JULIAN'S FORECASTING

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by

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ABSTRACT

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This report focuses on developing a solution to a current problem faced at Julian's Cafe and Bistro. The problem is that inaccurate order quantities are leading to inventory shortage and surplus which is causing unnecessary profit loss. After accessing and analyzing historical sales data, several forecasts were created using various approaches. After assessing each method and applying a mean absolute percentage error to see how accurate the forecasts were, the seasonal forecast with removing outliers initially was the selected method. After, this method was used to forecast the top three selling items at Julian's and make demand predictions for busy times during the quarter versus non-busy time. The forecast for the coming year and the predictions can be used by the supervisor at Julian's to make quicker and more accurate ordering decisions.

ACKNOWLEDGMENTS

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I. Introduction

The subject of this report is inventory management and order optimization using forecasting at Julian's Cafe Bistro. The idea for this project originated from a previous group project in a different class. In IME 305 (Operations Research II), a group of student and I briefly looked into the current inventory tracking methods at Julian's by interviewing one of their employees. We gathered that there was no standardized or clear method that all employees followed which lead to disorganization and incorrect order quantities because current inventory levels were unclear and the supervisor was struggling to order the correct amounts of raw material. This seemed like an interesting problem to look into and design a solution for my senior project. The problem is that incorrect order quantities are causing inventory shortages and surpluses which leads to sale opportunity loss and wasted space in their small storeroom. The supervisor needs a better system when it comes to making ordering decisions. It is also difficult to predict how much to order because of the varying demand at Julian's. This variation comes from variables such as weather, time of day, time in the quarter, and special sale items. Depending on these factors, Julian's will sell more or less of certain items. This is an important problem to address because it currently leads to unnecessary inventory shortages and surpluses which ultimately wastes money for the business. Metrics to evaluate this problem are how long it takes the supervisor to make an order and the wasted product cost when a shortage or surplus occurs.

Some objectives for my project are as follows:

- Execute the project using IME curriculum such as operations research, inventory management, order quantity optimization, seasonal forecasting and process improvement
- Plan and manage the project using timelines and due dates
- Perform research on the IME topics I will be utilizing
- Measure forecasting error
- Design an engineering solution for Julian's
- Present results and recommendations
- Write a complete technical report
- Give a business plan presentation

To solve the problem at Julian's, an accurate current state analysis is needed to be made using flow process charts and data to quantify how much of a problem it is. This also involves interviewing the supervisor and getting her feedback on how relevant procedures and operations are currently done. Then, there is a need for adequate research and finding appropriate literature review resources in order to become an expert on the topics and see how other similar businesses are currently running their inventory management and ordering systems. Next, brainstorming and designing the best design and methodology for my solution is crucial. For this project, there is a developed solution to the problem, a technical report, and a business plan presentation. A deliverable from the work done is a seasonal forecast of the sales at Julian's to better aid the supervisor in making orders and help her understand the seasonal trends on campus. Another deliverable is a comparison of busy times in the library to non busy times and how that effect sales. The solution approach to be used to reach these objectives involve getting a clear understanding of what is useful to the supervisor, forming potential solutions, choosing the best

solution that is the most beneficial to Julian's and how it will save them money if they use it in the future. This report begins with background information and literature review, then moves onto the design section, followed by methodology and results.

II. Background

This chapter contains background on Julian's, a current state report, and a summary of literature that pertains to my project. Julian's is located on the Cal Poly campus on the second floor of the Kennedy Library. They operate as a popular coffee and snack cafe for busy students as they are studying in the library. Some common items they sell are regular hot coffee, specialty coffee drinks, various snack items and pastries. Julian's operates under Campus Dining which operates under the Cal Poly Corporation. Recently, Julian's experienced many changes to their operations including a new supervisor and a new management software that the supervisor is expected to use. This software is called Order Management Software (OMS) and the supervisor at Julian's mainly uses it to keep track of inventory. Currently, the supervisor takes inventory about once a week by bringing a list to their storeroom and then counting and recording everything they have by hand. She then updates these inventory levels into OMS by Thursday to be reviewed by purchasing. For ordering, Julian's currently gets supplies from various vendors such as Sysco Corporation and LA & SF Specialty, depending on the product needed. After viewing current inventory levels and using her best judgment from previous experience, the supervisor places an order approximately weekly, depending on the vendor's delivery availability. The flow process chart in figure 1 shows this current process.

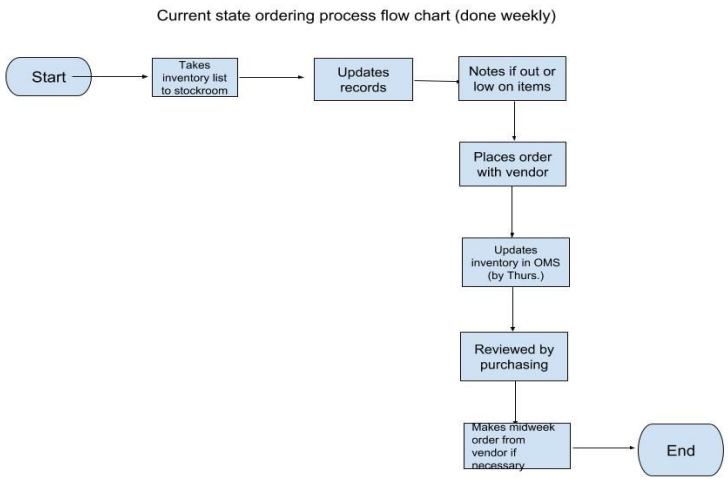

Figure 1 Current state flow process chart.

Since there is not a standardized system in place for ordering, there can be shortages and surpluses which creates missed sales opportunity and wasted space in their limited stockroom. Figure 2 shows a fishbone diagram to identify the root cause for these shortages and surpluses.

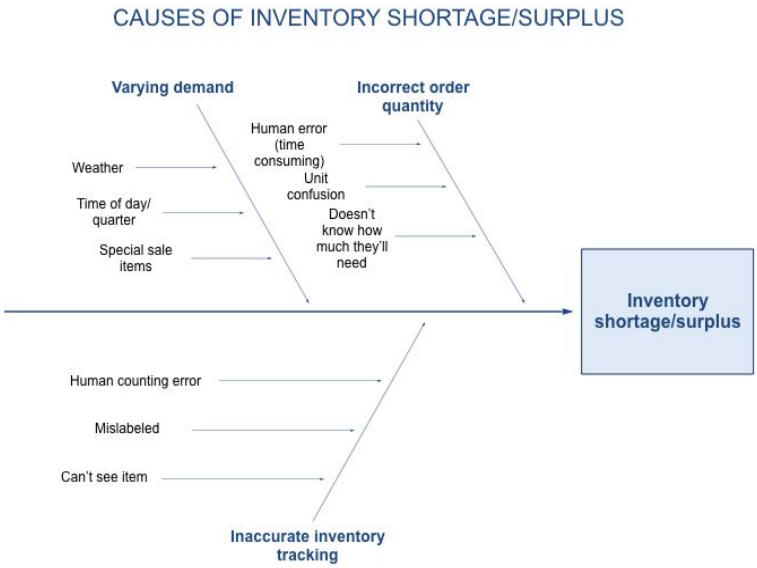

Figure 2 Fishbone diagram showing root cause of inventory shortage and surplus.

Literature Review

The literature review for this report consists of references and information within those references that pertains to this project. This information has various case studies, definitions, and possible solutions to problems that are similar to the challenges faced at Julian's. The references stem from the overarching topics of inventory management and optimal order quantity. The literature review helped me come up with ideas for possible solutions to the inventory management problem at Julian's.

Inventory Management

Proper inventory management is crucial for the success of a company, especially in a food service business like Julian's because they don't want any of their product to go bad and they also have a small storeroom so they can't afford excess inventory. There are five general types of inventory (Stevenson, 2005). The five most common are raw material and purchased goods, partially completed goods, finished goods, replacement parts, and goods-in-transit (Stevenson, 2005). Partially completed goods usually is classified as work in progress and finished goods can be a company's merchandise. The inventory types at Julian's are raw material, partially completed goods, and finished goods. The raw material are items such as coffee beans and chai latte powder while partially completed goods are drinks that are in the process of being made by the employees. Their inventory consists of mainly finished goods which are items such as cups, straws, and the food items that they order. The functions of inventory are to meet forecasted demand, smooth production requirements, decouple operations, avoid stock-out, take advantage of quality discounts and order cycles, and to help protect against price increases (Stevenson, 2005). Julian's mainly uses their inventory to meet forecasted

demand and avoid stock-out. The objective of inventory management is to achieve good customer service levels while keeping inventory costs low (Stevenson, 2005). These inventory costs usually consist of ordering and carrying costs. Effective inventory management leads to keeping track on current inventory levels, reliable forecasting of demand, knowledge of lead times, reasonable ordering, holding, and shortage cost estimates, and a proper classification system (Stevenson, 2005). The most important feature that effective inventory management can help improve Julian's is demand forecasting. There are many ways to keep track of inventory. Knowing accurate inventory levels can aid in accurate order quantities. The first inventory counting system is a periodic system when someone physically counts the items routinely (Stevenson 2005). This is what the supervisor at Julian's is currently doing. The next counting system is a perpetual inventory system which is when you accurately keep track of what comes out of inventory (Stevenson, 2005). That way you can know how much you need to replace on the next order. The next inventory counting system is a two-bin system. This is when each item in inventory has two containers that hold designated amounts and you reorder when the first container is empty (Stevenson, 2005). This is a method that might be useful at Julian's. The last inventory counting system is a universal barcode system where each item has a label that can be scanned on it with information pertaining to that item (Stevenson, 2005). These are all ways to keep more accurate current inventory levels which is crucial when deciding how much to order.

Inventory management in a foodservice organization can be particularly challenging because product has a shelf life and can go bad which is unwanted waste. You also don't want to order too much product because often there is limited storage space. In his paper, Spears discusses the flow of food through various food service options. Inventory control specifically

within food service organizations is crucial to keeping up with customer demand (Spears, 1995). There are many factor that go into the effectiveness of inventory management. After performing a study, Shiau Wei Chan found that "underproduction, overproduction, stockout situation, delays in the delivery of raw materials and discrepancy of records" are the main problems in inventory management (Chan, 2017). These can be seen in figure 3.

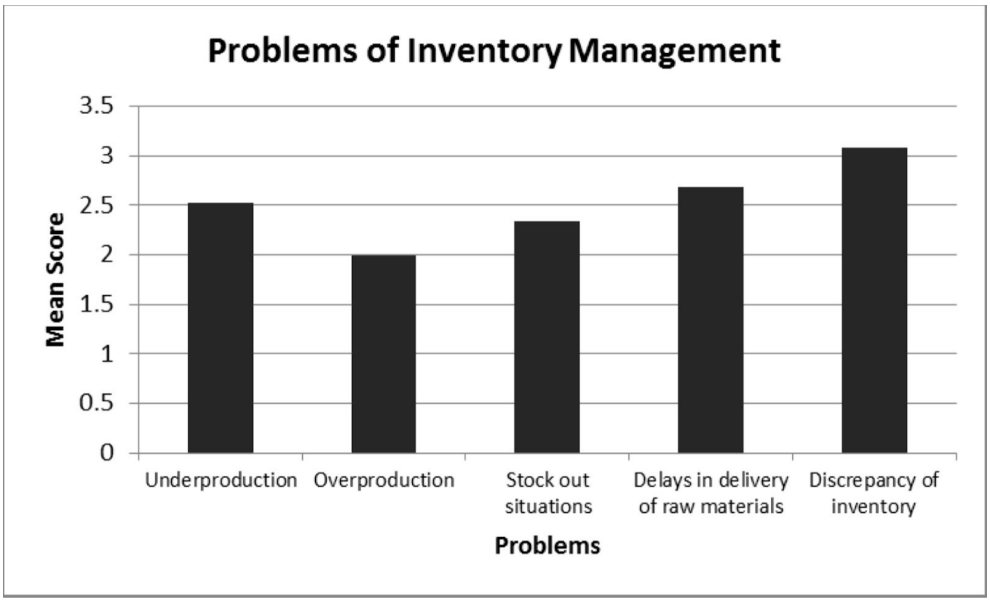

Figure 3 Main problems with inventory management.

