Analysis of Flour Market Segments: A study of how specialty products affect volume, sales dollars, and margin dollars

by

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ABSTRACT

The objectives of this thesis is to use regression models and market trends to determine whether the changing product mix of Ardent Mills has an impact on volume, sales dollars, and margin dollars. The results will be used to build a market analysis of Ardent Mills' product mix strategy.

Flour milling is a highly competitive industry. Ardent Mills is constantly looking to increase profits and become more valuable to its customers. Specialty products have created a new opportunity, but the opportunity costs must also be considered. Determining what new products to develop, where to manufacture them, and whether to create new capacity or convert existing capacity are difficult decisions that must be made.

The data used in this thesis were collected from Ardent Mills' sales records from June 1, 2014 through December 31, 2016. Type of product, sales volume, sales dollars, and margin dollars were collected for each month to be analyzed.

The study determined that increasing the volume of whole wheat flour sales decreases white flour volume, total flour volume, white flour sales dollars, and total flour sales dollars. Increasing the volume of UltraGrain increases white flour sales dollars and total flour sales dollars. Increasing the volume of wheat-based specialty products increases the volume of white flour and the volume of total flour. As the demand for UltraGrain and wheat-based specialty products increases, the demand for white flour increases as well. Decreasing wheat prices have allowed for additional margin to be captured.

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ACKNOWLEDGMENTS

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Personally, I could not have finished this program without the support of my family. My wife, Jessica, and daughter, Kailey, have been the most understanding people in the world and allowed me this great opportunity. Their patience, support, and understanding is truly appreciated.

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Finally, I would like to thank the MAB Class of 2017. I consider you all friends and the support we provided each other was invaluable.

CHAPTER I: PROBLEM STATEMENT

Does the demand for specialty flour products influence the demand for white flour? If so, in what way do these specialty products influence the demand for white flour and what role does price play in this influence? The objective of this thesis is to use regression models and market trends to determine whether the changing product mix of Ardent Mills has an impact on volume, sales dollars, and margin dollars. The results will be used to build a market analysis of Ardent Mills' product mix strategy.

1.1 Introduction

Traditional white flour is seen by the industry as a high-volume, low-margin product. To be profitable, a white flour mill must run full time and spread its costs across a high volume. However, in the past decade, there has been an increasing demand for higher margin, lower volume specialty flour products. This has left flour milling companies in a situation where they must decide if the best direction is to invest and be competitive in this growing segment of the industry.

1.2 The Milling Industry

Figure 1.1 shows the changes in United States per capita wheat flour use from 1964 to 2012. Beginning in the 1970s, the milling industry in the United States saw steady growth. Per capita consumption was steadily increasing, combined with increasing population. In the early 2000s consumer trends such as the Atkin's Diet, which focused on limiting carbohydrate consumption, put an end to this growth. Per capita consumption of wheat flour leveled off and began to decline. With the population continuing to increase, milling industry growth became relatively flat.

After years of expansion, milling companies faced a difficult climate to grow their businesses. This led to an increased focus on high margin, low volume specialty products. It was believed that these niche products could help companies grow and become more profitable, even if white flour demand stayed stagnant or decreased.

