, thereby boosting the total volume of avocados sold and hence revenue.

However, we acknowledge that our data excluded cost factors, which, realistically, would vary across regions. These differences could be attributed to factors like rental, storage, and distribution fees. Higher expenses in other non-sales operational activities could offset the higher profits from the sales of avocados. Thus, rental fees in certain states in the South Central region could be higher as it is more frequented by tourists, which could offset the profitability in those locations.

It is important to note that the different grades of avocados would also incur different costs, with better grades having higher costs. Therefore, despite avocados of Grade #4770 being the most profitable, we will recommend GreenGrocer to carry both #4770 and #4046 to maximize revenue. They should also have both conventional and organic avocados, with the bulk of them being conventional. Through product diversification, Green Grocer would be able to reduce risks and ensure stable revenue and profits, especially during periods of lower volumes. Despite the limitations as stated above, we believe that our analysis is sufficient with many different aspects evaluated and explored for GreenGrocer to venture into selling avocado in the US.

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9. Appendices

9.1 Additional Information on Avocado Grades

Grade	Description	Estimated Size
#4046	Small/Medium Hass Avocado	~3-5 oz
#4225	Large Hass Avocado	~8-10 oz
#4770	Extra Large Hass Avocado	~10-15 oz

9.2 Breakdown of States in each region

Region	States
Plains	St. Louis
South-East	Atlanta, Jacksonville, Miami/ Ft. Lauderdale, Orlando, South Carolina, Tampa
South-Central	Dallas, Houston, New Orleans
North-East	Albany, Boston, Buffalo/Rochester, Harrisburg/Scranton, Hartford/Springfield, Northern New England, New York, Philadelphia, 'Pittsburgh', Syracuse
West	Boise, Denver, Las Vegas, Phoenix/Tucson, Portland, Seattle, Spokane, West Texas/New Mexico
Mid-South	Baltimore/Washington, Charlotte, Louisville, Nashville, Raleigh/Greensboro, Richmond/Norfolk, Roanoke
California	Los Angeles, Sacramento, San Diego, San Francisco
Great Lakes	Chicago, Cincinnati/Dayton, Columbus, Detroit, Grand Rapids, Indianapolis

9.3 Months of the year classified into Seasons

Season	Months
Winter	January to March
Spring	April to June
Summer	July to September
Autumn	October to December

9.4 Assigned Scores for Each Category

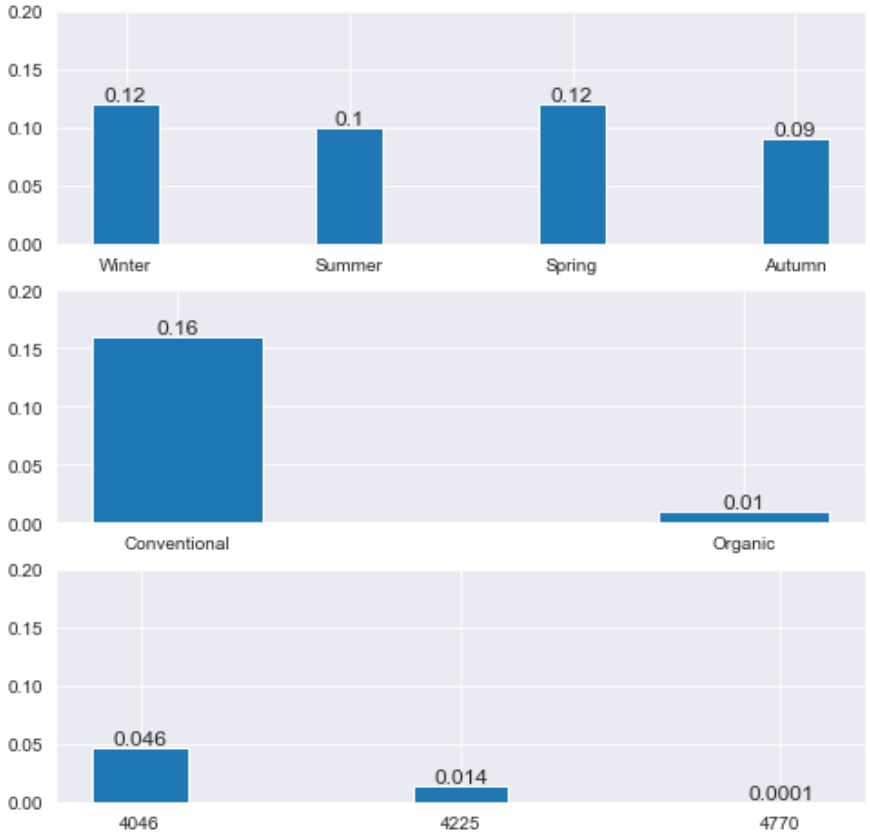
Season	Assigned Score
Spring	4
Summer	3
Winter	2
Autumn	1