Even though Julian's doesn't "produce" anything in the manufacturing sense, the concept still applies to when the supervisor over or under orders items. Chan also talks about how effective inventory management is important for a business to be more competitive. Common influencers on the effectiveness of inventory management are "the factors, documentation/store records, planning, and knowledge of employees/staff skill" (Chan, 2017). These are all important features to keep in mind when managing inventory.

Inventory management can also directly affect the daily operations at a company. There was a study done by Cham Springer to test a performance model that examined the relationship

between inventory management and firm operation performance. From the study, they found that "inventory efficiency and productivity significantly impact firm operating performance" and "firms that operate a leaner and more efficient inventory system significantly outperform competitors" (Springer, 2016). Dirk Pons in *Management Control. A Survey of Production and Inventory Control Models in Theory and Practice* also discusses the importance of inventory control while providing insight on production control objectives, sales and capacity planning, and integrated operating systems. He claims that "you should begin by raising the problem to a higher level and examining a great deal of the essential policy questions to be able to start working out the most suitable materials management system" (Pons, 51). All in all, adequate inventory management leads to a much more successful business with less waste.

Optimal Order Quantity

There are many methods when it comes to deciding how much and how often to order depending on the industry, demand, and inventory size allotment. Getting the most optimal order quantity can yield great savings and in the end can make or break a company. At Julian's, optimal ordering is especially important because of their limited storage space and perishable items. This can be a difficult task though with the varying and sometimes unpredictable demand. Chih-Hsiumg Wang reiterates this and claims that "the reorder point plays a role in balancing the costs between the inventory holding and shortage" (Wang, 2010). There a many techniques that have been discovered over the years to tackle this reordering problem. In 1963, Hadley and Whitin initially developed a quantity and reorder point model to deal with varying demand where an order of Q is placed once the inventory level reaches the reorder point R (Wang, 2010). Later in 1996, Wang and Gerchak created a more general formula for order quantity and reorder point

with varying capacity (Want, 2010). Some variables in this formula include production cost per unit, inventory holding cost per unit, and order quantity (Wang, 2010). To deal with the varying demand, they introduced an X variable that represents the random demand during a replenishment lead time with a probability density function, cumulative distribution, and a survival distribution (Wang, 2010). The solution structure then depends on the distribution of the lead time demand. This method was proven to be useful in many inventory environments.

Using point of sales data to decide how much to order is also a useful and more methodological technique. Understanding what customers want and when they want it can be a major advantage to a company. Sethi claims that companies should obtain in advance information on their customer demand. He explains that there is an optimal Markov policy that is a modified base-stock policy (Sethi). This can be useful when deciding how much to order. He also says that "regrouping the forecasting effort from all sources such as firm orders received, preseasonal sale information, and point of sales data, has been remarkably effective in obtaining advanced demand information" (Sethi). When you know what your customers want, you can order properly ahead of time and optimize sales. Another example of a technique to evaluate what customers want is using MarketAnalyzer. Market Analyzer is an interactive visual analytics system to help vendors increase their competitive intelligence by analyzing present sale data, trends, and market share growth (Wiley). Wiley explains why this is important for a company to be successful by claiming that "competitive intelligence is a systematic approach for gathering, analyzing, and managing information to make informed business decisions. Many companies use competitive intelligence to identify risks and opportunities within markets". Using approaches

like MarketAnalyzer can help a company get insight on what their customers are going to want so they can accurately order ahead of time in preparation.

Several other models have been developed to help aid optimal ordering quantity when there are unknowns such as demand. The IEEE Conference Publication posted an article about economic order quantity (EOQ) with "fuzzy" demand. The term "fuzzy" refers to a variable that is unstable and varies. They use three types of variables to represent the uncertain demand and expected value of the total cost function is minimized. They explain that "fuzzy set theory is applied to represent uncertainties arising in demand or the cost coefficients. By using it, one can easily quantify the vagueness and imprecision in data" (De). They use lambda pessimistic and optimistic values for various L-R types of numbers in varying demand inventory models (De). Using a method like this could greatly benefit Julian's because they experience a similar varying demand that the model accounts for. Another method that stems from the traditional EOQ model was developed by Victoria Mabin and is a simple approach to ordering only involving the order size Q and the reorder point R (Mabin, 1989). This approach appeals to inventory controllers and management because it can obtain order quantity directly and it is an easy to understand approach so they trust it (Mabin, 1989). The model involves a total cost function of order quantity and reorder level which can be broken down to constants such as safety stock and holding cost (Mabin, 1989). In order to get the final solution, it classifies reorder level as being equal to an average constant plus safety stock (Mabin, 1989). This method is known to be quick but effective. It also saves on computer time since the model is so easy to use by supervisors and managers. Julian's could also greatly benefit from a simple model like this that the supervisor could run before doing her weekly orders.

This project is important in the context of this literature review because I will be coming up with a solution to optimize both inventory and ordering at Julian's. This literature review shows the importance of proper inventory management and optimal order quantities and how it can help a business save money and time. It also provides many methods and models that have been done in the past to try and tackle this problem. The insights from this literature review will be used to form a clear solution to the inventory and ordering challenges faced at Julian's.

III. Design

This chapter will go through the design of solutions to the inventory problem faced at Julian's. After many meetings with the supervisor at Julian's to see what information and data was available, it seemed like their historical sales data was an underutilized resource. There was a clear need for a forecast at Julian's using their historical sales data so the supervisor could be more aware of trends throughout the quarter and make better order decisions accordingly. Some requirements for the design of the solution is that it uses valid data to make the forecast and that it accurately projects sales for the upcoming year. A constraint for the design is that it only uses the past four years of data in order to encompass a more manageable data size, but still enough to capture the seasonal trends.

To begin, the historical sales data was obtained from the supervisor at Julian's. I was given access to their Oracle MICROS system which captures all of the sales at Julian's. I decided to pull the weekly total amount of each item sold over the past four years because it captured the weekly varying demand that the project needed, but was still manageable for me to sort through. An example of the file that was exported from MICROS directly into Excel is shown on Table 1 in the appendix section. After creating 155 individual Excel files containing the weekly total sales, a VBA code was developed to pull the date, item, and quantity sold from each file and input it into four new Excel files for each of the four years. Then, the data was cleaned by removing duplicate and irrelevant data fields from the files.

Next, the data was to be visualized and analyzed. I combined all four years of data showing the item, quantity, and week period sold to one new Excel file. Then, I created a pivot table with the data sorted weekly and a seperate pivot table to analyze the data for monthly sales.

Table 2 in the appendix shows the total weekly sales data pivot table and Table 3 shows the total monthly sales data pivot table. After creating the pivot tables, the data was graphed to visually compare each year of sales to identify initial trends. The weekly and monthly graphs can be seen below in figure 4 and 5.

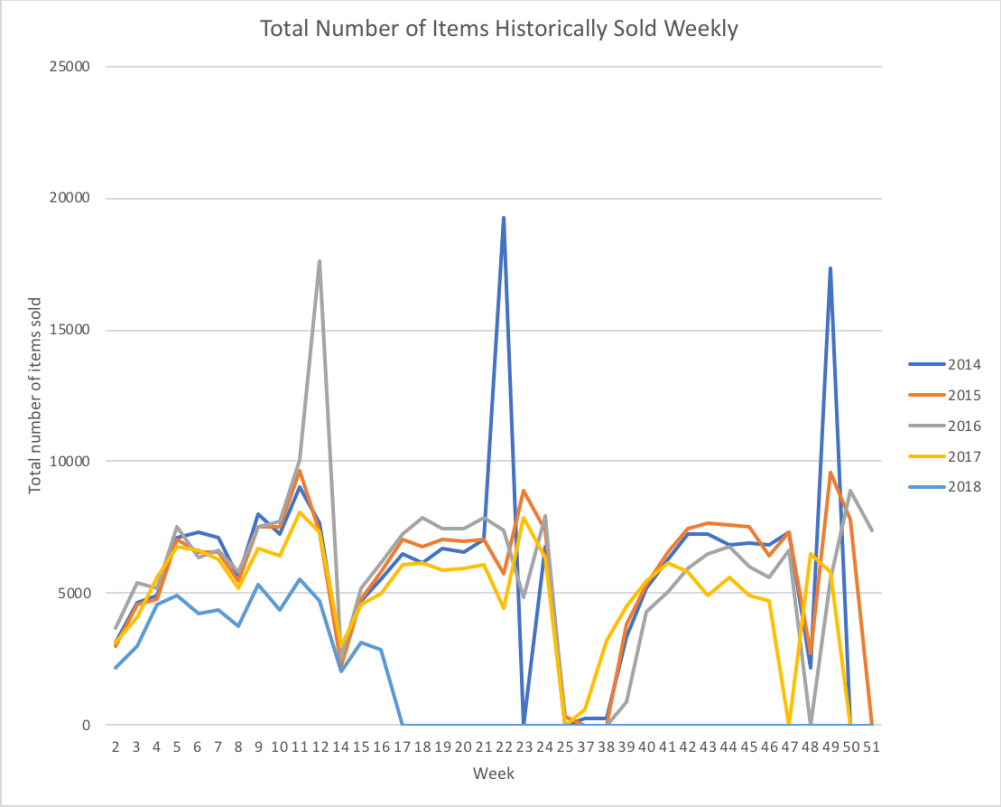

Figure 4 Weekly sales data.

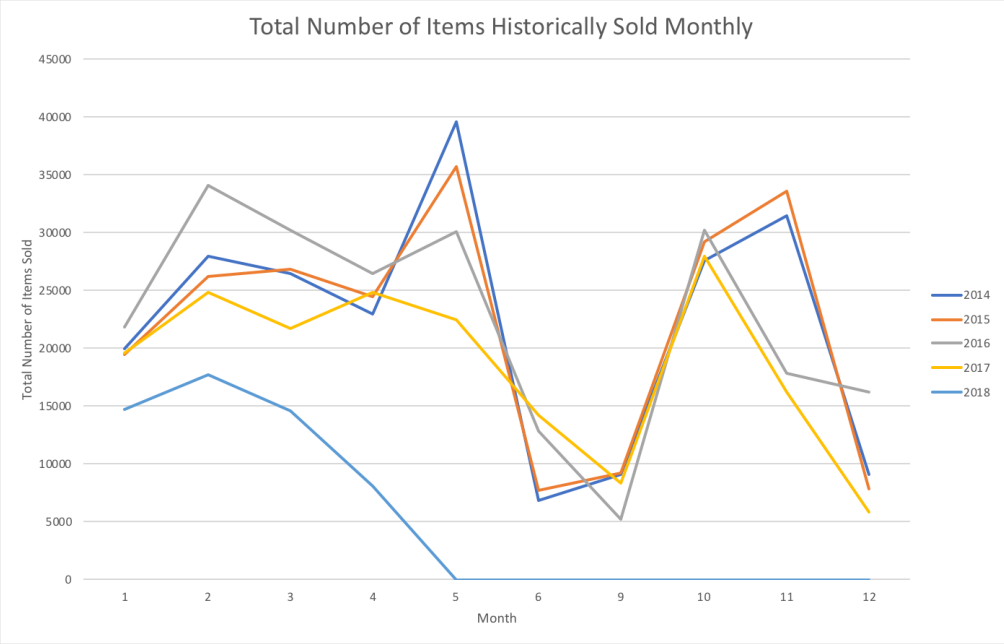

Figure 5 Monthly sales data.

