CASE STUDY NO. 2 LOGISTICS

TEAM "P"

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1   STRATEGY OVERVIEW

Our general strategy was to maintain strict inventory control through a pull logistics system and to avoid stockouts. We also adjusted our prices until we found a good balance between profit margin and sales.

1.1   LOGISTICS STRATEGY

1.1.1   Initial Strategy

Our logistics strategy remained consistent throughout the game. We used a pull system to replenish the inventory levels at our regional warehouses. We initially decided on this system because it allows for better inventory control.

1.1.2   Strategy Selection

Implementing a pull system allowed us to avoid overstocking our regional warehouses, which was especially important since there was no mechanism in place to return inventory from the regional warehouses to the main warehouse. With a push system, overstocking is a risk because if demand is overestimated and the push transfer levels are not adjusted in a timely manner, then the stock at the regional warehouse will accumulate until the push transfer levels are lowered. Overstocking at the regional level is undesirable, as it takes away from the maximum total capacity of 4000 boxes. For example, if the South region ends up with 500 boxes of cream that is not selling, then those 500 boxes will continue to count against the available capacity without bringing in profit. Idle inventory leads to lost opportunities. In order to get rid of the overstocked products, prices need to be lowered. However, because prices are lowered across all regions, lowering prices in order to eliminate overstock in one region can cause a stockout in another region. Because of these disadvantages of the push system, we decided that a pull system was more appropriate for our company.

1.1.3   Strategy Implementation

A pull system sets the inventory levels at the regional warehouses. Every time a delivery is made, each regional warehouse is restored to inventory levels that are set by the MM Manager. The initial regional warehouse stock levels were determined based off of our experience with the trial simulation. We knew that milk and yogurt would be higher volume sellers than the other products. However, we also knew that regional preferences would be different from the trial run. Thus, we initially set stock levels evenly across all three regions, with higher levels for the high volume sellers.

Throughout the simulation, stock levels were determined through a basic naïve forecasting method. The MM Manager would monitor the consumption of each product in each region and adjust the stock levels up or down according to past demand. For example, we observed that the North region consumed the most milk, and by the end of Round 6, we were restocking the North region to 900 boxes of milk with each delivery.

A pull system also has its disadvantages, primarily in the risk of stockouts. However, we found that with constant communication between our Planning and MM Managers, we were able to minimize our stockouts and effectively forecast the demand in each region. The MM Manager would also adjust the time between deliveries according to when the main warehouse would be restocked. We observed that

goods would be received in the main warehouse one day after submitting the purchase order. We were then able to plan our stock transfers for the day after the main warehouse inventory was replenished. Similarly, we extended the time between stock transfers to 3 days when the inventory in the main warehouse was low. This strategy was implemented to avoid paying the 300€ transportation costs when there was little inventory to transfer.

1.1.4   Strategy Evolution

Throughout the simulation, we made adjustments to our strategy in order to compete more aggressively. For example, we began the simulation by limiting our independent requirements to a total of 4000 boxes in order to avoid warehouse holding costs. However, toward the end of Round 3, we realized that the cost of holding extra inventory for a couple of days was vastly outweighed by the profit we would make from the extra inventory. We also observed that inventory in excess of our 4000 box capacity was quickly depleted, so even if we overstocked by 2000 units, we were only holding that excess inventory for a day or two at maximum. Given these observations, starting from Round 3, Day 10, we made larger orders.

1.1.5   Ending Strategy

The only point in the game that we changed logistics strategies was at the conclusion (Round 6, Day 8). At the end of the game we switched to a push strategy in order to move the remaining inventory from the main warehouse to the regional warehouses. At the end of Round 6, there was no advantage to having inventory in the main warehouse, so we pushed it to the regional warehouses and lowered prices in order to clear out the rest of the inventory. However, we implemented this change too late and were still left with significant inventory at the end of Round 6, Day 10.

1.2 PRICING STRATEGY

Our initial pricing strategy was to set high profit margins for each product. We set high margins so that we would have better control over our inventory. Higher prices mean lower sales, so we would have to restock our warehouses less frequently.

However, after Round 1 we found that we were in fourth place, primarily because we had low sales volume. We realized that in order to be competitive, we would need to lower our prices. This is similar to one of our lessons learned from the Distribution simulation. In the Distribution simulation, we were able to win with high margins, but only because our competitors had overspent on marketing. In this Logistics simulation, there were fewer opportunities for our competitors to overspend, so in order to be competitive it was necessary for us to lower prices and capture more market share.

Round 1 proved to be good practice for us, as it allowed us to solidify our logistics strategy with relatively low sales volume. When we lowered our prices, our Planning and MM Managers were already well-coordinated and were able to keep up with the higher pace of sales.

Throughout Rounds 2 through 6, we maintained consistent prices. We found that we were able to maintain higher profit margins on the extremely high demand products, such as milk and yogurt.

At the end of Round 6, we lowered prices in an attempt to clear out the rest of our inventory. This pricing change was made in conjunction with a switch from a pull to a push logistics strategy. However, these changes were made too late in the simulation and we were still left with significant stock at the conclusion.

2   PERFOMANCE EVALUATION

Our team had the greatest sales revenue, cost of goods sold, and net income (Figure 1) of the five teams. Figure 1 shows the influence of our strategy adjustments on our net income. After Round 1, we were in fourth place because our profit margins were too high and our sales volume was too low. In Round 2, we adjusted our prices and saw an increase in net profits due to higher sales volume. Because of these changes, we were able to move up to second place at the end of Round 2. We were able to keep pace with Team R through Round 3. At the end of Round 3, we refined our purchasing strategy to make larger orders, which would allow us to have greater sales volume and profit. Once we had refined our purchasing and stock transfer coordination, we were able to dominate the market in Rounds 4, 5, and 6.
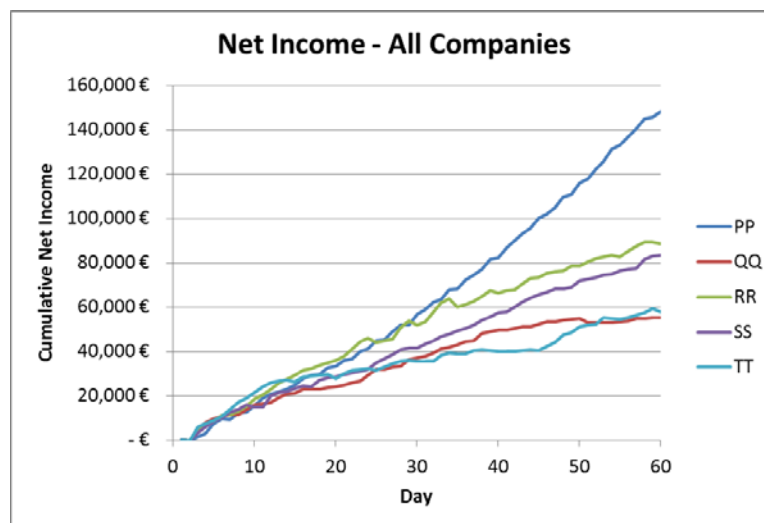
Figure 1. Comparison of net income over time

Figure 2 shows that we had the second lowest transportation and warehousing costs and zero interest costs. We were able to keep low transportation costs by minimizing the number of purchases and stock transfers. Our warehousing costs were offset by the additional profit that we made from the excess inventory. Finally, by keeping an eye on our financial statements, we were able to avoid taking out loans and paying interest. Compared to the second place team, Team R, we had much lower expenses in all three categories.
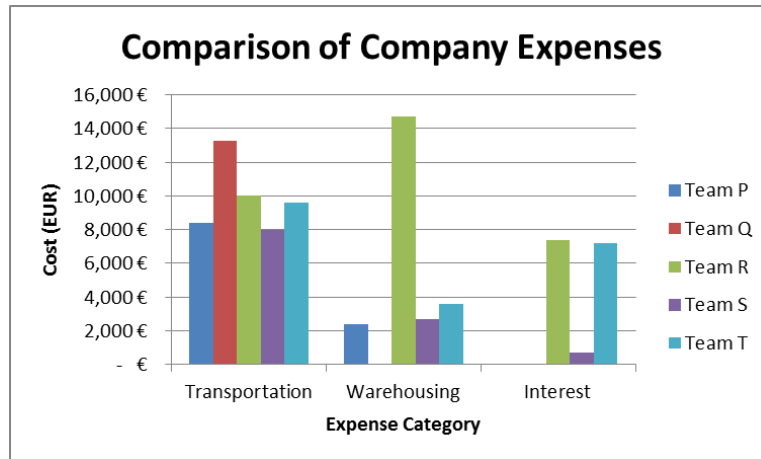
Figure 2. Comparison of company transportation, warehousing, and interest expenses

Appendix A shows the cumulative expenses, cash on hand, and income over time for all companies. These graphs show that we had comparatively low expenses, good control over our cash flow, no loans, and exceptionally high income.