Type	Assigned Score
Conventional	2
Organic	1

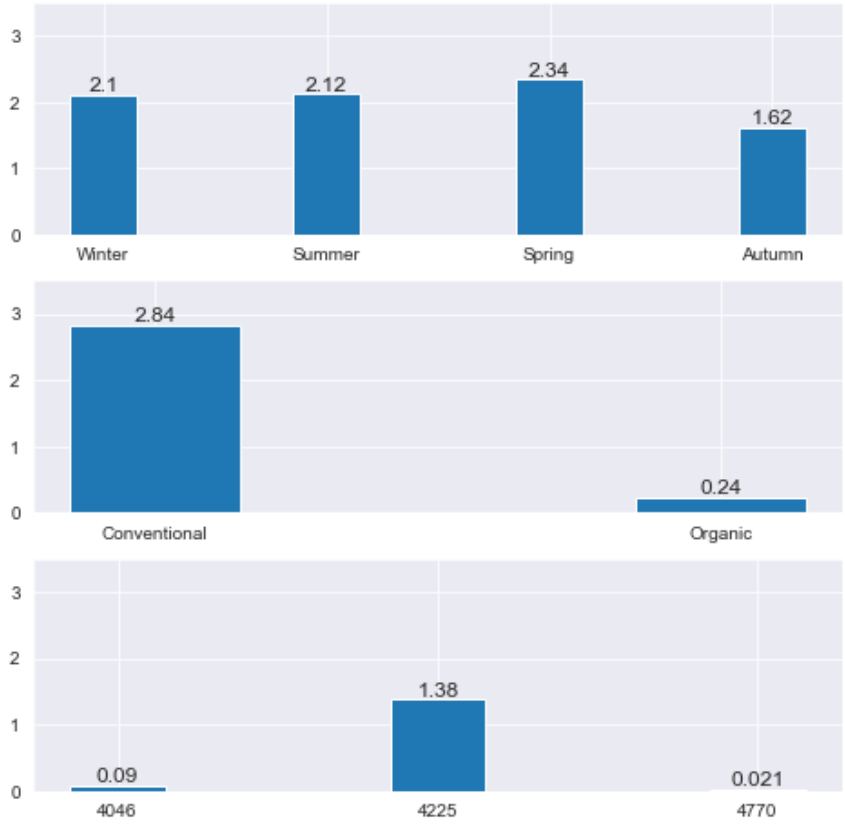
Grade	Assigned Score
4770	3
4046	2
4225	1