After analyzing the data, I decided to use the monthly sales data for the forecast because it was a more manageable data size that still captured the seasonal trends. I also knew the weekly sales data was available if I wanted to go back later and create an even more detailed forecast and analysis. By observing the graphs, the peaks occur during dead week and finals week which usually fall around week ten and eleven of the quarter. During these weeks of the quarter, more students are studying on campus and in the library and are more likely to purchase items at Julian's. The gaps in the graphs occur when classes are not in session such as winter or summer break when there are little to no customers at Julian's. The outliers in the data occur because throughout the past four years, the quarterly schedule hasn't been consistent. For example, one of the years we had three weeks off for winter break while another year we had four weeks off which created significantly less sales in December for that year.

To design the initial forecast, the data from the total items sold monthly at Julian's was used. A new Excel file was created that contained the month and corresponding total sales for that month in two columns. Then a "time" column was created as an ongoing time reference from 1 to 54. Then, the seasonal average for each month was obtained by taking the average sales for every corresponding month. Next, the seasonal index was created by dividing the seasonal average value by the average of all the monthly demand values. After that, the data was deseasonalized by dividing the original demand for each month by the seasonal index. To find the trend, the regression function was used with the time column and deseasonalized data column to obtain a y-intercept and a slope value. Then, to find the final trend value, the time value was multiplied by the slope and added to the y-intercept value previously found. Finally, the forecast was created by multiplying the trend value by the corresponding seasonal index. The mean absolute percentage error was also created by taking the absolute value of the difference between the forecast and the actual demand for that month and dividing it by the same actual demand and multiplying it by 100 to make it a percentage. The table for my initial forecasting solution can be found in the appendix on table 4. Next, I graphed the data which can be seen below in figure 6, comparing the actual demand in blue to my forecast in orange.

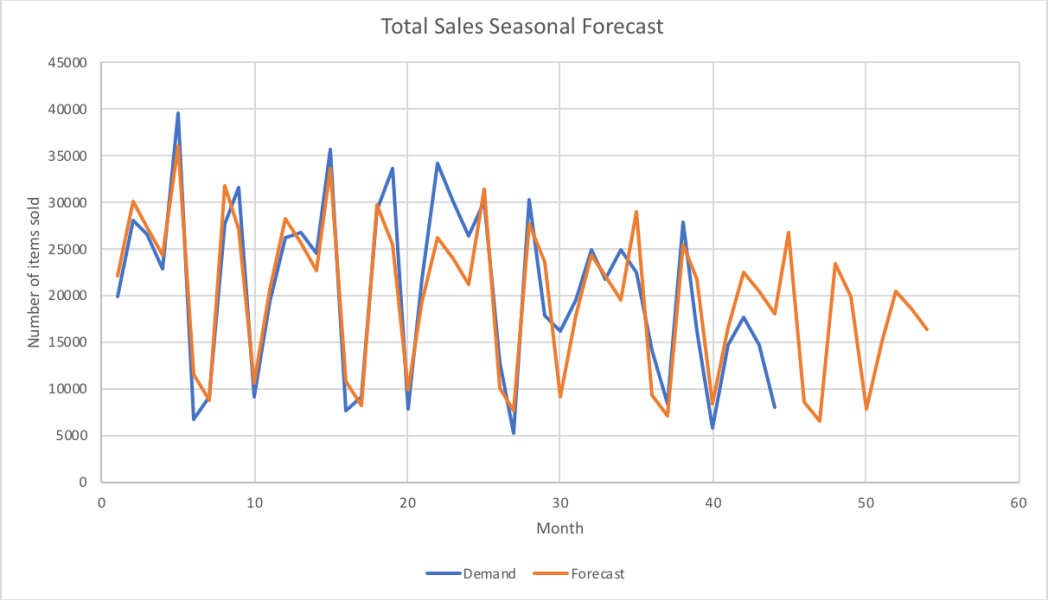

Figure 6 Graph using seasonal forecasting to compare actual demand to forecasted demand.

In order to create and compare alternative solutions using different forecasting methods, a moving ranges forecast was also created on a new Excel sheet. It started with the same time, month, and demand column as the previous solution. Then, the moving average forecast was found by taking the average of the previous year's monthly demand. Next, the ratio of moving averages was created by dividing the demand by the moving average forecast previously found. Then, the unadjusted seasonal index for one entire year cycle was calculated by taking the average of the ratio moving averages for every corresponding month over the four years of total data. Next, the adjusted seasonal index was created by dividing the unadjusted seasonal index for each month in the year cycle by the average of all the unadjusted seasonal index for the months in that same year cycle. Then, a seasonally adjusted series was created by dividing the actual demand for every month by the previously calculated adjusted seasonal index. Then, the regression function was used with the time column and the seasonally adjusted series column to obtain a y-intercept and slope value. To find the trend forecast, the time value was multiplied by

the slope value and added to the y-intercept. Then finally, the seasonally adjusted forecast was calculated by multiplying the previously found trend forecast value by its corresponding adjusted seasonal index. The mean absolute percentage error was also calculated the same way as the previous solution in order to evaluate the accuracy of the measurements. The calculations and values for this forecasting solution can be found on table 5 in the appendix. The graph comparing the actual demand in blue, the seasonally adjusted forecast in grey and the trend forecast in orange can be seen in figure 7 below.

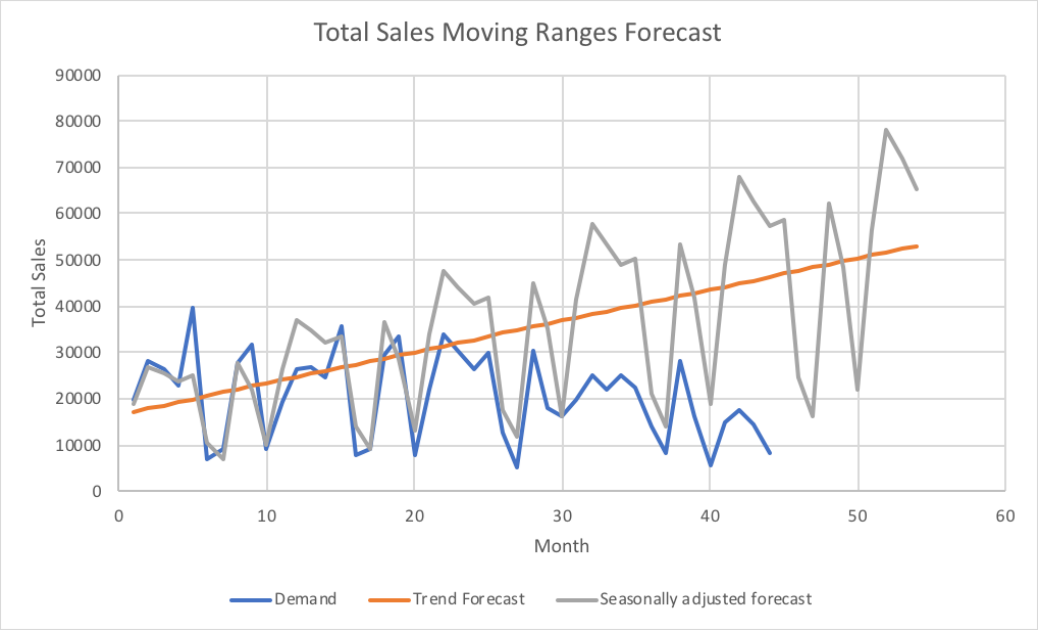

Figure 7 Graph using moving ranges forecasting to compare actual demand to trend and seasonally adjusted forecast.

The next alternative solution was similar to the first one but the outliers were removed from the data set initially. The outliers that were removed can be seen as the highlighted values in figure 8 below. They were selected because the month values were significantly different compared to the same month values over all four years.

Month	2014	2015	2016	2017	2018
1	19919	19411	21828	19593	14690
2	28041	26221	34127	24894	17689
3	26521	26816	30205	21768	14650
4	22967	24475	26473	24910	8062
5	39608	35702	30148	22432	
6	6799	7733	12818	14216	
9	9078	9156	5182	8362	
10	27621	29269	30257	27954	
11	31511	33589	17817	16175	
12	9079	7785	16245	5792	

Figure 8 Outliers removed from the data set.

After removing the outliers, the same calculations were made as the first seasonal forecasting solution. Table 6 in the appendix shows the calculations and values and figure 9 below shows the graph comparing the demand in blue to the forecasted demand in orange.

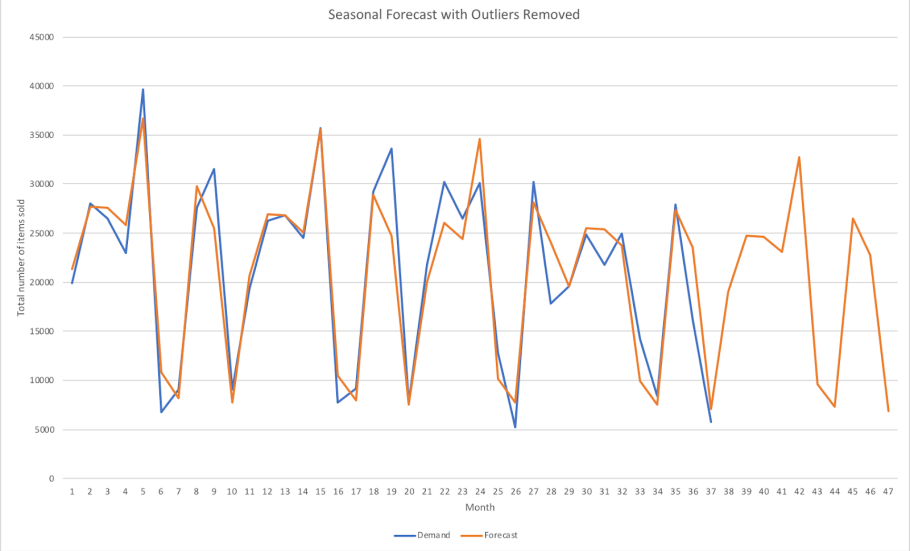

Figure 9 Graph using seasonal forecasting with outliers removed to compare actual demand to forecasted demand.

The final forecasting alternative solution was created by using a seasonal forecast with smoothing done first. A new Excel file was generated with the same time, month, and demand

columns as the previous solutions. Then, the smoothed demand was created with a damping factor of 0.9 by multiplying actual demand value by 0.1 and multiplying the previous smoothed demand value by 0.9 and then adding those two values together. Next, a seasonal average was created by taking the average of all the corresponding month values over the four years of data. Then, the seasonal index was found by dividing the previously found seasonal average value by the average of all the smoothed demand values. Then, the data was deseasonalized by dividing the smoothed data by the seasonal index. Then the trend, forecast, and mean absolute percentage error were calculated by using the same regression method and formulas as the first solution. The values for these calculations can be found on table 7 in the appendix and the graph can be seen below in figure 10 with the actual demand represented by the blue line, the smoothed demand in orange, and the forecast in grey.