Figure 1.1: U.S. Per Capita Wheat Flour Consumption, 1964-2012
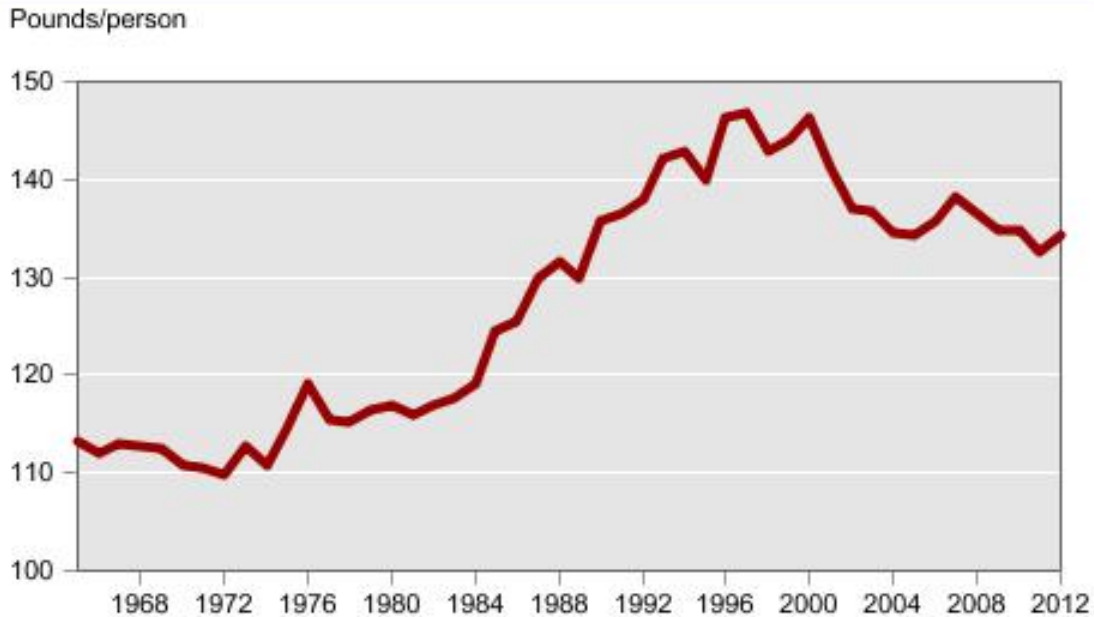
Source: (Wheat's Role in the U.S. Diet 2016)

1.3 Enlightened Eaters

Over the past decade, a change has occurred in the way some consumers purchase food products. Often called "Enlightened Eaters," six percent of the adult population focuses on humane treatment of animals, avoiding processed foods, avoiding GMOs, crops grown with chemicals, and looking for organic labeling when making food purchasing decisions (Sheluga 2016a). While they only make up six percent of the adult population, they are vocal in their opinions. Using social media, blogs, and forums, they can reach thousands of other consumers to share their passionate views.

Another 20% of the adult population are considered "Enlightened Non-Influencers." They are knowledgeable about current issues; however, they do not broadly share their views with others. They typically use word-of-mouth, so their influence stretches to friends, family, and co-workers.

Figure 1.2 summarizes these groups and highlights the issues they are most passionate about (Sheluga 2016a). These groups make up over a quarter of the adult population who are looking to better understand where their foods come from. This has led to an increase in demand of specialty flour products, both wheat-based and non-wheat based, that are perceived as healthier and more organic.

Figure 1.2: Enlightened Eaters

Source: (Sheluga 2016a)

1.4 Changing Milling Industry

As the white flour market became more competitive and consumers' tastes began to change, companies started to look at specialty flour products to increase profits. Specialty flours are typically low-volume, high-margin products. Even though a mill may only produce small amounts of a product, the high margin can make it more profitable than producing white flour.

Milling companies are working quickly to meet these new and growing demands from consumers. Research and development departments are working to develop new products, while engineering and operations are installing new capacity for specialty products or converting existing capacity into specialty product production. Many in the industry wonder if this pays for itself. Is this specialty product demand a fad, or will it continue into the future? Should mills spend money on adding specialty product production? Should mills give up capacity for white flour for a higher-margin product?

1.5 Justification for Thesis

This thesis will focus around the business of Ardent Mills. Ardent Mills is the largest wheat flour milling company in the United States. Headquartered in Denver, Colorado, Ardent Mills operates 39 milling locations, two bakeries, and a mix facility in the United States, Canada, and Puerto Rico. The company has a capacity of 521,500 hundredweights (52,150,000 pounds) of flour per day and has the ability to store 57,915,000 bushels of grain (2016 Grain and Milling Annual 2016). While largely focused on the production of traditional white flour, Ardent Mills is also expanding into specialty markets to meet the needs of this growing segment of the consumer population.