2.1 INVENTORY LEVELS

One of the primary focuses of our strategy was to maintain strict inventory control. As the simulation progressed, we got better at maintaining our inventory levels in the regional warehouses and avoiding stockouts. The product that we had difficulty stocking was milk. The North region in particular consumed copious amounts of milk and by the end of the simulation we were stocking the North region up to 900 boxes of milk. The inventory was quickly depleted after each stock transfer. However, Figure 3 shows that our team did not have as many stockout days as Team R.
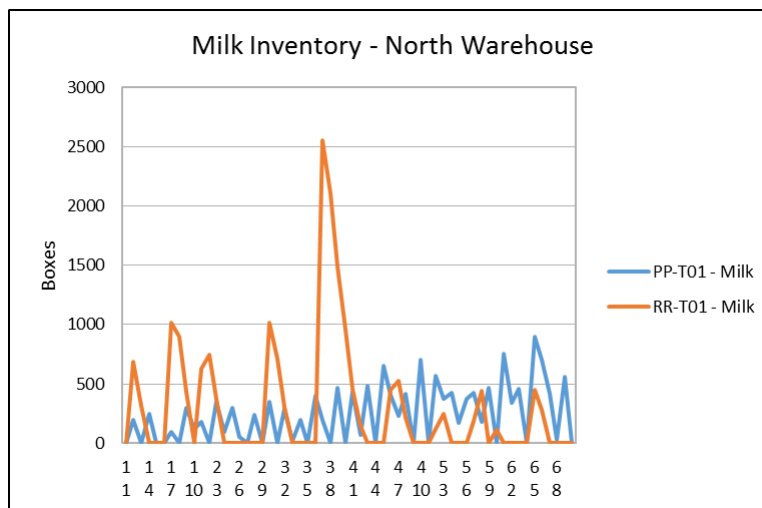
Figure 3. Comparison of North warehouse milk inventory levels for Team P and Team R

The butter inventories at the North and West warehouses illustrate the consistency of our inventory levels. In the North warehouse, we continued to replenish our stock, whereas Team R had several stockout periods (Figure 4).
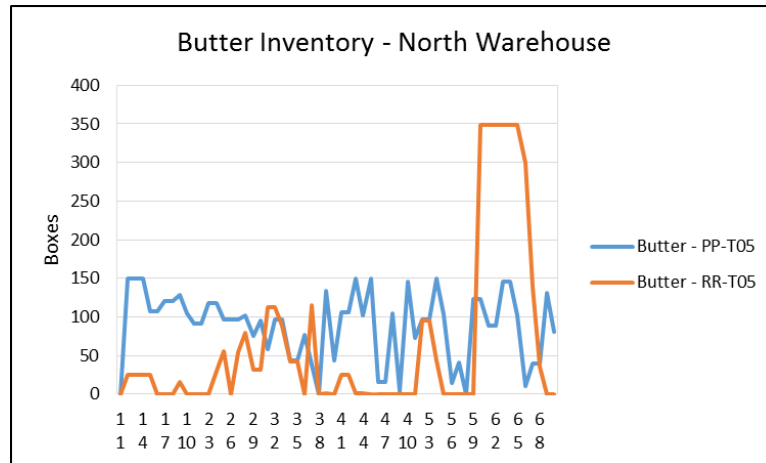
Figure 4. Comparison of North warehouse butter inventory levels for Team P and Team R

In the West warehouse, we only stocked out one time early on, and were able to maintain consistent butter inventory levels throughout the simulation (Figure 5). We stocked the West warehouse with slightly more butter than our expected demand. Keeping inventory levels higher than demand was protection from stockouts in the event that consumption of butter in the West region unexpectedly increased. Team R also stocked more butter than was demanded, but with much higher reserves than our team. Team R's extremely high inventory level was unnecessary and was essentially idle inventory. Our team tried to find a balance between the risks of overstocking and understocking.
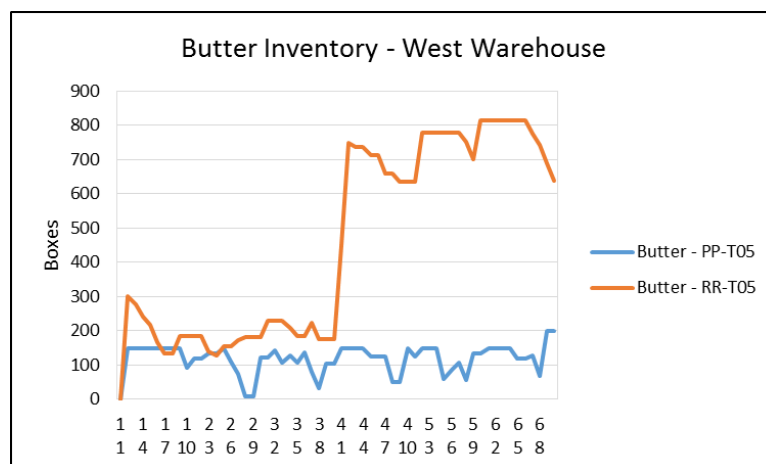
Figure 5. Comparison of West warehouse butter inventory levels for Team P and Team R

Appendix B compares the inventory levels in the Team P and Team R main, North, West, and South warehouses for each product. Maintaining appropriate inventory levels and minimizing stockout days was integral to our strategy. Figure 6 compares the number of stockout days at each warehouse for our

team and Team R. This figure clearly shows that we had fewer stockout days than our competition for most products in all warehouses.
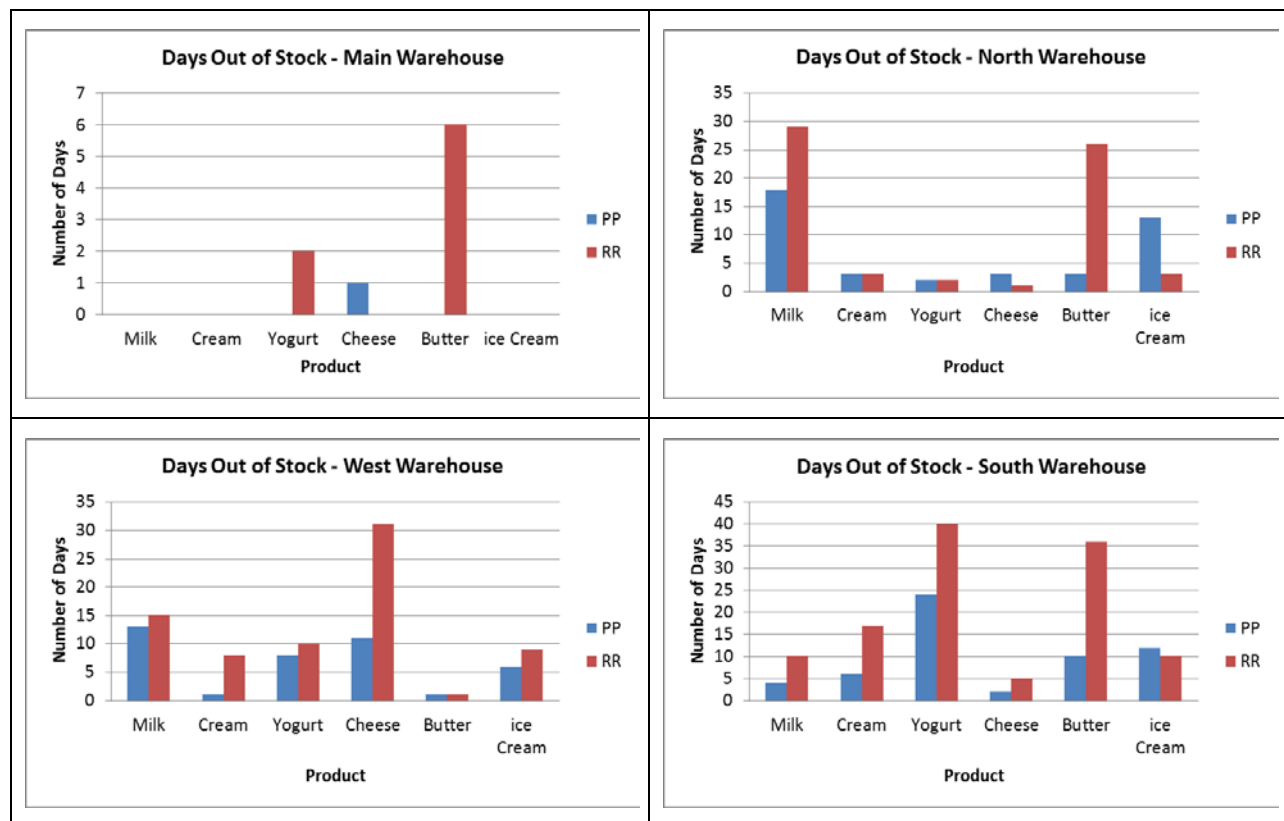
Figure 6. Comparison of number of days out of stock at each warehouse for Team P and Team R

2.2 PRICING AND PROFIT MARGIN

One of the lessons that we learned after Round 1 was that it is necessary to find a balance between profit margin and sales volume. We began the simulation with the strategy of high profit margins and lower sales volume. However, it became clear after Round 1 that our profit margins were too high to be competitive and that we would need to lower our prices in order to gain more sales volume and make more profit. Our profit margins for each product are shown in Figure 7. This figure clearly shows that we drastically reduced our profit margin after Round 1. After Round 1, our prices and profit margin remained steady. We did adjust some prices upward in response to the market conditions, but generally kept our prices competitive with the other teams. At the end of the simulation, we dropped our prices further in an attempt to clear out our remaining inventory.
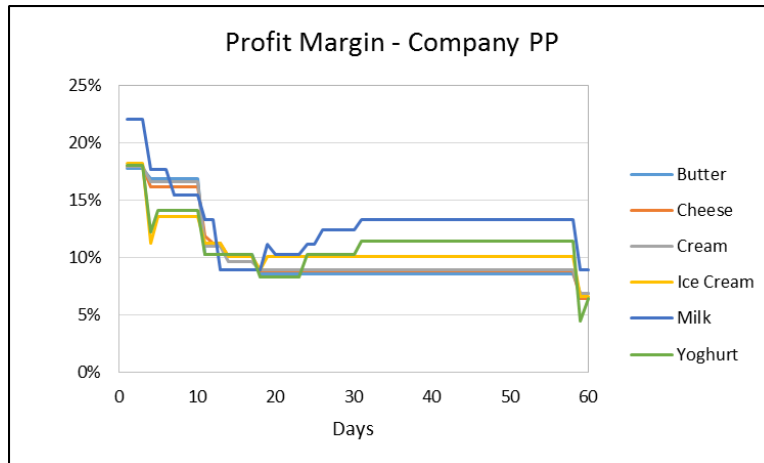
Figure 7. Team P profit margins for each product