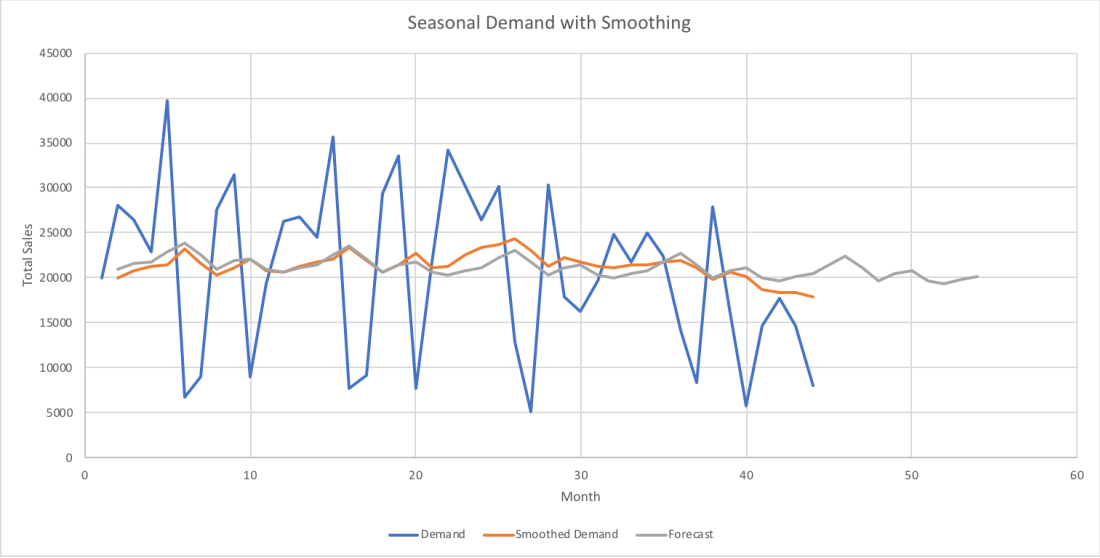

Figure 10 Graph using seasonal forecasting with smoothing to compare actual demand to the smoothed demand and forecasted demand.

This chapter explains the design of the forecasting solutions for the project in detail.

There are four solutions revolving around seasonal forecasting. One is more traditional seasonal forecast, a moving ranges forecast, a seasonal forecast with outliers removed and a seasonal forecast with smoothing.

IV. Methodology

This chapter will discuss the methods for testing the designs of project solutions and choosing the best solution. As discussed in the previous design chapter, the mean absolute percentage error was calculated for each solution. The average MAPE for each of the solutions can be seen in figure 11 below.

Method	Seasonal	Moving ranges	Seasonal w/o outliers	Seasonal smoothing
MAPE	21.1%	84.2%	14.2%	3.7%

Figure 11 Average MAPE for each solution.

By default, I was going to choose the solution with the lowest average MAPE value which would be the seasonal forecasting with smoothing. However, when looking at figure 9 above, the smoothed demand varies greatly from the actual demand and doesn't capture the variation seen at Julian's enough. Therefore, I chose the next lowest MAPE solution which is the seasonal forecasting with outliers removed. This chapter shows how a solution was selected to pursue for the rest of the project.

V. Results and Discussion

This chapter will present the results of my project when applying the selected solution above. Next, I applied the seasonal forecasting with outliers removed solution to the top three selling items at Julian's. These items are iced coffees, 16 ounce hot coffees, and iced lattes. I used the initial pivot tables that I created to sort these three items individually sold monthly over the past four years. Then I created three new Excel files for each item.

Outliers were removed from the data set for each item which can be seen in the highlighted fields in tables 8, 9, and 10 in the appendix. Then I performed the chosen seasonal forecasting with outliers removed method to each item. The calculations and values can be found in the appendix section on tables 11, 12, and 13. The graph for the iced coffee solution can be seen below in figure 12.

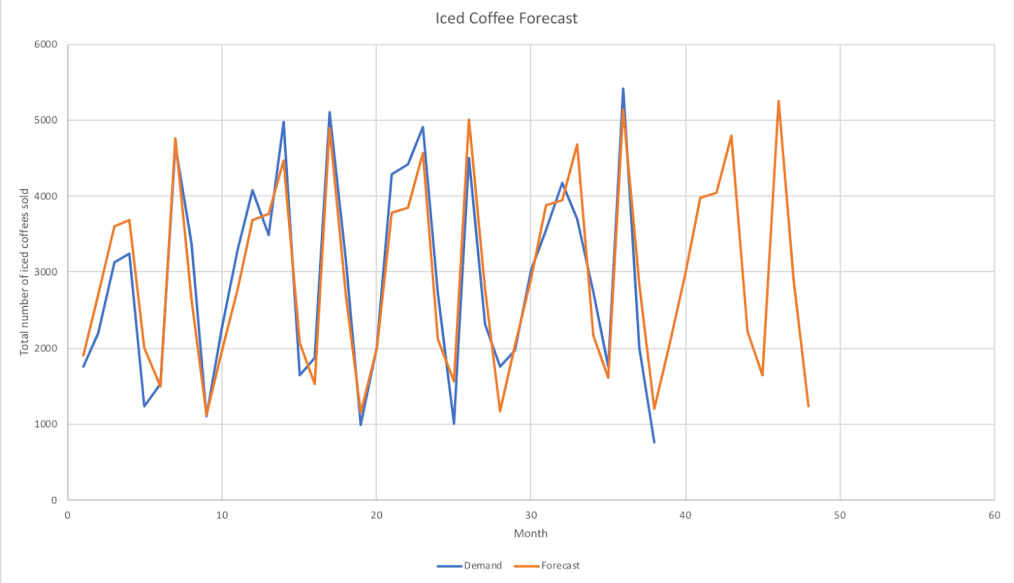

Figure 12 Iced coffee forecast.

The blue line represents the actual demand while the orange line shows the forecasted demand. The peaks occur during busy times in the library in addition to warm weather because people generally want iced drinks when it is hot outside. The graphs for the 16 ounce hot coffee and iced latte are shown below in figure 13 and 14 with the blue line being the actual demand and the forecasted demand in orange.

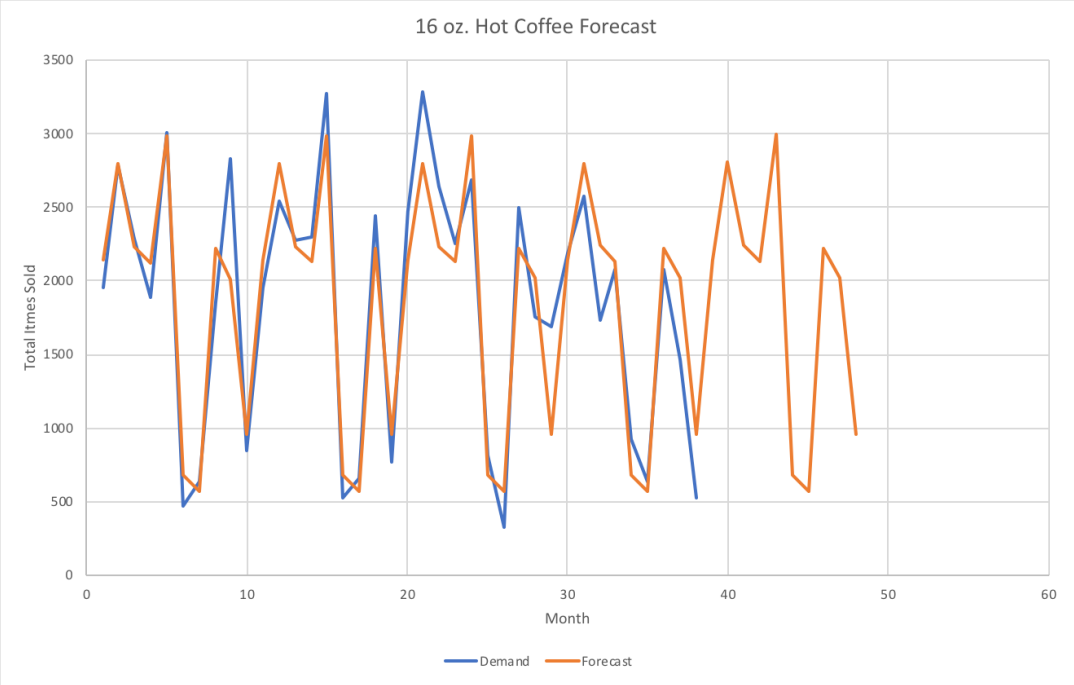

Figure 13 16 oz. hot coffee forecast.

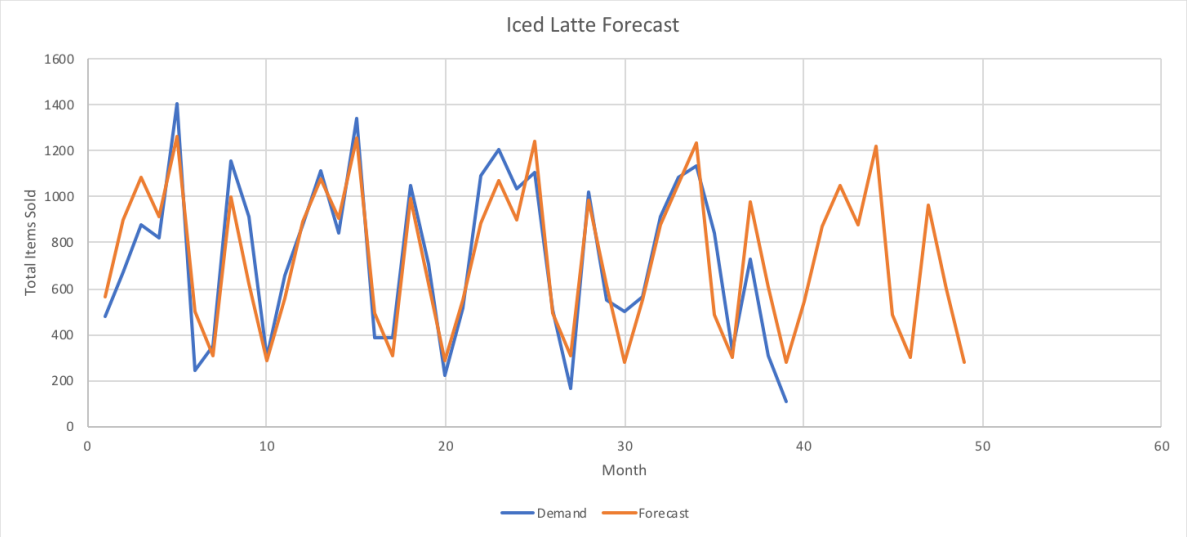

Figure 14 Iced latte forecast

Next, I extended the formulas to come up with the forecasted sales for the three top selling items. The results can be seen in figure 15 below.

Month	Iced coffee forecast	16 oz coffee forecast	Iced latte forecast
1	2094	2145	544
2	2988	2802	870
3	3971	2239	1048
4	4049	2132	880
5	4800	2995	1220
6	2218	684	483
9	1647	567	300
10	5258	2224	966

11	2903	2021	602
12	1236	960	277
MAPE	16.9%	18.1%	24.4%

Figure 15 Projected forecast of top selling items.

There is a gap in between months 6 and 9 because of July and August when Julian's is closed are there is no sales data. The MAPE is also calculated at the bottom to show the accuracy of the calculations. As observed, the months containing busy times such as dead week and finals week, have a forecasted demand that is significantly higher. The supervisor at Julian's should anticipate this increase in sales and make sure to order accordingly beforehand. The results were as expected because they followed the seasonal trends that occur throughout the year when considering busier time such as finals week and slower times such as the first week in each quarter when not very many people have a lot of work to do so they are not in the library as often. It is a good design because of the relatively low mean absolute percentage error which shows that the results are valid.

In order to compare the top selling items during a regular week in the quarter, week 5, and a busy time in the quarter, week 10, I looked found the top three selling items. In figure 16 below, it shows that iced coffee, 16 ounce hot coffee, and 12 ounce hot coffee are consistently the top selling items, regardless of the time in the quarter.

Week/Item	Iced coffee	16 oz. coffee	12 oz. coffee
5	673	643	533
% of total sales	9.43%	9.01%	7.47%
10	1173	739	577
% of total sales	12.94%	8.15%	6.37%

Figure 16 Comparison of top selling items.

In addition, I wanted to compare the average total items sold during week 5 of the quarter to week 10 of the quarter to the supervisor can anticipate how much more to order during busy times in the library. Figure 17 below shows the total sales averages. By dividing the week 10 total sales by the week 5 total sales, it shows that the supervisor should order 231% more material during the busy times at the library. I predict with the aid of this forecast and analysis, it will take the supervisor at Julian's about half as long to place orders.

Week 5 average total sales	Week 10 average total sales
6583	15208

Figure 17 Busy vs. not busy comparison.