9.5 Average Revenue per Km^2 vs Season, Type, and Grade for Each Region Respectively

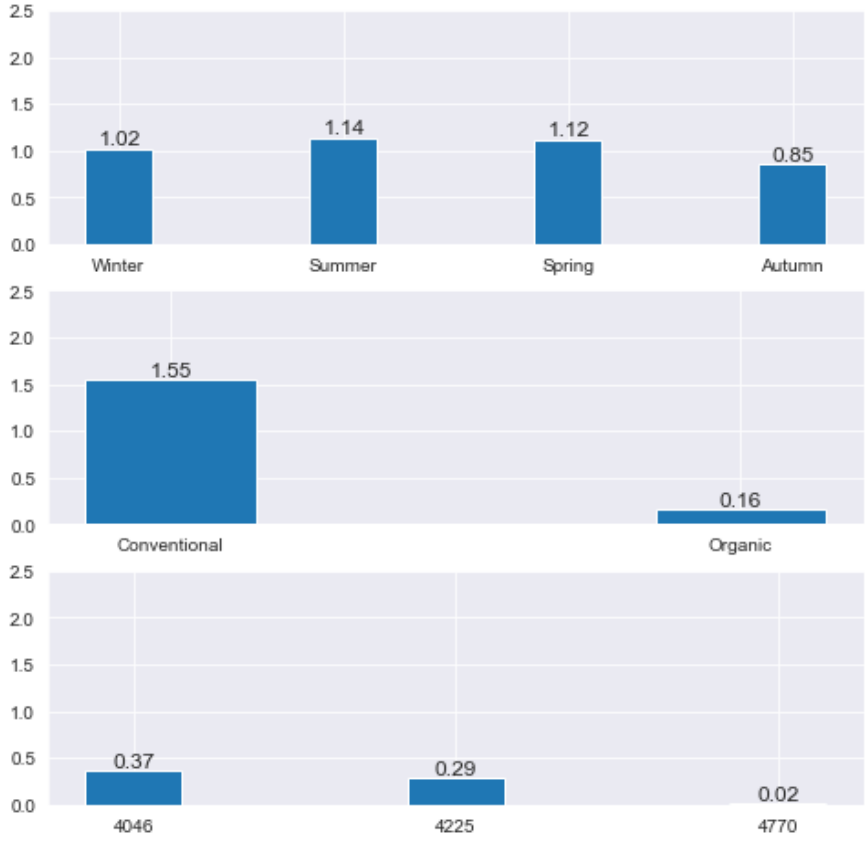
Plains



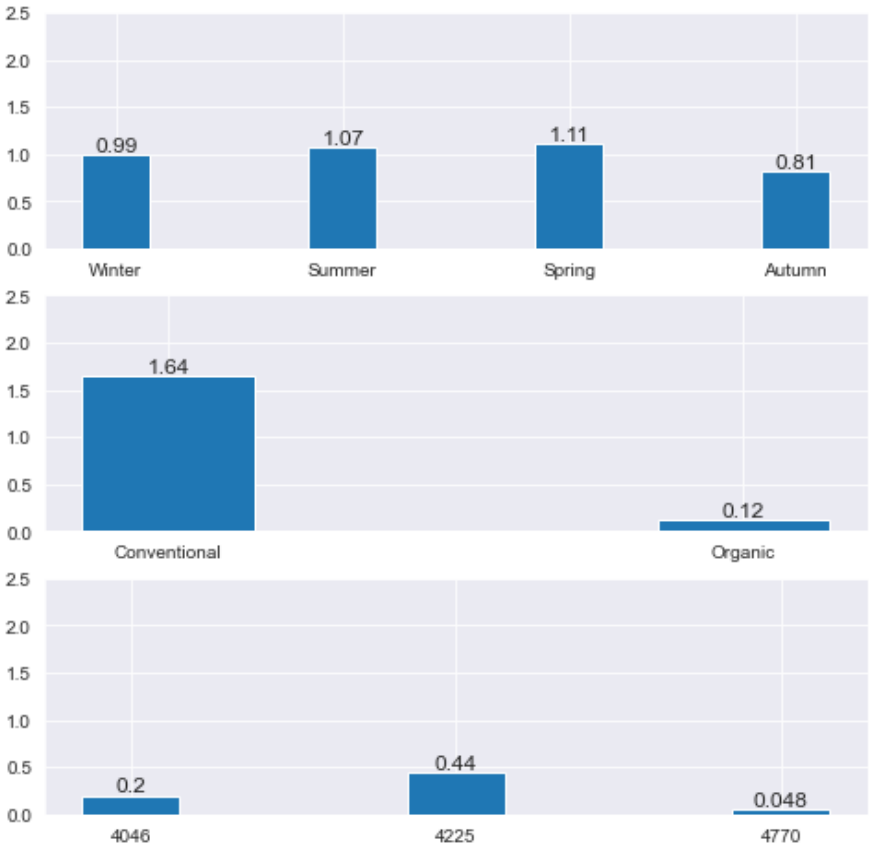
Northeast



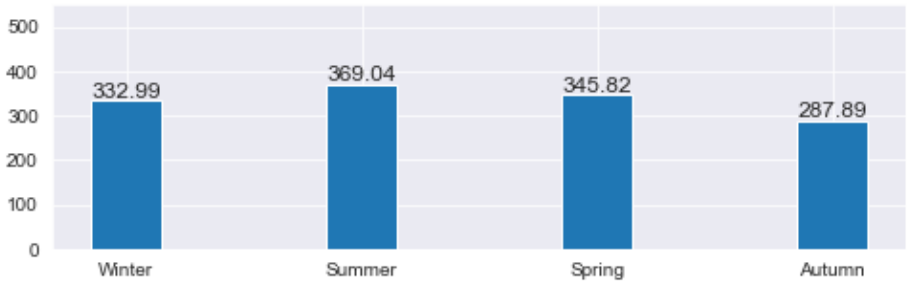
West

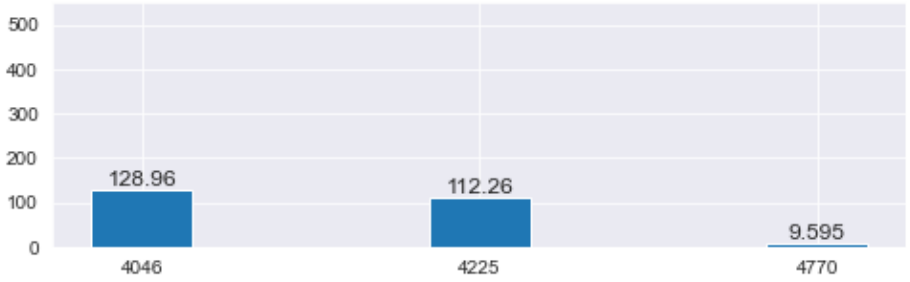


Midsouth

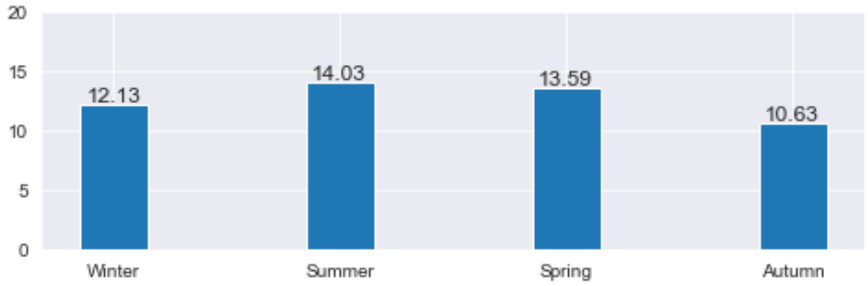


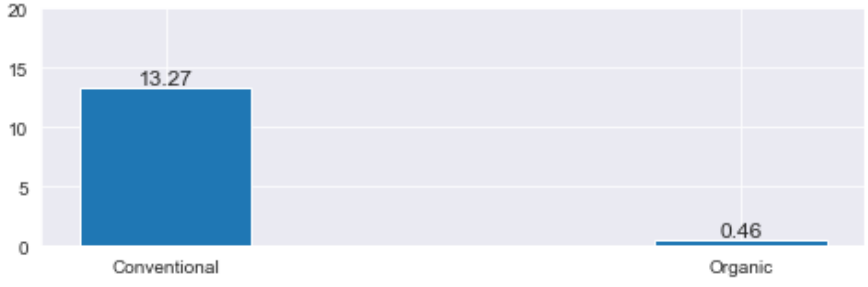