Figure 8 compares the butter profit margin between our team and Team R. This figure shows that we started with a profit margin of 18%, compared to Team R, which started with a profit margin of 10%. After Round 1, we dropped our prices and kept a competitive profit margin compared to Team R for the remainder of the simulation.
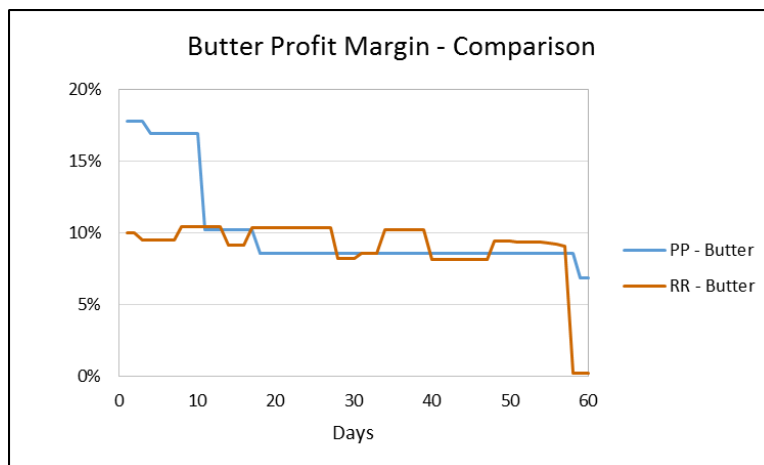
Figure 8. Comparison of butter profit margin for Team P and Team R

Price comparisons between all five teams for all products are shown in Appendix C. Profit margin comparisons between Team P and Team R for all products are shown in Appendix D.

2.3 SALES AND DEMAND

Our experience in the trial run led us to believe that milk and yogurt would be the highest sellers during the simulation. Given this belief, we started the simulation with a purchase order for higher amounts of milk and yogurt than the other four products. We knew that regional preferences would vary with each game, so we planned our first stock transfer for even levels at each regional warehouse.

Figure 9 shows the number of boxes sold of each product for our team compared to Team R. Milk and yogurt were our two highest sellers, whereas milk and ice cream were Team R's highest sellers. This figure shows that our team outsold Team R in all products with the exception of ice cream.
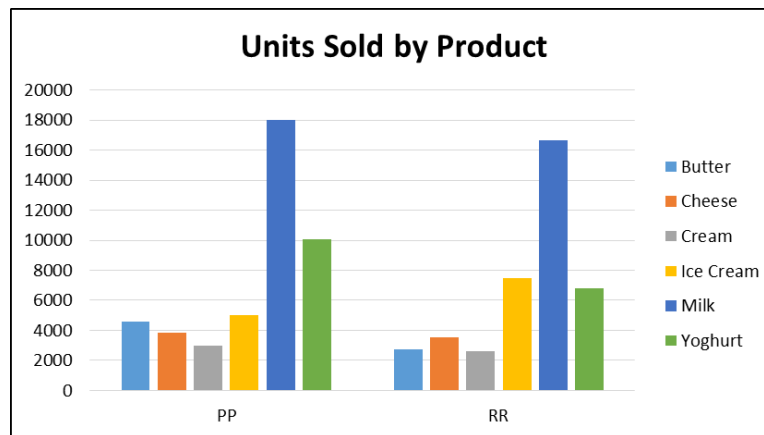
Figure 9. Comparison of number of boxes sold of each product by Team P and Team R

Figure 10 confirms our observations that milk and yogurt were our team's best sellers. The North region consumed the most milk and the South region consumed the most yogurt. These were the two product/region combinations that we had the most difficulty keeping stocked to appropriate levels.
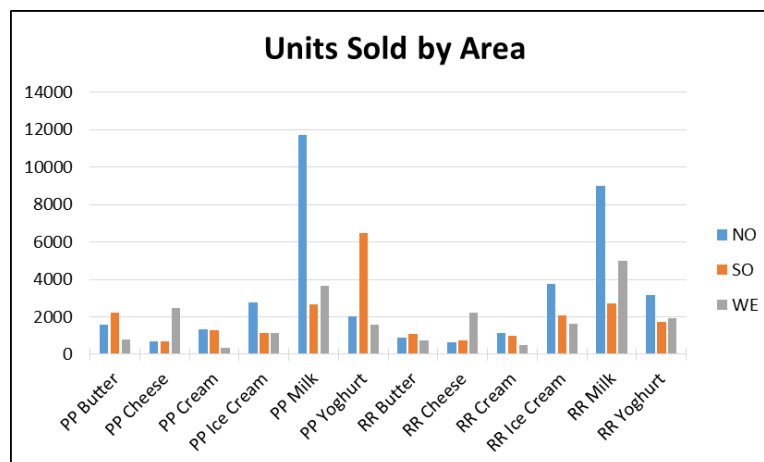
Figure 10. Comparison of number of boxes sold of each product in each region by Team P and Team R

Figure 11 shows that our sales volume increased each quarter. This increase in sales volume was a direct consequence of the strategy adjustments we made. Figure 11 shows that we had extremely low sales volume the first round. However, once we lowered our prices, we were able to increase our sales volume. We were able to further increase our sales in Rounds 4-6 because we increased our purchase order quantities and thus had more inventory to sell.
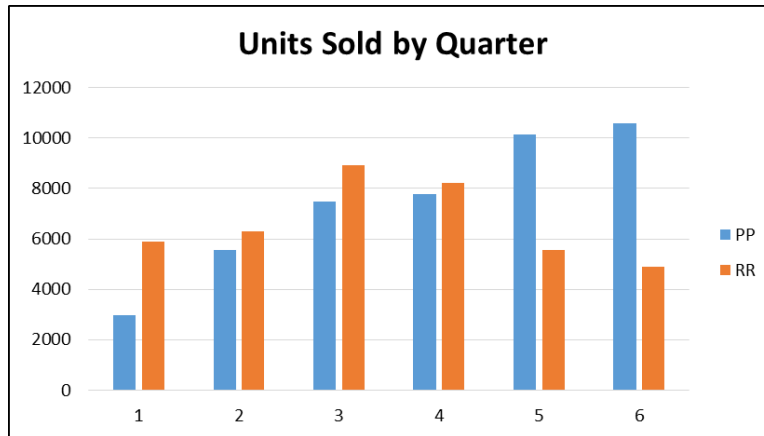
Figure 11. Number of boxes sold of all products by Team P and Team R

Appendix E compares the sales revenue per quarter for each product across all teams. These graphs show that we maintained steady revenues for most of our products. However, for milk and yogurt, we far outsold our competitors in Rounds 4-6.

2.4 CORRELATIONS

An analysis of the correlations in the data showed only weak correlations. Figure 12 shows the correlation between price and revenue per sales order for yogurt. This was the strongest correlation in the data, with a coefficient of determination of 0.0366. Because we did not vary our prices often, the data is clustered between 28€ to 29€. Because we used a pull strategy, changing the price to influence demand was not a big part of our strategy. Anecdotally we know that lowering our prices increase our sales volume (as shown in Figure 11), but this is not readily evident in our correlation data.
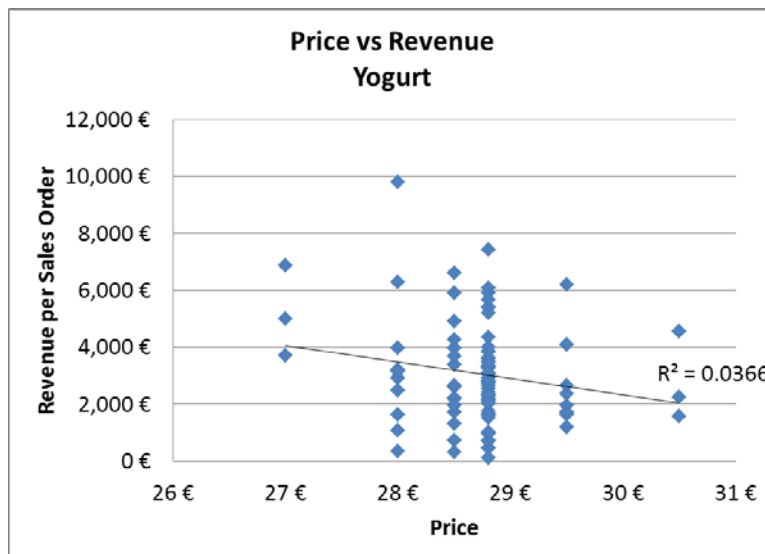
Figure 12. Correlation of price and revenue per sales order

Further correlation analyses are shown in Appendix F.

3 CONCLUSION

Our pull logistics strategy, coupled with careful monitoring of market conditions, allowed our team to maintain competitive profit margins and overwhelming sales volume. Our cost of goods manufactured was 1,719,872.88€, which was 172,181.78€ more than the second place team. Because we were able to minimize our transportation costs, warehousing expenses, and interest, we were able to bring in net income of 146,333.72€, which surpassed the second place team by 58,855.82€.