A difficulty that came up when interpreting the results was when the trends for various items didn't match month to month over the four years. This most likely occurred because of weather variability meaning when it's hot out people usually want iced drinks and when it's cold out people usually want hot drinks more. Another difficulty when interpreting the results was the presence of outliers in the data set because of varying quarter lengths. This inconsistency required careful attention, especially when applying the forecasting formulas in Excel.

Implementing this solution will help the supervisor at Julian's make more accurate and exact order quantity decisions. Based on the results, it can be predicted that the sales at Julian's

will follow the forecast and trends presented. Problems might occur when the supervisor adds new items to the menu because we don't have sales data on those new items yet so therefore, cannot make a forecast. However, the staple items such as cups, coffee beans, milk, and espresso beans have been ordered for years and years in the past and will continue to be ordered for many years to come. Implementing my project will have numerous impacts. The first is an organizational impact. Providing an accurate seasonal forecast will not only make Julian's more money because of the decrease in shortages and surpluses when it comes to ordering, but it will ultimately make the supervisor's job easier. The supervisor that I have be working with is very busy and it seems like employees are constantly coming to her asking questions or for help with various tasks during her time at Julian's. Not only is she suppose to be readily available for the student employee baristas, but she has many other tasks to be doing including going to meetings, answering emails, taking inventory, receiving shipments, and making orders. By referencing my forecast, the supervisor will spend less of her valuable time thinking about order quantities and varieties and can place orders quicker. Implementing this project will also have an environmental impact because there will be less surpluses and wasted raw material. This especially effects products that spoil quickly such as food and milk. Knowing the optimal amount of product to have in their store room will avoid ordering too much which later has to be thrown away. All in all, my project will reduce the carbon footprint at Julian's and create a more sustainable system with less waste.

VI. Conclusions

This chapter will conclude the report and summarize the project. The calculated forecast will be helpful to the supervisor at Julian's in many ways. First, she can be more aware of the monthly sales trends at Julian's. She can also use the insights from the data visualization and analysis to make more accurate and educated ordering decisions of over 100 items sold at Julian's. For example, she knows now to order twice as many raw material for iced coffee during dead week and finals week compared to most other regular weeks during the quarter. These more accurate order quantities will create less shortage and surplus inventory waste and in the end help them make more profit. Throughout this project, I learned about data gathering and analysis and how to apply the data to create a forecast. I learned about forecasting in my classes, however that was usually with small amount of data points. It was interesting to use a vast amount of real data to apply forecasting techniques.

If I were to do some further studies at Julian's, I would look into forecasting all of the items sold at Julian's and not just the top 3 sellers. I would also try to convert the numbers of items sold to its raw material equivalence so that the supervisor knows exactly how many cups or espresso beans to order if they're expecting to sell 5,000 cappuccinos next March for example. I would also like to compare my forecast for the next year to the actual sales that happen over the next year and see how much the inventory shortage and surplus went down if the supervisor followed my order suggestions. I would also like to look into automatic forecasting for all the items sold at Julian's.

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Appendix

Table 1 Historical sales data file for 2/22/2015-2/28/2015 imported into Excel.

Sales Mix by Item Group							
Business Dates	2/22/2015 - 2/28/2015						
Locations	CPSLO						
Revenue Centers	Julians Patisse						
Group	Sales Less Item Disc	% Sales	% Major Group	% Family Group	Item Discounts	Qty Sold	Average Price
Food Sales	**27,945.28**	**100.0%**			**(70.00)**	**11,393**	**2.45**
Julians	**17,314.34**	**62.0%**	**62.0%**		**(63.48)**	**7,561**	**2.29**
Iced Coffee	1,652.53	5.9%	5.9%	9.5%	(2.37)	871	1.90
Coffee 16oz	1,453.77	5.2%	5.2%	8.4%	(24.43)	778	1.87
Coffee 20oz	1,114.92	4.0%	4.0%	6.4%	(3.08)	559	1.99
Coffee 12oz	1,104.27	4.0%	4.0%	6.4%	(19.43)	661	1.67
Iced ToraniLatte	967.66	3.5%	3.5%	5.6%	(0.09)	245	3.95
Tea 1 Bag	649.66	2.3%	2.3%	3.8%	(3.09)	373	1.74
ToraniLatte 16oz	635.95	2.3%	2.3%	3.7%	0.00	161	3.95
Flavored Blast	612.00	2.2%	2.2%	3.5%	0.00	153	4.00
Mocha Latte 16oz	595.35	2.1%	2.1%	3.4%	(1.10)	151	3.94
Java Blast	479.50	1.7%	1.7%	2.8%	0.00	137	3.50
Iced Latte	415.59	1.5%	1.5%	2.4%	(0.21)	126	3.30
Latte 16oz	401.38	1.4%	1.4%	2.3%	(1.22)	122	3.29
Mocha Latte 12oz	381.15	1.4%	1.4%	2.2%	0.00	121	3.15
Latte 12oz	375.56	1.3%	1.3%	2.2%	(1.19)	137	2.74
Iced Tea	357.75	1.3%	1.3%	2.1%	(0.25)	179	2.00
Chai Hot 16oz	355.31	1.3%	1.3%	2.1%	(0.69)	89	3.99
Iced Mocha Latte	355.00	1.3%	1.3%	2.1%	(0.50)	90	3.94
EspDbl	350.10	1.3%	1.3%	2.0%	(0.27)	153	2.29
Iced Chai	347.82	1.2%	1.2%	2.0%	(0.18)	87	4.00
ToraniLatte 12oz	330.62	1.2%	1.2%	1.9%	(0.13)	105	3.15
ToraniLatte 20oz	268.80	1.0%	1.0%	1.6%	0.00	64	4.20
Water	266.85	1.0%	1.0%	1.5%	(0.35)	167	1.60
Chai Hot 12oz	227.88	0.8%	0.8%	1.3%	(0.12)	76	3.00
HotChocolate12oz	212.25	0.8%	0.8%	1.2%	(0.25)	85	2.50
HotChocolate16oz	207.40	0.7%	0.7%	1.2%	0.00	68	3.05
EspTri	179.18	0.6%	0.6%	1.0%	0.00	62	2.89
Mocha Latte 20oz	176.40	0.6%	0.6%	1.0%	0.00	42	4.20
Chai Blast	167.75	0.6%	0.6%	1.0%	(0.25)	42	3.99
HotChocolate20oz	165.75	0.6%	0.6%	1.0%	0.00	51	3.25
Cappuccino 12oz	161.75	0.6%	0.6%	0.9%	(0.50)	59	2.74
Mocha Java Blast	156.00	0.6%	0.6%	0.9%	0.00	39	4.00
Fruit Blast	140.00	0.5%	0.5%	0.8%	0.00	35	4.00
Juice	130.65	0.5%	0.5%	0.8%	0.00	67	1.95
Cappuccino 16oz	125.80	0.5%	0.5%	0.7%	0.00	37	3.40
Chai Hot 20oz	125.00	0.4%	0.4%	0.7%	0.00	25	5.00
Tea 2 Bags	114.00	0.4%	0.4%	0.7%	0.00	57	2.00
EspSgle	111.95	0.4%	0.4%	0.6%	(0.25)	66	1.70
Latte 20oz	109.50	0.4%	0.4%	0.6%	0.00	30	3.65
Extra Shot	104.91	0.4%	0.4%	0.6%	(0.09)	175	0.60
RedEye-sl	65.00	0.2%	0.2%	0.4%	0.00	26	2.50
Yerba Mate 16oz	59.55	0.2%	0.2%	0.3%	(0.75)	18	3.31
Yerba Mate 12oz	57.00	0.2%	0.2%	0.3%	(0.50)	23	2.48
Extra add in	55.61	0.2%	0.2%	0.3%	(0.04)	159	0.35
0.25	52.75	0.2%	0.2%	0.3%	0.00	211	0.25
Promo	52.00	0.2%	0.2%	0.3%	0.00	12	4.33
16 oz Eggnog	50.75	0.2%	0.2%	0.3%	(0.50)	12	4.23
Yerba Mate 20oz	50.05	0.2%	0.2%	0.3%	0.00	11	4.55

Table 1 continued.

Red Eye Sng 16oz	50.00	0.2%	0.2%	0.3%	0.00	20	2.50
Xtra Addin	48.96	0.2%	0.2%	0.3%	(0.04)	140	0.35
Cappuccino 20oz	48.10	0.2%	0.2%	0.3%	0.00	13	3.70
RedEye Dbl	39.75	0.1%	0.1%	0.2%	0.00	15	2.65
Red Eye Dbl 16oz	36.71	0.1%	0.1%	0.2%	(0.25)	14	2.62
Box Coffee	35.00	0.1%	0.1%	0.2%	0.00	2	17.50
Extra shot	32.36	0.1%	0.1%	0.2%	(0.04)	54	0.60
CafeAu Lait 12oz	27.95	0.1%	0.1%	0.2%	(0.25)	12	2.33
CafeAu Lait 20oz	27.45	0.1%	0.1%	0.2%	0.00	9	3.05
Mate Latte 20oz	26.40	0.1%	0.1%	0.2%	0.00	8	3.30
Red Eye Sng 20oz	26.00	0.1%	0.1%	0.2%	0.00	10	2.60
Red Eye Sng 12oz	24.75	0.1%	0.1%	0.1%	0.00	11	2.25
20 oz Eggnog	23.00	0.1%	0.1%	0.1%	0.00	5	4.60
Macchiato Double	20.80	0.1%	0.1%	0.1%	0.00	8	2.60
12oz promo	20.30	0.1%	0.1%	0.1%	0.00	6	3.38
Non Tax Item	19.95	0.1%	0.1%	0.1%	0.00	4	4.99
SoyAddinSgl	18.37	0.1%	0.1%	0.1%	(0.03)	46	0.40
Hot Milk 12oz	18.20	0.1%	0.1%	0.1%	0.00	13	1.40
Oatmeal ApplCin	18.00	0.1%	0.1%	0.1%	0.00	8	2.25
MochaAuLait 16oz	17.70	0.1%	0.1%	0.1%	0.00	6	2.95
Hot Milk 16oz	16.50	0.1%	0.1%	0.1%	0.00	10	1.65
MochaAuLait 12oz	15.95	0.1%	0.1%	0.1%	(0.25)	6	2.66
Mate Latte 12oz	14.60	0.1%	0.1%	0.1%	0.00	4	3.65
Red Eye Dbl 20oz	14.25	0.1%	0.1%	0.1%	0.00	5	2.85
CafeAu Lait 16oz	12.50	0.0%	0.0%	0.1%	(0.25)	5	2.50
Mate Latte 12oz	10.75	0.0%	0.0%	0.1%	(0.25)	4	2.69
MochaAuLait 20oz	10.35	0.0%	0.0%	0.1%	0.00	3	3.45
Red Eye Dbl 12oz	10.00	0.0%	0.0%	0.1%	0.00	4	2.50
Red Eye Trp 20oz	9.42	0.0%	0.0%	0.1%	0.00	3	3.14
Macchiato Single	9.20	0.0%	0.0%	0.1%	0.00	4	2.30
RedEye Trp	8.85	0.0%	0.0%	0.1%	0.00	3	2.95
Iced Promo	8.60	0.0%	0.0%	0.0%	0.00	2	4.30
Hot Milk 20oz	8.00	0.0%	0.0%	0.0%	0.00	4	2.00
Mate Blast	8.00	0.0%	0.0%	0.0%	0.00	2	4.00
Oatmeal CnmSpice	6.75	0.0%	0.0%	0.0%	0.00	3	2.25
Extra Add In 16	6.61	0.0%	0.0%	0.0%	(0.04)	19	0.35
Extra Add In 20	5.95	0.0%	0.0%	0.0%	0.00	17	0.35
Red Eye Trp 16oz	5.65	0.0%	0.0%	0.0%	(0.25)	2	2.83
16oz 0.25	3.50	0.0%	0.0%	0.0%	0.00	14	0.25
Red Eye Qdr 20oz	3.45	0.0%	0.0%	0.0%	0.00	1	3.45
Extra Add In 12	3.15	0.0%	0.0%	0.0%	0.00	9	0.35
Red Eye Trp 12oz	2.79	0.0%	0.0%	0.0%	0.00	1	2.79
Oatmeal BrownSug	2.25	0.0%	0.0%	0.0%	0.00	1	2.25
Oatmeal Orig	2.25	0.0%	0.0%	0.0%	0.00	1	2.25
12oz 0.25	2.00	0.0%	0.0%	0.0%	0.00	8	0.25
HotSoy	1.85	0.0%	0.0%	0.0%	0.00	1	1.85
20oz 0.25	1.00	0.0%	0.0%	0.0%	0.00	4	0.25
Show Price Levels							

Table 2 Weekly sales data pivot table.