California

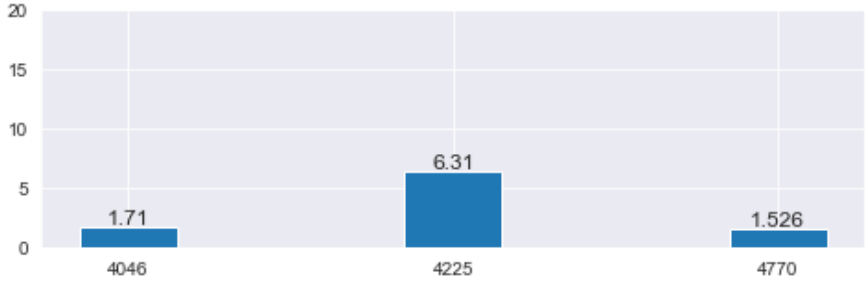




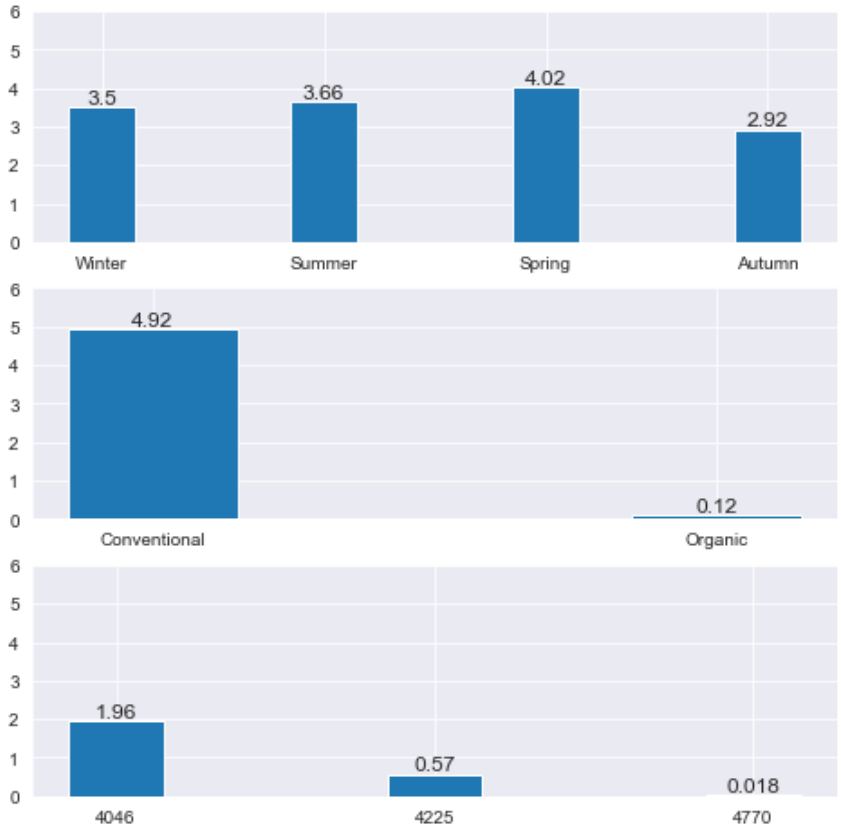
Great Lakes



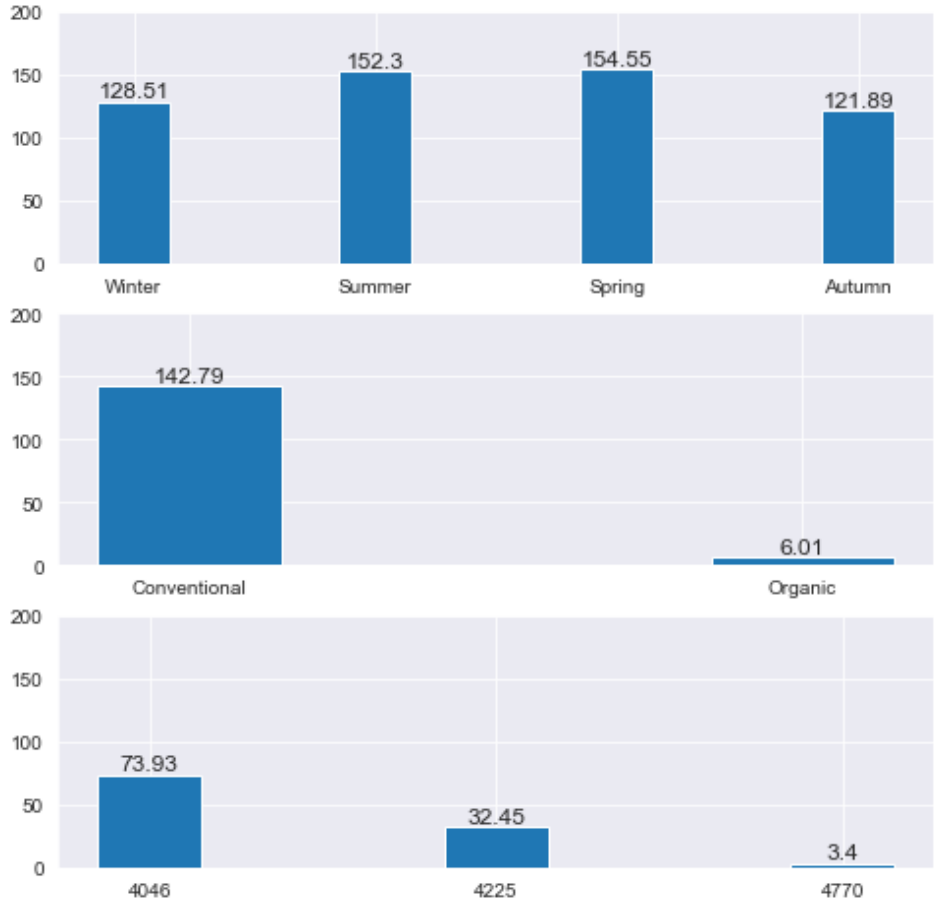




Southeast



Southcentral



9.6 Computation of Scores for Each Region

Region	Scores	Computation
Plains	1.55	0.12*2 + 0.1*3 + 0.12*4 + 0.09*1 + 0.16*2 + 0.01*1 + 0.046*2 + 0.014*1 + 0.0001*3