3.1 BEST PRACTICES

The most significant Best Practice that we took away from this simulation is the importance of communication across departments. Our pull strategy would not have been successful if our Planning and MM Managers had operated independently. However, because our team worked as a cohesive unit, we were able to put each piece of the logistics process together to effectively respond to changes in the market.

Additionally, it is extremely important to be flexible and to adapt to changing market conditions. Our strategy was successful because it was not unchangeable. We modified our strategy multiple times in order to adjust to changes in demand and observations of financial trade-offs. If we had maintained our initial strategy throughout the simulation, we most certainly would not have won.

3.2 LESSONS LEARNED

The biggest lesson that we learned from this simulation was the importance of striking a balance between profit margin and sales volume. As stated previously, in the Distribution game we were able to maintain unrealistically high margins yet exceed our competitors' net profits, but only because our competitors had mismanaged finances. In this game, we were not able to maintain high margins. In Round 1 we started with high margins relative to our competitors, but by Round 2, we had learned from our mistakes and had lowered our prices in order to be more competitive in the market and increase our sales volume. Thus, finding that balance between profit margin and sales volume is hugely important in maximizing profits.

This experience also taught us the importance of inventory control. We did a relatively good job controlling our stock levels at the regional warehouses, but with some products, such as milk, we consistently sold out right before each stock transfer. We continued to adjust our forecasts, but we probably could have increased our stock levels even more than we did. While we did not have many full stockout days, we did have many days in which we depleted our inventory early in the day and had to spend half a day idle until our stock transfer arrived the next day. If we had increased our stock levels more appropriately, we probably could have made even more sales.

Lastly, we learned the importance of doing the calculations of profit, warehouse costs, and transportation costs early on in the simulation. We did not realize until the end of Round 3 that it was worth paying the warehouse costs to make larger orders. The additional profit that we made from the excess inventory was more than enough to cover the associated warehouse costs. If we had realized this sooner, we may have been able to gain even more market share through greater sales volume.
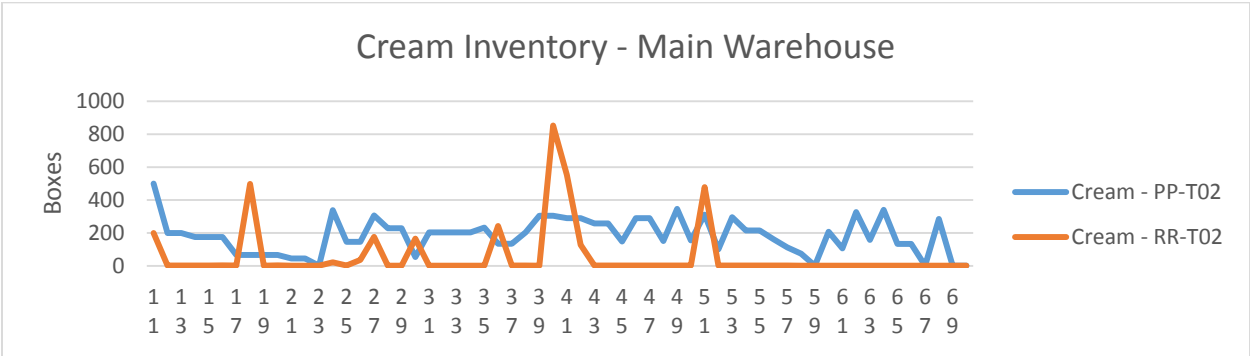
4 APPENDIX A: FINANCIAL ANALYSIS

5 APPENDIX B: INVENTORY LEVELS

5.1 MILK INVENTORY

Milk Inventory - Main Warehouse

Milk Inventory - North Warehouse

Milk Inventory - South Warehouse

Milk Inventory - West Warehouse

5.2 CREAM INVENTORY

Cream Inventory - Main Warehouse

Cream Inventory - North Warehouse

Cream Inventory - South Warehouse
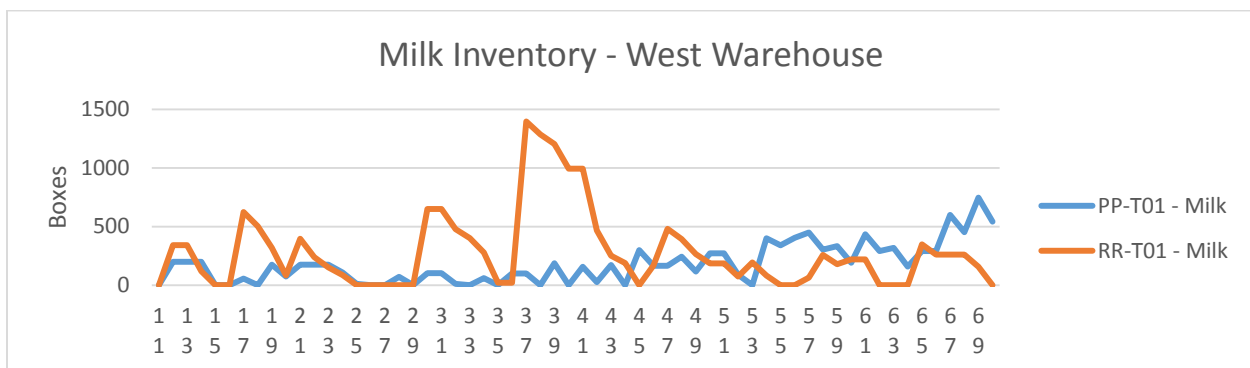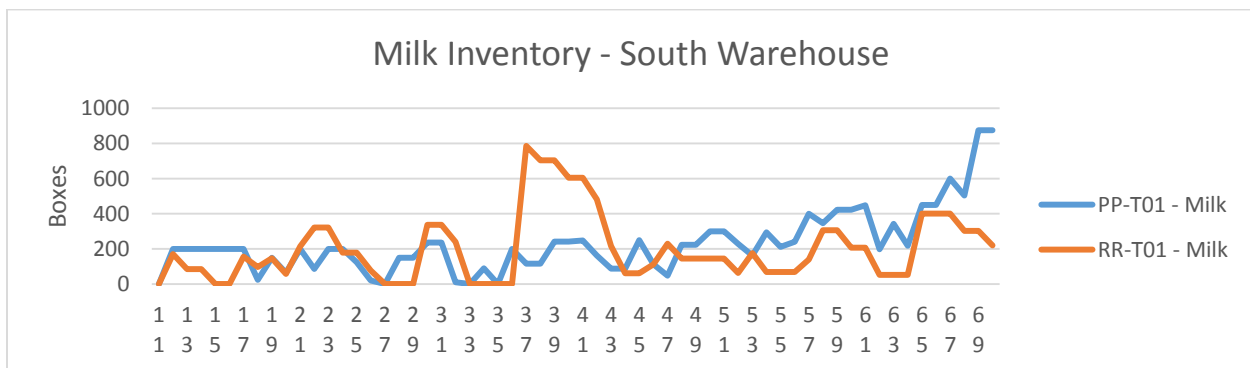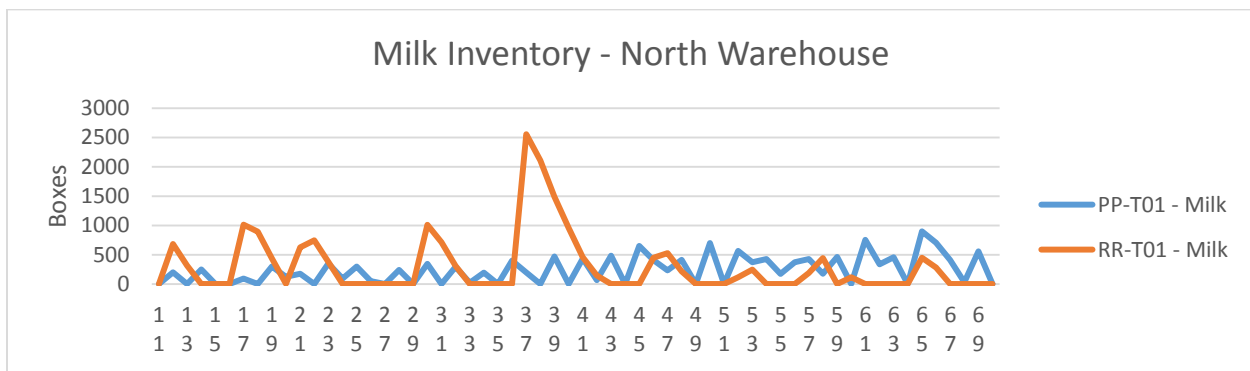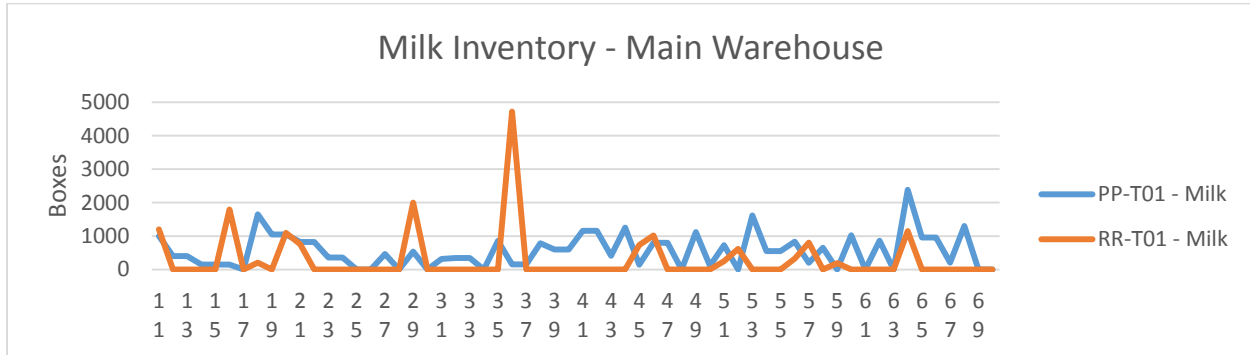
Cream Inventory - West Warehouse
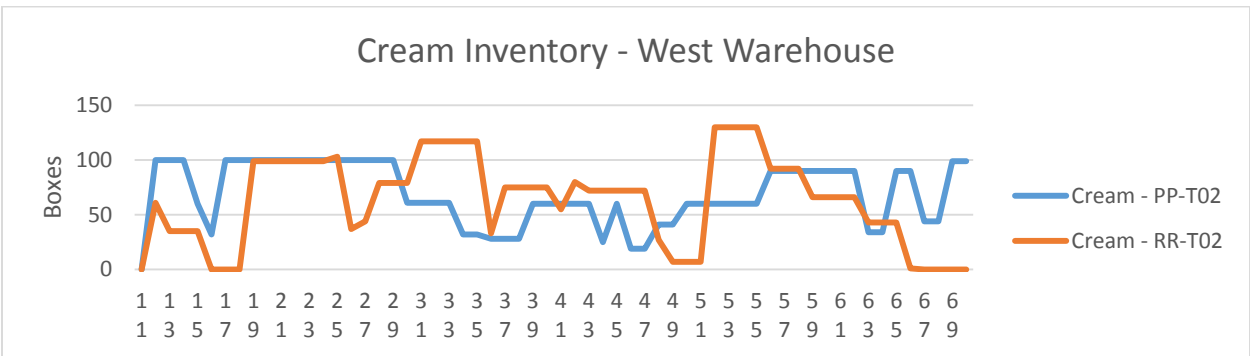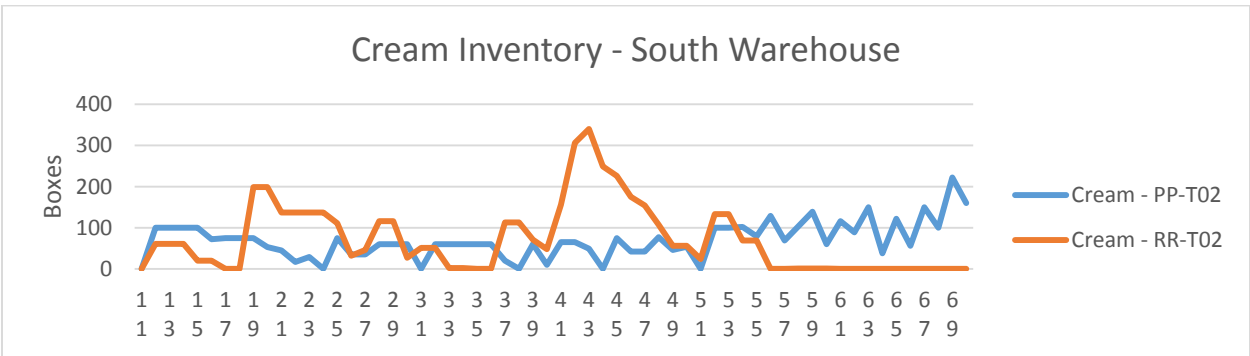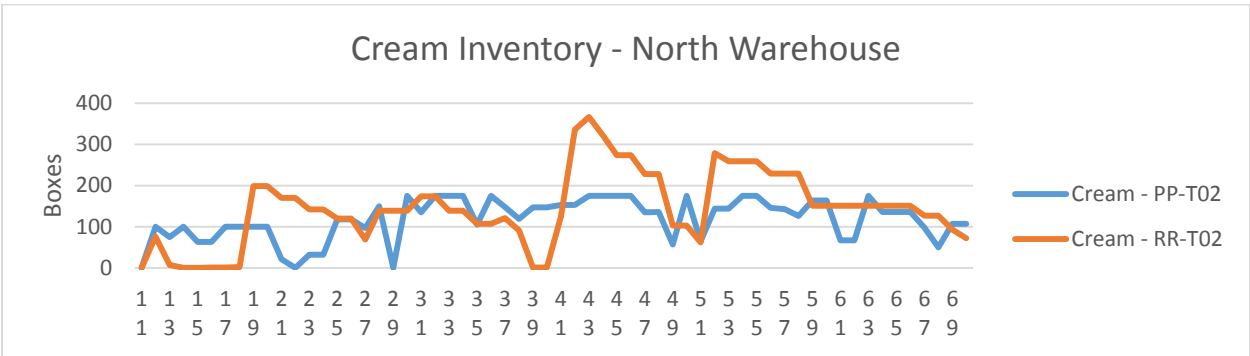
5.3 YOGURT INVENTORY