Item	(All)					
Sum of Sales	Column Labels					
Row Labels	2014	2015	2016	2017	2018	Grand Total
2	3160	3008	3704	3128	2167	15167
3	4682	4566	5392	4089	3016	21745
4	4942	4796	5220	5604	4592	25154
5	7135	7041	7512	6772	4915	33375
6	7302	6569	6367	6674	4269	31181
7	7111	6584	6662	6287	4366	31010
8	5620	5507	5793	5209	3739	25868
9	8008	7561	7541	6724	5315	35149
10	7238	7541	7764	6405	4374	33322
11	9063	9690	10052	8070	5549	42424
12	7650	7344	17618	7293	4727	44632
14	2570	2241	2535	3037	2081	12464
15	4704	4806	5196	4591	3135	22432
16	5577	5836	6190	5019	2846	25468
17	6506	7050	7234	6090		26880
18	6180	6783	7853	6173		26989
19	6723	7030	7443	5917		27113
20	6566	6973	7467	5964		26970
21	7061	7050	7866	6095		28072
22	19258	5730	7372	4456		36816
23		8919	4886	7847		21652
24	6799	7397	7932	6369		28497
25		336				336
37	246			613		859
38	292			3201		3493
39	3370	3800	878	4548		12596
40	5170	5356	4304	5496		20326
41	6267	6579	5067	6141		24054
42	7280	7446	5948	5816		26490
43	7232	7668	6471	4916		26287
44	6842	7576	6747	5585		26750
45	6886	7540	6024	4926		25376
46	6859	6412	5630	4723		23624
47	7322	7308	6609			21239
48	2219	2712		6526		11457
49	17304	9617	5578	5792		38291
50		7785	8883			16668
51			7362			7362
Grand Total	221144	220157	225100	186096	55091	907588

Table 3 Monthly sales data pivot table.

Item	(All)					
Sum of Sales	Column Labels					
Row Labels	2014	2015	2016	2017	2018	Grand Total
1	19919	19411	21828	19593	14690	95441
2	28041	26221	34127	24894	17689	130972
3	26521	26816	30205	21768	14650	119960
4	22967	24475	26473	24910	8062	106887
5	39608	35702	30148	22432		127890
6	6799	7733	12818	14216		41566
9	9078	9156	5182	8362		31778
10	27621	29269	30257	27954		115101
11	31511	33589	17817	16175		99092
12	9079	7785	16245	5792		38901
Grand Total	221144	220157	225100	186096	55091	907588

Table 4 Seasonal forecast solution table.

Time	Month	Demand	Moving average forecast	Ratio moving averages	Unadjusted seasonal index	Adjusted seasonal index	Seasonally adjusted series	Trend Forecast	Seasonally adjusted forecast	MAPE
1	1	19919				1.10472898	18030.6666	17272.1775	19081.0751	4.2067
2	2	28041				1.50728392	18603.6616	17946.8881	27051.0558	3.5303
3	3	26521				1.3764402	19267.8185	18621.5987	25631.517	3.3539
4	4	22967				1.23528328	18592.4965	19296.3092	23836.4081	3.7855
5	5	39608				1.2515514	31647.1222	19971.0198	24994.7577	36.8947
6	6	6799				0.51307343	13251.5146	20645.7303	10592.7756	55.7990
7	9	9078				0.33326717	27239.4069	21320.4409	7105.40294	21.7294
8	10	27621				1.26656354	21807.8282	21995.1514	27858.2568	0.8590
9	11	31511				0.9747737	32326.4774	22669.862	22097.9853	29.8722
10	12	9079				0.43703439	20774.109	23344.5725	10202.381	12.3734
11	1	19411	22114.4	0.87775386	0.8822547	1.10472898	17570.8253	24019.2831	26534.7982	36.6998
12	2	26221	22063.6	1.188428	1.20374168	1.50728392	17396.1917	24693.9937	37220.8595	41.9506
13	3	26816	21881.6	1.22550453	1.09924774	1.3764402	19482.1395	25368.7042	34918.5043	30.2152
14	4	24475	21911.1	1.11701375	0.98651751	1.23528328	19813.2691	26043.4148	32170.9948	31.4443
15	5	35702	22061.9	1.61826497	0.99950949	1.2515514	28526.1956	26718.1253	33439.1071	6.3383
16	6	7733	21671.3	0.35683139	0.40974886	0.51307343	15071.9168	27392.8359	14054.5362	81.7475
17	9	9156	21764.7	0.42068119	0.26615263	0.33326717	27473.4534	28067.5464	9353.9917	2.1624
18	10	29269	21772.5	1.34431048	1.01149843	1.26656354	23108.9867	28742.257	36403.8947	24.3770
19	11	33589	21937.3	1.53113647	0.77847028	0.9747737	34458.2542	29416.9675	28674.8863	14.6301
20	12	7785	22145.1	0.35154504	0.34902284	0.43703439	17813.2436	30091.6781	13151.0981	68.9287
21	1	21828	22015.7	0.99147427		1.10472898	19758.6923	30766.3886	33988.5212	55.7107
22	2	34127	22257.4	1.53328781		1.50728392	22641.388	31441.0992	47390.6632	38.8656
23	3	30205	23048	1.31052586		1.3764402	21944.2879	32115.8098	44205.4916	46.3516
24	4	26473	23386.9	1.13195849		1.23528328	21430.7118	32790.5203	40505.5815	53.0071
25	5	30148	23586.7	1.27817796		1.2515514	24088.5033	33465.2309	41883.4564	38.9262
26	6	12818	23031.3	0.55654696		0.51307343	24982.7789	34139.9414	17516.2968	36.6539
27	9	5182	23539.8	0.22013781		0.33326717	15549.0864	34814.652	11602.5805	123.9016
28	10	30257	23142.4	1.30742706		1.26656354	23889.0503	35489.3625	44949.5325	48.5591
29	11	17817	23241.2	0.76661274		0.9747737	18278.0885	36164.0731	35251.7874	97.8548
30	12	16245	21664	0.74986152		0.43703439	37170.9881	36838.7836	16099.8152	0.8937
31	1	19593	22510	0.87041315		1.10472898	17735.5716	37513.4942	41442.2443	111.5156
32	2	24894	22286.5	1.11699908		1.50728392	16515.8002	38188.2048	57560.4669	131.2223
33	3	21768	21363.2	1.01894847		1.3764402	15814.7081	38862.9153	53492.4789	145.7391
34	4	24910	20519.5	1.2139672		1.23528328	20165.415	39537.6259	48840.1682	96.0665
35	5	22432	20363.2	1.10159503		1.2515514	17923.355	40212.3364	50327.8058	124.3572
36	6	14216	19591.6	0.7256171		0.51307343	27707.5351	40887.047	20978.0573	47.5665
37	9	8362	19731.4	0.42379152		0.33326717	25090.9805	41561.7575	13851.1692	65.6442
38	10	27954	20049.4	1.39425619		1.26656354	22070.7443	42236.4681	53495.1704	91.3686
39	11	16175	19819.1	0.81613191		0.9747737	16593.595	42911.1786	41828.6884	158.6009
40	12	5792	19654.9	0.29468479		0.43703439	13252.9617	43585.8892	19048.5324	228.8766
41	1	14690	18609.6	0.78937753		1.10472898	13297.379	44260.5998	48895.9673	232.8521
42	2	17689	18119.3	0.97625184		1.50728392	11735.6788	44935.3103	67730.2706	282.8949
43	3	14650	17398.8	0.84201209		1.3764402	10643.3974	45610.0209	62779.4662	328.5288
44	4	8062	16687	0.48313058		1.23528328	6526.43821	46284.7314	57174.7548	609.1882

Table 5 Moving ranges forecast solution table.

Time	Month	Demand	Seasonal Average	Seasonal Index	Deseasonalized	Trend	Forecast	MAPE
1	1	19919	19088.2	0.925398749	21524.77515	23877.68344	22096.37839	10.93116316
2	2	28041	26194.4	1.269908373	22081.12066	23726.48886	30130.46686	7.451470548
3	3	26521	23992	1.163135696	22801.29489	23575.29428	27421.26632	3.394541394
4	4	22967	21377.4	1.036379503	22160.80108	23424.0997	24276.2568	5.700599994
5	5	39608	31972.5	1.550031512	25553.02888	23272.90513	36073.73632	8.923105627
6	6	6799	10391.5	0.503781451	13495.93158	23121.71055	11648.2889	71.32356083
7	9	9078	7944.5	0.385150531	23570.00516	22970.51597	8847.106419	2.543441072
8	10	27621	28775.25	1.395028361	19799.59747	22819.32139	31833.60052	15.25144099
9	11	31511	24773	1.200998691	26237.33084	22668.12681	27224.39063	13.60353328
10	12	9079	9725.25	0.471481553	19256.32071	22516.93223	10616.31818	16.93268185
11	1	19411	19088.2	0.925398749	20975.8226	22365.73765	20697.22565	6.626271962
12	2	26221	26194.4	1.269908373	20647.94639	22214.54308	28210.43424	7.587179144
13	3	26816	23992	1.163135696	23054.91964	22063.3485	25662.66821	4.300909126
14	4	24475	21377.4	1.036379503	23615.86652	21912.15392	22709.30718	7.214270976
15	5	35702	31972.5	1.550031512	23033.08012	21760.95934	33730.17271	5.52301633
16	6	7733	10391.5	0.503781451	15349.91012	21609.76476	10886.59866	40.78105079
17	9	9156	7944.5	0.385150531	23772.52338	21458.57018	8264.779697	9.733729825
18	10	29269	28775.25	1.395028361	20980.93546	21307.3756	29724.39326	1.555889383
19	11	33589	24773	1.200998691	27967.55754	21156.18103	25408.54572	24.35456334
20	12	7785	9725.25	0.471481553	16511.78067	21004.98645	9903.463637	27.21212122
21	1	21828	19088.2	0.925398749	23587.66966	20853.79187	19298.07291	11.59028353
22	2	34127	26194.4	1.269908373	26873.59241	20702.59729	26290.40163	22.96304501
23	3	30205	23992	1.163135696	25968.59516	20551.40271	23904.07009	20.86055258
24	4	26473	21377.4	1.036379503	25543.73174	20400.20813	21142.35756	20.13614794
25	5	30148	31972.5	1.550031512	19449.92716	20249.01355	31386.6091	4.10842874
26	6	12818	10391.5	0.503781451	25443.57273	20097.81897	10124.90842	21.01023237
27	9	5182	7944.5	0.385150531	13454.4797	19946.6244	7682.452975	48.25266258
28	10	30257	28775.25	1.395028361	21689.16479	19795.42982	27615.18601	8.73124893
29	11	17817	24773	1.200998691	14835.15355	19644.23524	23592.70081	32.41679749
30	12	16245	9725.25	0.471481553	34455.21863	19493.04066	9190.609089	43.42499791
31	1	19593	19088.2	0.925398749	21172.49458	19341.84608	17898.92017	8.646352415
32	2	24894	26194.4	1.269908373	19602.98911	19190.6515	24370.36902	2.103442525
33	3	21768	23992	1.163135696	18714.92731	19039.45692	22145.47198	1.734068265
34	4	24910	21377.4	1.036379503	24035.59694	18888.26235	19575.40793	21.41546393
35	5	22432	31972.5	1.550031512	14471.96384	18737.06777	29043.04548	29.47149377
36	6	14216	10391.5	0.503781451	28218.58557	18585.87319	9363.218172	34.13605675
37	9	8362	7944.5	0.385150531	21710.99176	18434.67861	7100.126253	15.09057339
38	10	27954	28775.25	1.395028361	20038.30229	18283.48403	25505.97876	8.757320028
39	11	16175	24773	1.200998691	13467.95806	18132.28945	21776.8559	34.63280308
40	12	5792	9725.25	0.471481553	12284.67998	17981.09487	8477.754541	46.3700715
41	1	14690	19088.2	0.925398749	15874.23801	17829.9003	16499.76743	12.31972384
42	2	17689	26194.4	1.269908373	13929.35143	17678.70572	22450.3364	26.91693372
43	3	14650	23992	1.163135696	12595.263	17527.51114	20386.87387	39.15954857
44	4	8062	21377.4	1.036379503	7779.003714	17376.31656	18008.45831	123.3745759

Table 6 Seasonal forecast with outliers removed solution table.