Northeast	29.08	2.1*2 + 2.12*3 + 2.34*4 + 1.62*1 + 2.84*2 + 0.24*1 + 0.09*2 + 1.38*1 + 0.021*3
West	15.14	1.02*2 + 1.14*3 + 1.12*4 + 0.85*1 + 1.55*2 + 0.16*1 + 0.37*2 + 0.29*1 + 0.02*3
Midsouth	14.83	0.99*2 + 1.07*3 + 1.11*4 + 0.81*1 + 1.64*2 + 0.12*1 + 0.2*2 + 0.44*1 + 0.048*3
California	4786.76	332.99*2 + 369.04*3 + 345.82*4 + 287.89*1 + 453.66*2 + 36.21*1 + 128.96*2 + 112.26*1 + 9.595*3
Great Lakes	172.65	12.13*2 + 14.03*3 + 13.59*4 + 10.63*1 + 13.27*2 + 0.46*1 + 1.71*2 + 6.31*1 + 1.526*3
Southeast	51.48	3.5*2 + 3.66*3 + 4.02*4 + 2.92*1 + 4.92*2 + 0.12*1 + 1.96*2 + 0.57*1 + 0.018*3
Southcentral	1936.11	128.51*2 + 152.3*3 + 154.55*4 + 121.89*1 + 142.79*2 + 6.01*1 + 73.93*2 + 32.45*1 + 3.4*3

(Values are obtained from Appendix 9.5)