5.4 CHEESE INVENTORY

Cheese Inventory - Main Warehouse

Cheese Inventory - North Warehouse

Cheese Inventory - South Warehouse

Cheese Inventory - West Warehouse

5.5 BUTTER INVENTORY

Butter Inventory - Main Warehouse

Butter Inventory - North Warehouse

Butter Inventory - South Warehouse

Butter Inventory - West Warehouse

5.6 ICE CREAM INVENTORY

Ice Cream Inventory - Main Warehouse

Ice Cream Inventory - North Warehouse

Ice Cream Inventory - South Warehouse

Ice Cream Inventory - West Warehouse

6 APPENDIX C: PRICING

Milk Price Comparison

Cream Price Comparison

Butter Price Comparison

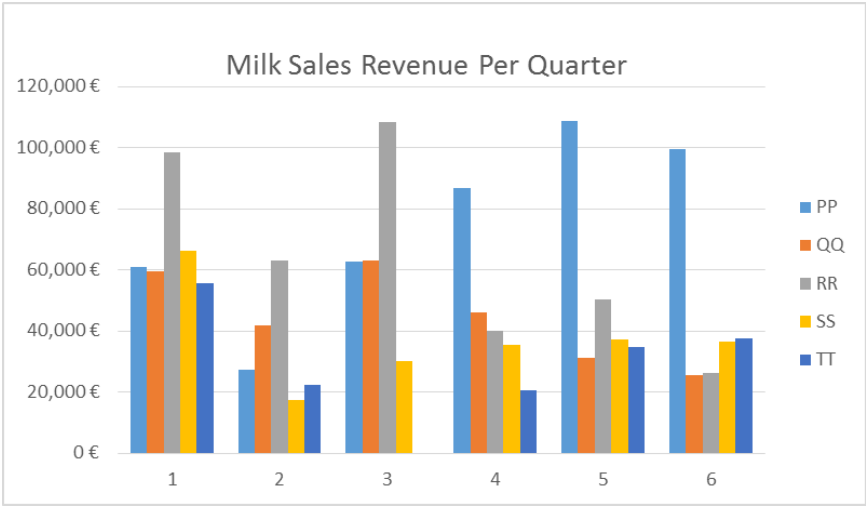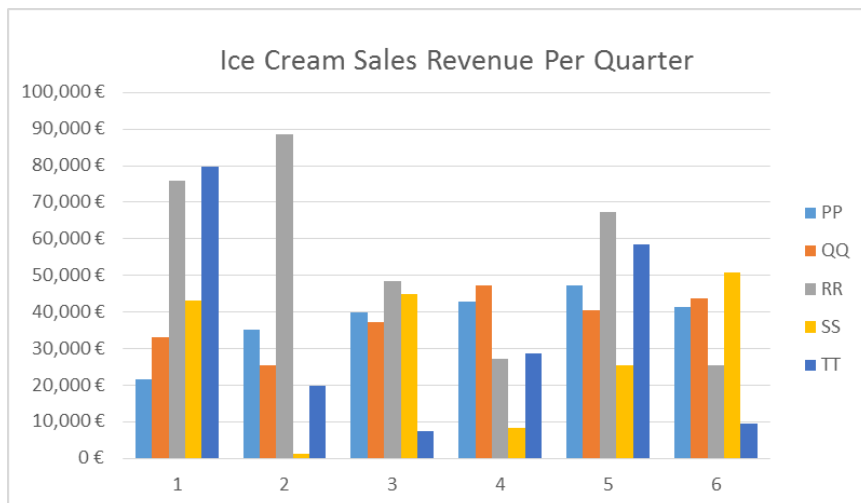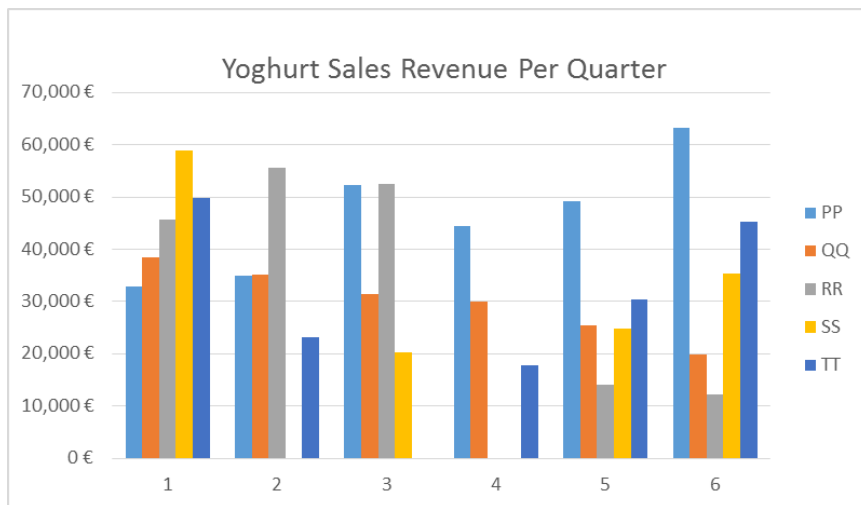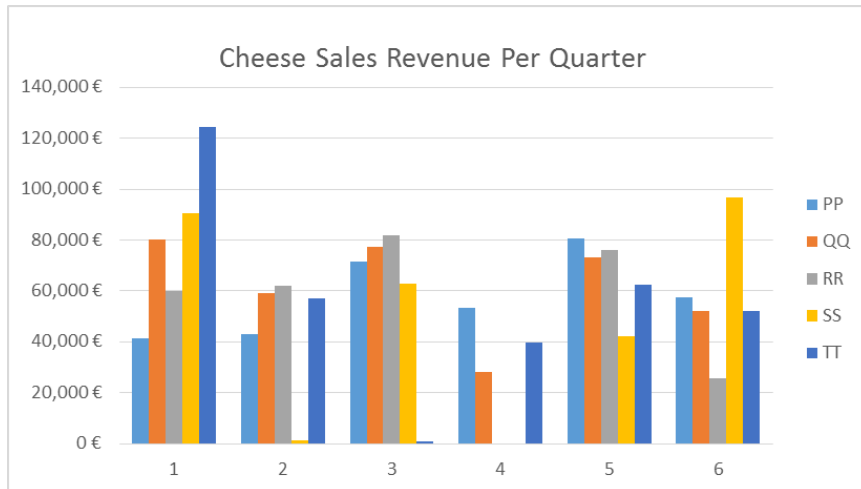# Cheese Price Comparison