Time	Month	Demand	Seasonal Ave	Seasonal Inde	Deseasonaliz	Trend	Forecast	MAPE
1	1	19919	20187.75	0.9580011	20792.2517	22219.0544	21285.8785	6.86218428
2	2	28041	26385.3333	1.25210478	22395.0906	22155.3727	27740.8481	1.07040383
3	3	26521	26327.5	1.24936033	21227.663	22091.691	27600.4822	4.07029231
4	4	22967	24706.25	1.1724246	19589.3195	22028.0093	25826.1799	12.4490785
5	5	39608	35152.6667	1.66815486	23743.599	21964.3276	36639.8998	7.4936887
6	6	6799	10391.5	0.49312422	13787.6011	21900.6459	10799.7388	58.8430482
7	9	9078	7944.5	0.37700287	24079.3922	21836.9642	8232.5982	9.31264371
8	10	27621	28775.25	1.36551726	20227.4997	21773.2825	29731.7931	7.64198639
9	11	31511	24773	1.17559219	26804.3632	21709.6008	25521.6371	19.0072131
10	12	9079	7552	0.35837695	25333.6605	21645.9191	7757.39848	14.556686
11	1	19411	20187.75	0.9580011	20261.981	21582.2374	20675.8071	6.51592965
12	2	26221	26385.3333	1.25210478	20941.5381	21518.5557	26943.4865	2.75537339
13	3	26816	26327.5	1.24936033	21463.7839	21454.874	26804.8683	0.04151129
14	4	24475	24706.25	1.1724246	20875.543	21391.1923	25079.56	2.47011217
15	5	35702	35152.6667	1.66815486	21402.0897	21327.5106	35577.5904	0.34846672
16	6	7733	10391.5	0.49312422	15681.6472	21263.8289	10485.709	35.5969089
17	9	9156	7944.5	0.37700287	24286.2872	21200.1472	7992.51637	12.7073354
18	10	29269	28775.25	1.36551726	21434.3684	21136.4655	28862.2085	1.38983751
19	11	33589	24773	1.17559219	28571.983	21072.7838	24773	26.2466879
20	12	7785	7552	0.35837695	21722.9372	21009.1021	7529.17795	3.28608932
21	1	21828	20187.75	0.9580011	22784.9426	20945.4204	20065.7357	8.07341156
22	3	30205	26327.5	1.24936033	24176.372	20881.7387	26088.8158	13.6274927
23	4	26473	24706.25	1.1724246	22579.7037	20818.057	24407.602	7.80190369
24	5	30148	35152.6667	1.66815486	18072.6626	20754.3753	34621.512	14.8385033
25	6	12818	10391.5	0.49312422	25993.4507	20690.6936	10203.0821	20.4003583
26	9	5182	7944.5	0.37700287	13745.2534	20627.0119	7776.44271	50.066436
27	10	30257	28775.25	1.36551726	22157.9037	20563.3302	28079.5823	7.19640969
28	11	17817	24773	1.17559219	15155.7659	20499.6485	24099.2266	35.259733
29	1	19593	20187.75	0.9580011	20451.9599	20435.9668	19577.6786	0.07819824
30	2	24894	26385.3333	1.25210478	19881.7227	20372.2851	25508.2356	2.46740406
31	3	21768	26327.5	1.24936033	17423.3162	20308.6034	25372.7633	16.5599198
32	4	24910	24706.25	1.1724246	21246.5689	20244.9217	23735.6441	4.71439535
33	6	14216	10391.5	0.49312422	28828.4362	20181.24	9951.85816	29.9953703
34	9	8362	7944.5	0.37700287	22180.2024	20117.5583	7584.37725	9.29948283
35	10	27954	28775.25	1.36551726	20471.3633	20053.8766	27383.9146	2.03936954
36	11	16175	24773	1.17559219	13759.023	19990.1949	23500.317	45.2878946
37	12	5792	7552	0.35837695	16161.7537	19926.5132	7141.20304	23.2942514

Table 7 Seasonal forecast with smoothing solution table.

Time	Month	Demand	Smoothed Demand	Seasonal Average	Seasonal Inde	Deseasonalized	Trend	Forecast	MAPE
1		19919	#N/A						
2	2	28041	19919	20258.40151	0.94948145	20978.81945	22052.0168	20937.9809	5.11562297
3	3	26521	20731.2	20852.00136	0.97730261	21212.6724	22017.934	21518.1843	3.79613472
4	4	22967	21310.18	21166.00122	0.99201932	21481.61799	21983.8513	21808.4051	2.33796772
5	5	39608	21475.862	22248.95164	1.04277561	20594.90252	21949.7686	22888.6833	6.57864747
6	6	6799	23289.0758	23221.30648	1.08834845	21398.54735	21915.6858	23851.9026	2.41669892
7	9	9078	21640.06822	21938.32583	1.02821703	21046.2067	21881.6031	22499.037	3.96934421
8	10	27621	20383.8614	20538.94325	0.96263003	21175.17708	21847.5203	21031.0792	3.17514825
9	11	31511	21107.57526	21362.57392	1.00123239	21081.59452	21813.4376	21840.3203	3.47147881
10	12	9079	22147.91773	21703.61653	1.01721655	21773.06065	21779.3549	22154.3203	0.02890832
11	1	19411	20841.02596	20505.77988	0.96107571	21685.10312	21745.2721	20898.8529	0.27746709
12	2	26221	20698.02336	20258.40151	0.94948145	21799.29189	21711.1894	20614.3717	0.40415297
13	3	26816	21250.32103	20852.00136	0.97730261	21743.84977	21677.1067	21185.0928	0.30695163
14	4	24475	21806.88892	21166.00122	0.99201932	21982.32288	21643.0239	21470.2978	1.54350818
15	5	35702	22073.70003	22248.95164	1.04277561	21168.21669	21608.9412	22533.2768	2.08201058
16	6	7733	23436.53003	23221.30648	1.08834845	21534.03175	21574.8585	23480.9637	0.1895916
17	9	9156	21866.17703	21938.32583	1.02821703	21266.11047	21540.7757	22148.5925	1.29156321
18	10	29269	20595.15932	20538.94325	0.96263003	21394.67774	21506.693	20702.9886	0.52356597
19	11	33589	21462.54339	21362.57392	1.00123239	21436.12573	21472.6103	21499.0729	0.1702011
20	12	7785	22675.18905	21703.61653	1.01721655	22291.40782	21438.5275	21807.6251	3.82604949
21	1	21828	21186.17015	20505.77988	0.96107571	22044.2259	21404.4448	20571.2921	2.90226165
22	2	34127	21250.35313	20258.40151	0.94948145	22381.00917	21370.3621	20290.7624	4.51564588
23	3	30205	22538.01782	20852.00136	0.97730261	23061.45272	21336.2793	20852.0014	7.48076638
24	4	26473	23304.71604	21166.00122	0.99201932	23492.19985	21302.1966	21132.1905	9.3222571
25	5	30148	23621.54443	22248.95164	1.04277561	22652.5671	21268.1138	22177.8703	6.11168371
26	6	12818	24274.18999	23221.30648	1.08834845	22303.6933	21234.0311	23110.0248	4.79589717
27	9	5182	23128.57099	21938.32583	1.02821703	22493.86096	21199.9484	21798.148	5.75229209
28	10	30257	21333.91389	20538.94325	0.96263003	22162.11127	21165.8656	20374.8979	4.49526502
29	11	17817	22226.2225	21362.57392	1.00123239	22198.86485	21131.7829	21157.8255	4.80692125
30	12	16245	21785.30025	21703.61653	1.01721655	21416.58053	21097.7002	21460.9299	1.48894153
31	1	19593	21231.27023	20505.77988	0.96107571	22091.15257	21063.6174	20243.7312	4.65134236
32	2	24894	21067.4432	20258.40151	0.94948145	22188.36725	21029.5347	19967.1532	5.22270315
33	3	21768	21450.09888	20852.00136	0.97730261	21948.26737	20995.452	20518.9099	4.34118738
34	4	24910	21481.889	21166.00122	0.99201932	21654.70837	20961.3692	20794.0832	3.20179395
35	5	22432	21824.7001	22248.95164	1.04277561	20929.43096	20927.2865	21822.4639	0.01024618
36	6	14216	21885.43009	23221.30648	1.08834845	20108.84485	20893.2038	22739.0859	3.90056667
37	9	8362	21118.48708	21938.32583	1.02821703	20538.93914	20859.121	21447.7035	1.55890175
38	10	27954	19842.83837	20538.94325	0.96263003	20613.15116	20825.0383	20046.8073	1.02792202
39	11	16175	20653.95453	21362.57392	1.00123239	20628.53215	20790.9555	20816.5781	0.78737256
40	12	5792	20206.05908	21703.61653	1.01721655	19864.06827	20756.8728	21114.2346	4.49457047
41	1	14690	18764.65317	20505.77988	0.96107571	19524.63568	20722.7901	19916.1703	6.13662873
42	2	17689	18357.18785	20258.40151	0.94948145	19333.90881	20688.7073	19643.5439	7.00737002
43	3	14650	18290.36907	20852.00136	0.97730261	18715.15432	20654.6246	20185.8184	10.3631007
44	4	8062	17926.33216	21166.00122	0.99201932	18070.54748	20620.5419	20455.9759	14.1113289

Table 8 Iced coffee outliers removed.

Month	2014	2015	2016	2017	2018
1	1752	2238	2021	1966	1767
2	2201	3293	5340	3023	1413
3	3136	4073	4292	3554	1148
4	3240	3490	4413	4170	741
5	6574	4968	4908	3707	
6	1240	1652	2724	2732	
9	1532	1878	1010	1765	
10	4670	5107	4507	5410	
11	3371	3162	2307	2008	
12	1105	984	1752	768	

Table 9 16 ounce hot coffee outliers removed.

Month	2014	2015	2016	2017	2018
1	1953	1950	2480	2182	1335
2	2790	2541	3287	2572	1652
3	2290	2272	2639	1738	1377
4	1885	2294	2256	2078	694
5	3002	3275	2690	1868	
6	466	527	813	924	
9	641	660	321	642	
10	1859	2438	2501	2079	
11	2825	3766	1755	1469	
12	842	774	1692	525	

Table 10 Iced latte outliers removed.

Row Labels	2014	2015	2016	2017	2018
1	479	657	516	566	438
2	670	878	1092	911	553
3	878	1110	1209	1084	493
4	819	844	1036	1337	277
5	1406	1340	1107	1137	
6	247	387	505	841	
9	348	388	166	328	
10	1157	1051	1024	731	
11	912	704	550	306	
12	304	224	502	110	

Table 11 Iced coffee solution table.

Time	Month	Demand	Seasonal Ave	Seasonal Ind	Deseasonaliz	Trend	Forecast	MAPE
1	1	1752	1994.25	0.68811576	2546.08325	2760.81281	1899.758788	8.4337208
2	2	2201	2839	0.97959665	2246.84312	2768.23544	2711.754178	23.205551
3	3	3136	3763.75	1.29868155	2414.75673	2775.65808	3604.695925	14.9456609
4	4	3240	3828.25	1.32093726	2452.80384	2783.08071	3676.275026	13.4652786
5	6	1240	2087	0.72011913	1721.93731	2790.50335	2009.494854	62.0560366
6	9	1532	1546.25	0.5335334	2871.42285	2797.92599	1492.78697	2.55959727
7	10	4670	4923.5	1.69885316	2748.91327	2805.34862	4765.875383	2.05300606
8	11	3371	2712	0.93577532	3602.36045	2812.77126	2632.121921	21.9186615
9	12	1105	1152.25	0.39758374	2779.28869	2820.1939	1121.263245	1.47178684
10	1	2238	1994.25	0.68811576	3252.35977	2827.61653	1945.727486	13.0595404
11	2	3293	2839	0.97959665	3361.58763	2835.03917	2777.194887	15.663684
12	3	4073	3763.75	1.29868155	3136.2577	2842.46181	3691.452693	9.36772175
13	4	3490	3828.25	1.32093726	2642.0634	2849.88444	3764.518559	7.8658613
14	5	4968	4527.66667	1.56227091	3179.98624	2857.30708	4463.887737	10.1471873
15	6	1652	2087	0.72011913	2294.06486	2864.72972	2062.946679	24.8757069
16	9	1878	1546.25	0.5335334	3519.92957	2872.15235	1532.389214	18.4031302
17	10	5107	4923.5	1.69885316	3006.14562	2879.57499	4891.975077	4.21039599
18	11	3162	2712	0.93577532	3379.01624	2886.99762	2701.58112	14.5610019
19	12	984	1152.25	0.39758374	2474.95029	2894.42026	1150.77444	16.948622
20	1	2021	1994.25	0.68811576	2937.00585	2901.8429	1996.803817	1.19723817
21	3	4292	3763.75	1.29868155	3304.89027	2909.26553	3778.209461	11.9708886
22	4	4413	3828.25	1.32093726	3340.80968	2916.68817	3852.762093	12.6951713
23	5	4908	4527.66667	1.56227091	3141.58061	2924.11081	4568.253258	6.92230526
24	6	2724	2087	0.72011913	3782.70744	2931.53344	2111.053321	22.5017136
25	9	1010	1546.25	0.5335334	1893.03987	2938.95608	1568.031235	55.2506173
26	10	4507	4923.5	1.69885316	2652.96619	2946.37872	5005.464801	11.0597915
27	11	2307	2712	0.93577532	2465.33538	2953.80135	2764.0944	19.813368
28	12	1752	1152.25	0.39758374	4406.61881	2961.22399	1177.334516	32.8005413
29	1	1966	1994.25	0.68811576	2857.07744	2968.64662	2042.772514	3.90501089
30	2	3023	2839	0.97959665	3085.96399	2976.06926	2915.347493	3.56111502
31	3	3554	3763.75	1.29868155	2736.62162	2983.4919	3874.605871	9.0209868
32	4	4170	3828.25	1.32093726	3156.84939	2990.91453	3950.810463	5.25634381
33	5	3707	4527.66667	1.56227091	2372.82789	2998.33717	4684.214948	26.361342
34	6	2732	2087	0.72011913	3793.81671	3005.75981	2164.505146	20.7721396
35	9	1765	1546.25	0.5335334	3308.13403	3013.18244	1607.633479	8.91595019
36	10	5410	4923.5	1.69885316	3184.50124	3020.60508	5131.564494	5.14668217
37	11	2008	2712	0.93577532	2145.81424	3028.02772	2833.553599	41.1132271
38	12	768	1152.25	0.39758374	1931.66852	3035.45035	1206.845712	57.1413687

Table 12 16 ounce coffee solution table.

Time	Month	Demand	Seasonal Ave	Seasonal Inde	Deseasonalize	Trend	Forecast	MAPE
1	1	1953	2141.25	1.16360633	1678.40269	1837.46463	2138.08548	9.47698311
2	2	2790	2797.5	1.52022824	1835.25074	1837.61164	2793.589099	0.12864153
3	3	2290	2234.75	1.21441646	1885.67931	1837.75864	2231.804347	2.5412949
4	4	1885	2128.25	1.15654182	1629.85892	1837.90564	2125.614743	12.7647078
5	5	3002	2989	1.62429391	1848.18769	1838.05265	2985.537716	0.5483772
6	6	466	682.5	0.37088678	1256.44812	1838.19965	681.7639537	46.3012776
7	9	641	566	0.3075779	2084.02487	1838.34666	565.4348091	11.7886413
8	10	1859	2219.25	1.20599339	1541.46781	1838.49366	2217.211209	19.2690268
9	11	2825	2016.33333	1.09572364	2578.20486	1838.64067	2014.642035	28.6852377
10	12	842	958.25	0.52073591	1616.94245	1838.78767	957.5227711	13.7200441
11	1	1950	2141.25	1.16360633	1675.8245	1838.93467	2139.796031	9.73312982
12	2	2541	2797.5	1.52022824	1671.45955	1839.08168	2795.823899	10.0284888
13	3	2272	2234.75	1.21441646	1870.85738	1839.22868	2233.589591	1.69059898
14	4	2294	2128.25	1.15654182	1983.49939	1839.37569	2127.314909	7.26613301
15	5	3275	2989	1.62429391	2016.26072	1839.52269	2987.925498	8.76563364
16	6	527	682.5	0.37088678	1420.9188	1839.6697	682.3091732	29.4704313
17	9	660	566	0.3075779	2145.79784	1839.8167	565.8869618	14.2595512
18	10	2438	2219.25	1.20599339	2021.56995	1839.9637	2218.984071	8.98342614
19	12	774	958.25	0.52073591	1486.35803	1840.11071	958.2117248	23.7999644
20	1	2480	2141.25	1.16360633	2131.30501	1840.25771	2141.335528	13.6558255
21	2	3287	2797.5	1.52022824	2162.17534	1840.40472	2797.83522	14.8818004
22	3	2639	2234.75	1.21441646	2173.06013	1840.55172	2235.196311	15.3013903
23	4	2256	2128.25	1.15654182	1950.64282	1840.69873	2128.845058	5.63630061
24	5	2690	2989	1.62429391	1656.10422	1840.84573	2990.074502	11.1551859
25	6	813	682.5	0.37088678	2192.04361	1840.99273	682.7998707	16.014776
26	9	321	566	0.3075779	1043.63804	1841.13974	566.2938993	76.4155449
27	10	2501	2219.25	1.20599339	2073.80904	1841.28674	2220.579647	11.2123292
28	11	1755	2016.33333	1.09572364	1601.68125	1841.43375	2017.70248	14.9688023
29	12	1692	958.25	0.52073591	3249.24778	1841.58075	958.9772289	43.3228588
30	1	2182	2141.25	1.16360633	1875.20465	1841.72776	2143.046079	1.78523929
31	2	2572	2797.5	1.52022824	1691.85122	1841.87476	2800.070021	8.86741916
32	3	1738	2234.75	1.21441646	1431.14002	1842.02176	2236.981555	28.710101
33	4	2078	2128.25	1.15654182	1796.73572	1842.16877	2130.545224	2.52864409
34	6	924	682.5	0.37088678	2491.32632	1842.31577	683.2905683	26.0508043
35	9	642	566	0.3075779	2087.27608	1842.46278	566.7008367	11.7288416
36	10	2079	2219.25	1.20599339	1723.89004	1842.60978	2222.175222	6.88673508
37	11	1469	2016.33333	1.09572364	1340.66653	1842.75679	2019.152165	37.4507941
38	12	525	958.25	0.52073591	1008.18858	1842.90379	959.6661826	82.7935586

Table 13. Iced latte solution table.

Time	Month	Demand	Seasonal Average	Seasonal Index	Deseasonalized	Trend	Forecast	MAPE
1	1	479	554.5	0.758151031	631.8002358	744.3543	564.3330171	17.81483
2	2	670	887.75	1.213793647	551.988389	743.6717	902.6640237	34.72597
3	3	878	1070.25	1.463320362	600.0053187	742.9891	1087.231099	23.83042
4	4	819	899.6666667	1.230086944	665.806595	742.3065	913.1015301	11.48981
5	5	1406	1247.5	1.70566891	824.3100355	741.6239	1264.964794	10.03095
6	6	247	495	0.676798485	364.9535354	740.9413	501.4679235	103.0235
7	9	348	307.5	0.420435423	827.7133208	740.2586	311.2309559	10.56582
8	10	1157	990.75	1.354622423	854.112541	739.576	1001.846269	13.41
9	11	912	618	0.844972655	1079.324869	738.8934	624.344725	31.54115
10	12	304	285	0.389671855	780.1435897	738.2108	287.6599686	5.37501
11	1	657	554.5	0.758151031	866.5819519	737.5282	559.1577449	14.89228
12	2	878	887.75	1.213793647	723.3519485	736.8456	894.378455	1.865428
13	3	1110	1070.25	1.463320362	758.5488653	736.1629	1077.242217	2.951152
14	4	844	899.6666667	1.230086944	686.1303617	735.4803	904.7047404	7.192505
15	5	1340	1247.5	1.70566891	785.6155388	734.7977	1253.321598	6.468537
16	6	387	495	0.676798485	571.8097902	734.1151	496.8479782	28.38449
17	9	388	307.5	0.420435423	922.852783	733.4325	308.3609898	20.52552
18	10	1051	990.75	1.354622423	775.8619538	732.7499	992.5993781	5.556672
19	11	704	618	0.844972655	833.163057	732.0672	618.5767932	12.13398
20	12	224	285	0.389671855	574.8426451	731.3846	285	27.23214
21	1	516	554.5	0.758151031	680.6031768	730.702	553.9824728	7.360944
22	2	1092	887.75	1.213793647	899.6586877	730.0194	886.0928863	18.85596
23	3	1209	1070.25	1.463320362	826.2032235	729.3368	1067.253335	11.72429
24	4	1036	899.6666667	1.230086944	842.2168894	728.6541	896.3079508	13.48379
25	5	1107	1247.5	1.70566891	649.0122399	727.9715	1241.678402	12.16607
26	6	505	495	0.676798485	746.1600622	727.2889	492.2280328	2.529102
27	9	166	307.5	0.420435423	394.828768	726.6063	305.4910237	84.03074
28	10	1024	990.75	1.354622423	755.9302005	725.9237	983.3524875	3.969484
29	11	550	618	0.844972655	650.9086383	725.2411	612.8088614	11.41979
30	12	502	285	0.389671855	1288.263428	724.5584	282.3400314	43.75697
31	1	566	554.5	0.758151031	746.553097	723.8758	548.8072006	3.037597
32	2	911	887.75	1.213793647	750.5394363	723.1932	877.8073175	3.643544
33	3	1084	1070.25	1.463320362	740.781054	722.5106	1057.264454	2.466379
34	5	1137	1247.5	1.70566891	666.6006474	721.828	1231.199526	8.284919
35	6	841	495	0.676798485	1242.615074	721.1454	488.0700819	41.96551
36	9	328	307.5	0.420435423	780.1435897	720.4627	302.9080543	7.649983
37	10	731	990.75	1.354622423	539.6337662	719.7801	975.0302858	33.38308
38	11	306	618	0.844972655	362.1418969	719.0975	607.6177227	98.56788
39	12	110	285	0.389671855	282.2887989	718.4149	279.9460597	154.4964