Yoghurt Price Comparison

Ice Cream Price Comparison

7 APPENDIX D: PROFIT MARGINS

Milk Profit Margin - Comparison

Cream Profit Margin - Comparison

Butter Profit Margin - Comparison

Cheese Profit Margin - Comparison
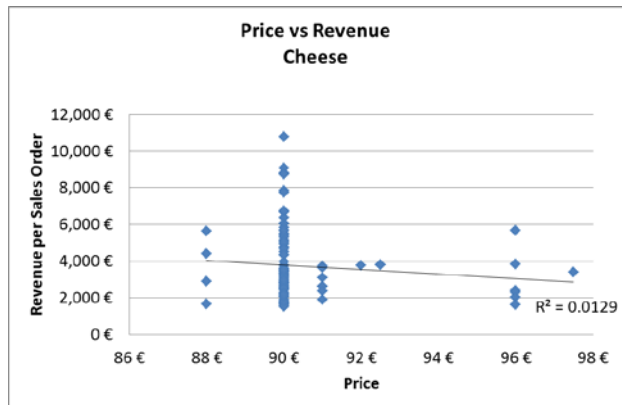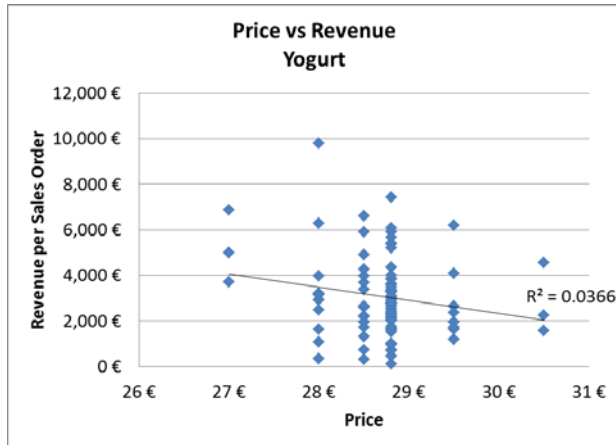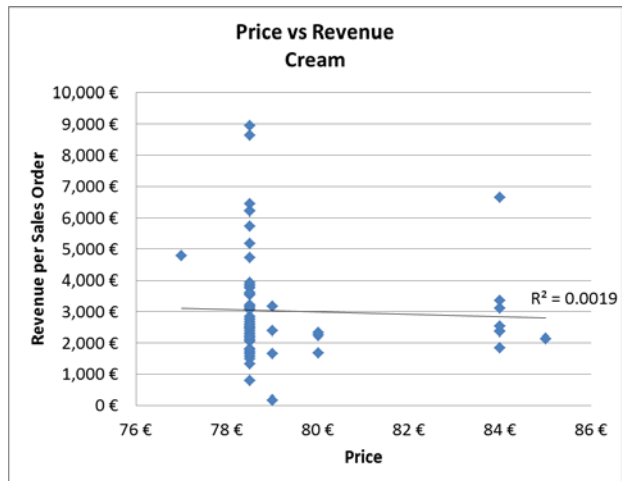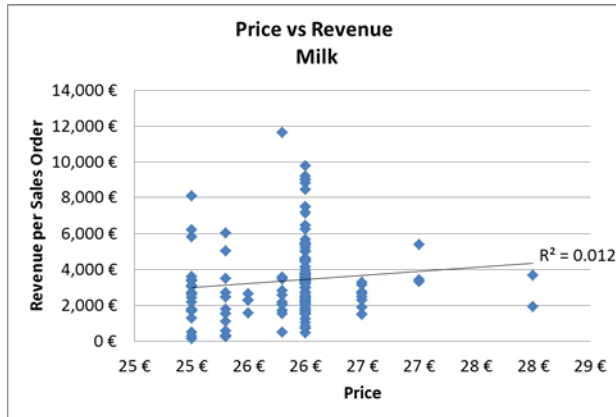

Yoghurt Profit Margin - Comparison

Ice Cream Profit Margin - Comparison
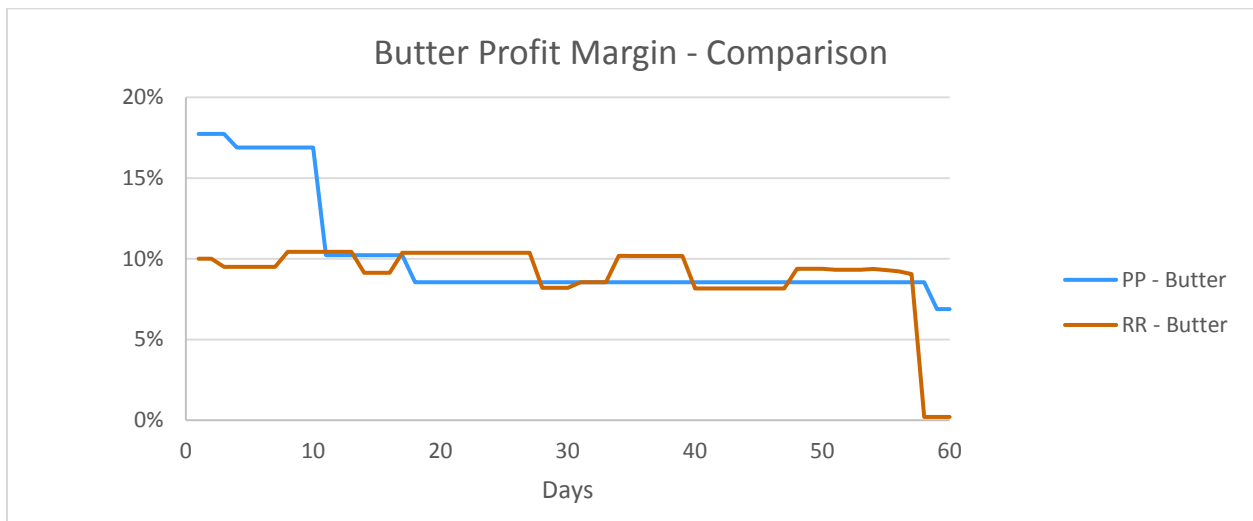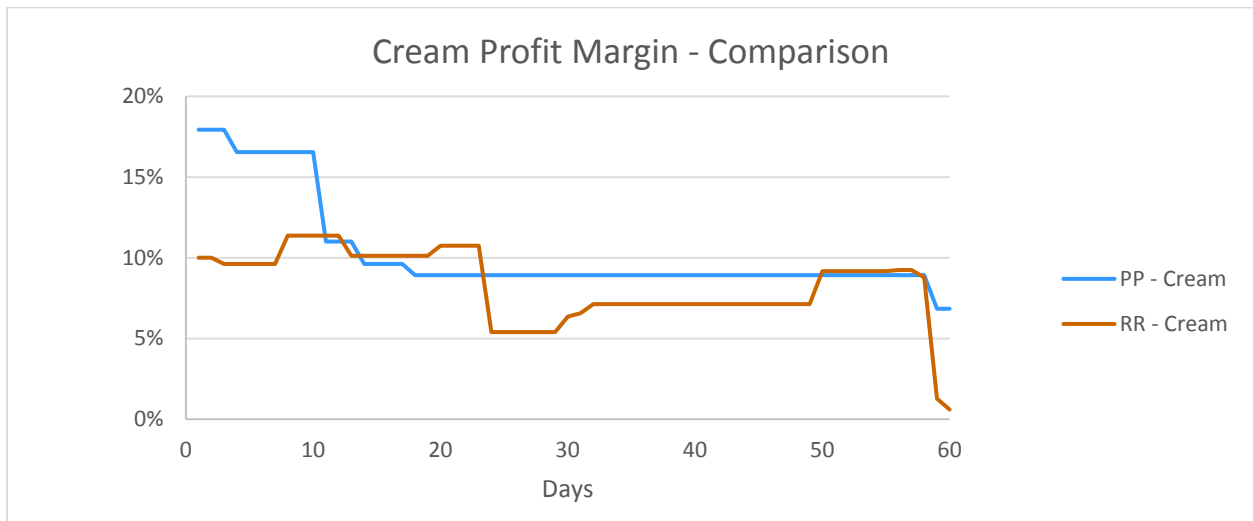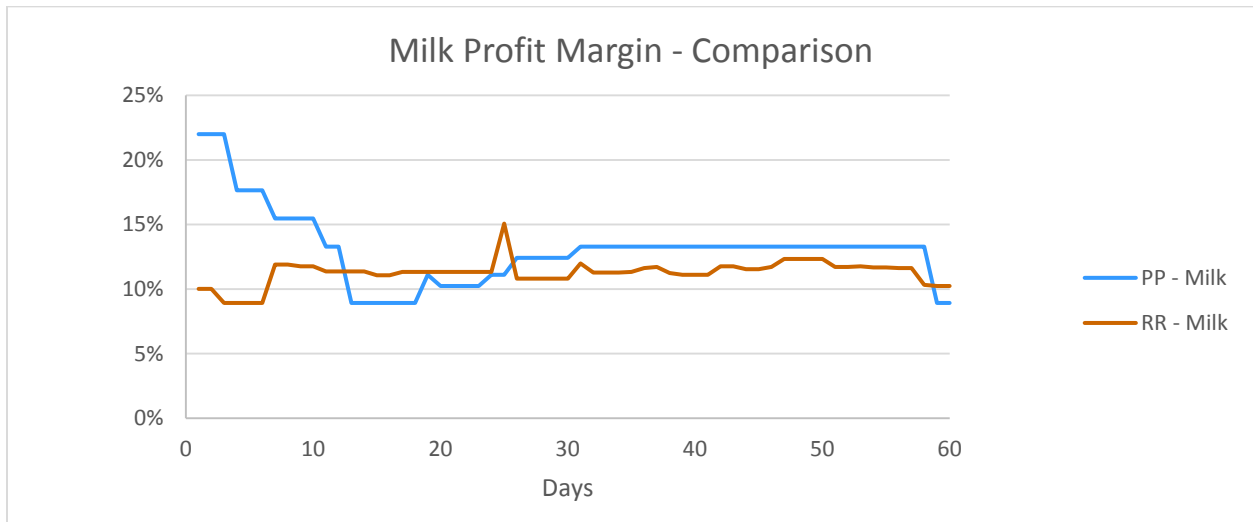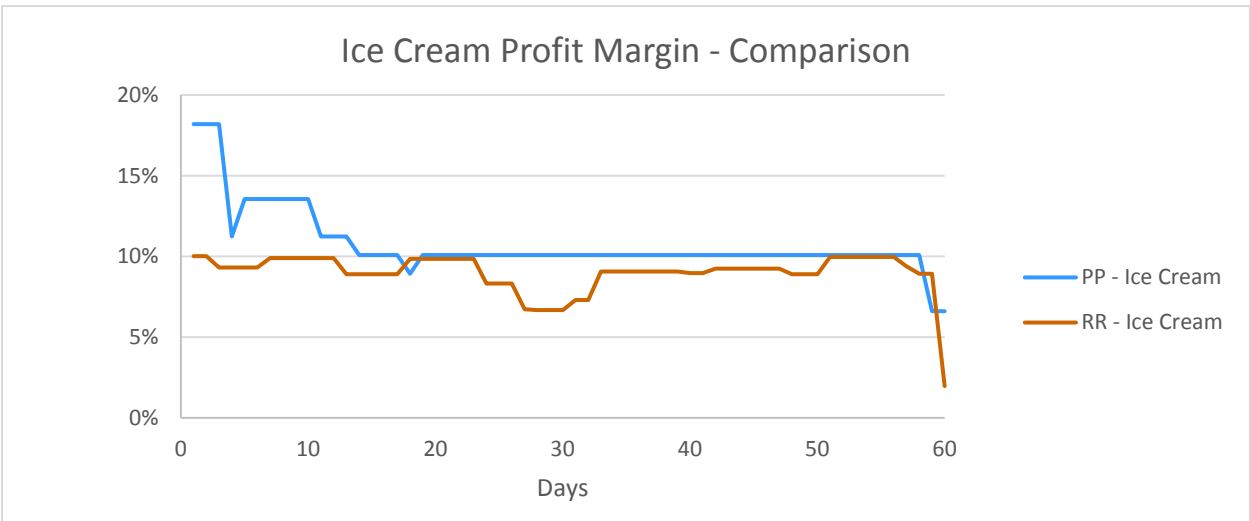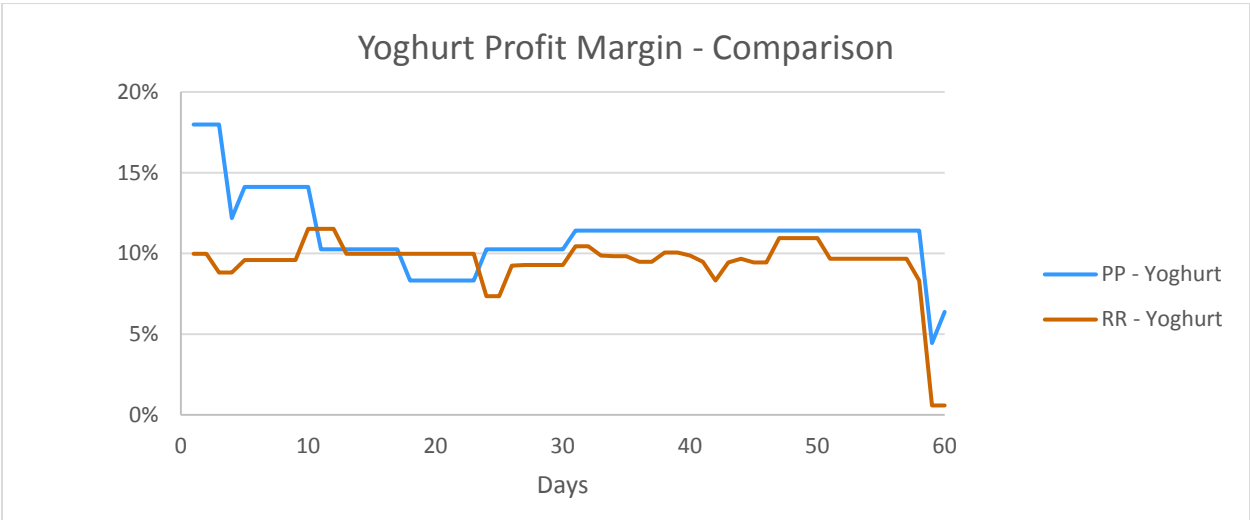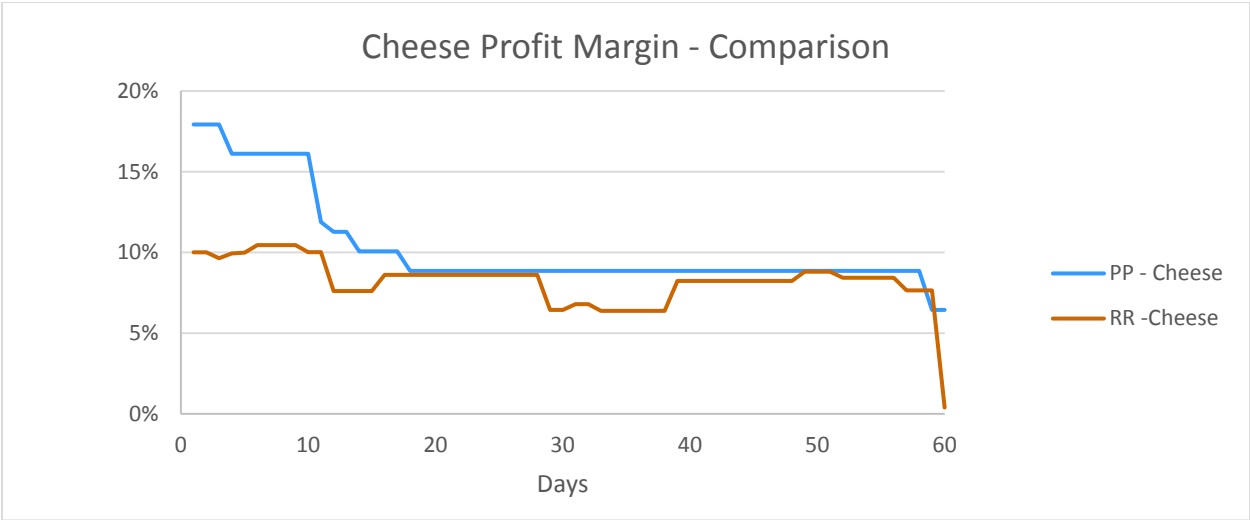
8 APPENDIX E: SALES REVENUE

Milk Sales Revenue Per Quarter

Cream Sales Revenue Per Quarter

Butter Sales Revenue Per Quarter

Cheese Sales Revenue Per Quarter

Yoghurt Sales Revenue Per Quarter

Ice Cream Sales Revenue Per Quarter
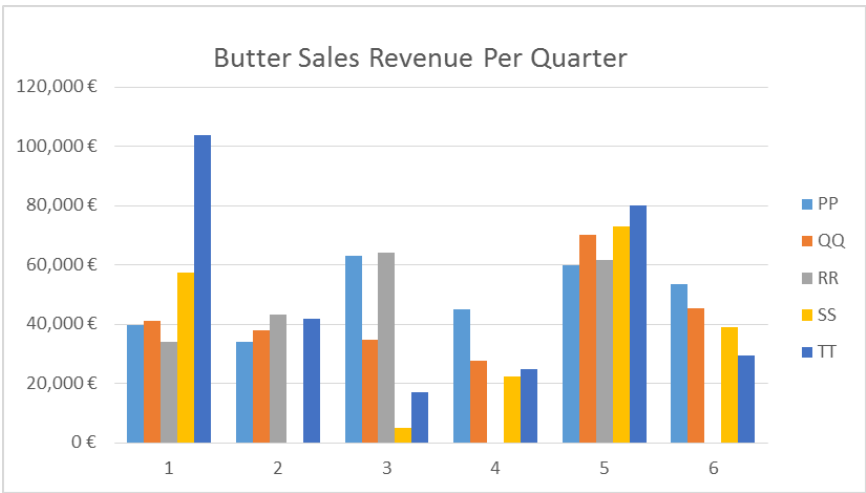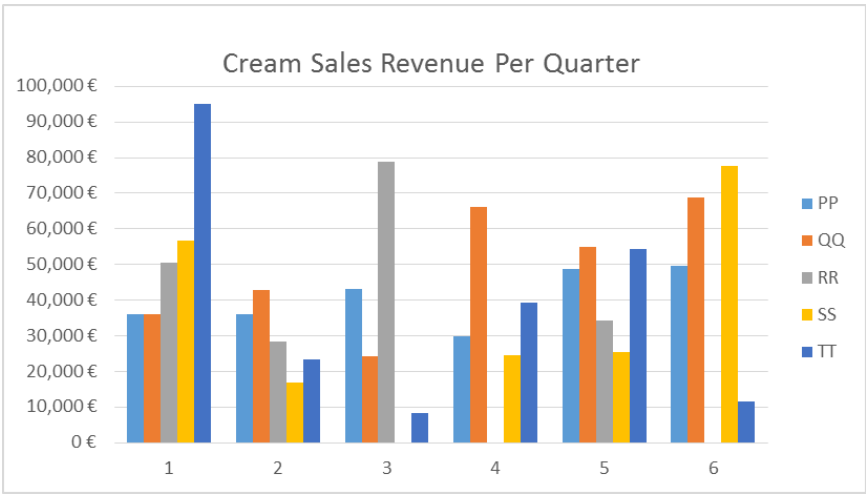
9 APPENDIX F: CORRELATION GRAPHS

9.1 PRICE VERSUS REVENUE

Price vs Revenue Milk — $R^2 = 0.012$

Price vs Revenue Cream — $R^2 = 0.0019$

Price vs Revenue Yogurt — $R^2 = 0.0366$

Price vs Revenue Cheese — $R^2 = 0.0129$

Price vs Revenue Butter — $R^2 = 0.0041$

Price vs Revenue Ice Cream — $R^2 = 0.0121$

9.2 PRICE VERSUS PROFIT

Price vs Profit
Milk

Price vs Profit
Cream

Price vs Profit
Yogurt

Price vs Profit
Cheese

Price vs Profit
Butter
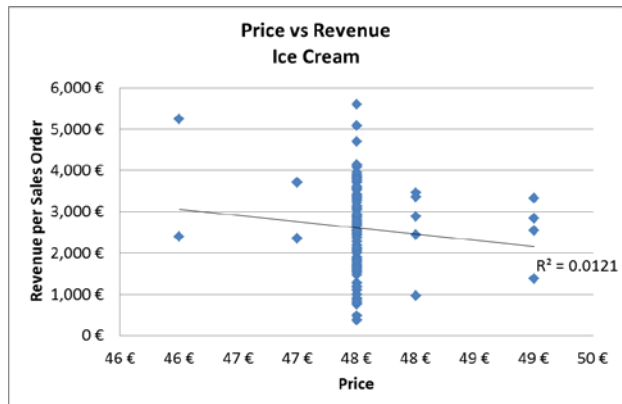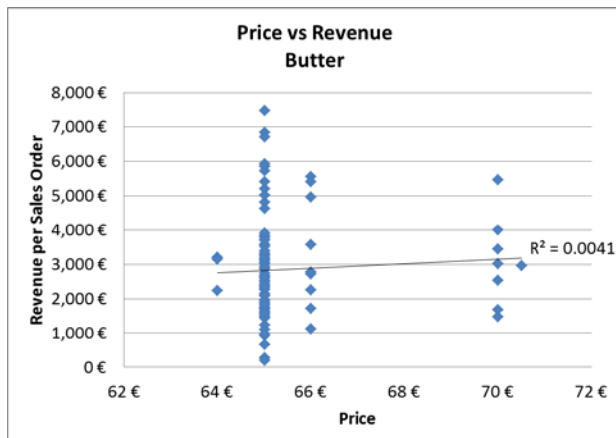
Price vs Profit
Ice Cream
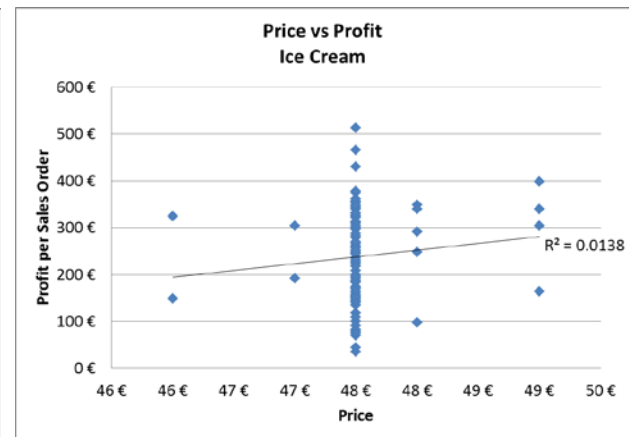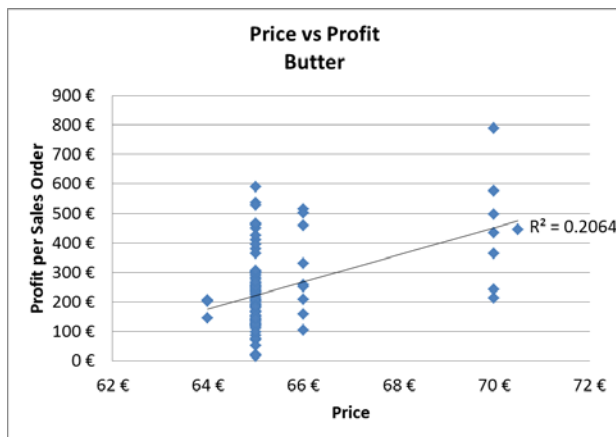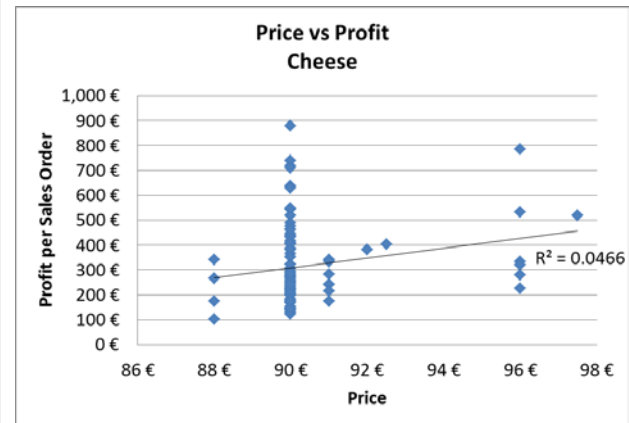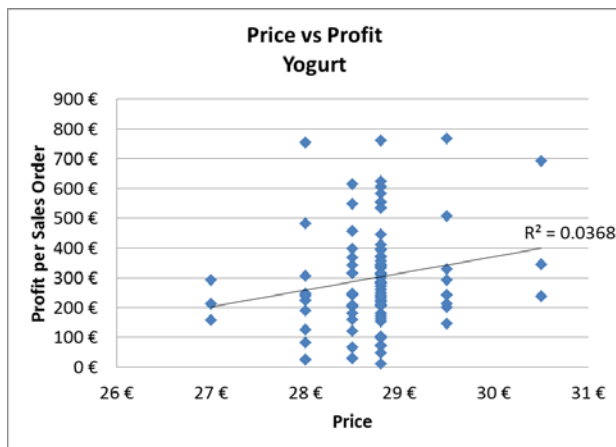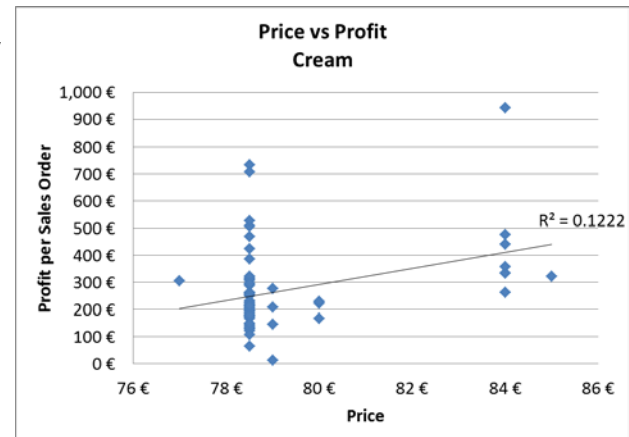
9.3 WAREHOUSE EXPENSE VERSUS PROFIT

Warehouse Cost vs Profit (PP)

$y = 0.0119x - 275.13$
$R^2 = 0.8655$

Warehouse Cost vs Profit (RR)

$y = 0.2249x - 4493.9$
$R^2 = 0.8359$