Looking at the flour milling industry, and specifically Ardent Mills, one of the largest challenges being face is changing consumer tastes and the increasing demand for specialty products. An increasing segment of consumers are asking for gluten-free, non-GMO, locally sourced, and other characteristics of food. This has led Ardent Mills to make substantial investments in finding new grain sources, developing new milling processes, and marketing these products to consumers.

Two and a half years after its formation, Ardent Mills wants to examine the demand for specialty products and whether it has an influence on the demand for white flour. This information can be used to determine if the company needs additional capacity to keep up with specialty product demand while continuing to supply white flour customers, or if white flour capacity can be converted to specialty product production.

Chapter 2 will review previous literature and research related to this topic, Chapter 3 will examine the methods used to analyze the data, Chapter 4 will discuss the data, Chapter 5 will cover the model used and the results of the analysis of the data, and Chapter 6 will summarize the conclusions drawn from the research.

CHAPTER II: LITERATURE REVIEW

2.1 Determinants of Demand

When examining the demand for a product, there are several factors that can have an impact. Price plays a major role in determining the quantity demanded for a product from consumers. There are also several nonprice determinants of demand that must be considered: tastes and preferences, income, related goods, consumer expectations about future prices and income, and the number of consumers.

The product must match with the consumer's taste and preferences. If the consumer does not like the product, then they are unlikely to purchase it. Next, they must have the income available to purchase the good. If they do not have the money available to purchase the good they will move to a lower-cost alternative. The higher their income, the more they are able to purchase. Also, consumers will examine related goods. They will look for substitutes that could be used in its place that might cost less or better meet their tastes and preferences. They will also consider complementary goods. If purchasing this good requires them to purchase another product as well, the cost of the additional product must be considered. Consumers must decide if it is the right time to purchase the product. If they expect the price to decrease or their income to increase in the future they may delay purchasing until that time. Finally, the number of consumers must be considered. If there is a high number of consumers, demand will be higher (Goodwin, et al. 2009).

2.2 Changing Role of Wheat Flour

The demand for wheat flour in the United States has gone through continuous cycles of increases and decreases over the past several centuries. Beginning in the 1600s and 1700s, high costs of production and transportation made flour too expensive to use on a

regular basis. In the 1800s, taking advantage of new farming and milling processes, flour prices began to decrease, leading to an increase in quantity demanded. Additionally, in the mid-1800s, hard wheat varieties were introduced in the United States, allowing for the development of new wheat-based products. This peaked in the last decade of the 1800s when breakfast-food manufacturers began heavily promoting grains for breakfast. Even with all of these changes, demand decreased steadily through the first seven decades of the 1900s. This was due to lower sugar costs, decreasing food consumption, and a move to a more diversified and balanced diet. In the 1970s, consumers became aware of the link between a diet high in animal products and heart disease, so grains became the healthy alternative. In addition, the fast food industry began expanding rapidly, leading to large increase in flour demand (Wheat's Role in the U.S. Diet 2016).

From 1972 to 1997, milling companies depended on rising per capita flour consumption to help them grow and be profitable. This growth peaked in 1997 with flour consumption at 147 pounds per capita. Consumer preferences began to change to lower carbohydrate diets (Wheat's Role in the U.S. Diet 2016). Consumption continued to drop, with consumption in 2015 at 133 pounds per capita, a 10 percent decrease over 18 years (Per capita U.S. flour use dops to lowest level in 18 years 2016).

2.3 Consumers' Tastes and Preferences

One challenge to the industry is to understand what consumers are wanting. The vocal "Enlightened Eaters" can skew the perception of what products will be successful once developed and produced. David Sheluga, Ardent Mills' Director of Consumer Insights, conducted a study looking at how consumers viewed twenty-three different bread descriptions (Figure 2.1). Sheluga's study demonstrates a pattern of what consumers are

currently seeking. Sweet breads, such as sweet honey wheat and cinnamon raisin swirl,

scored the highest; while gluten free and GMO free scored very low.

Figure 2.1: Map of Bread Idea Sales Potential Among Total Consumers
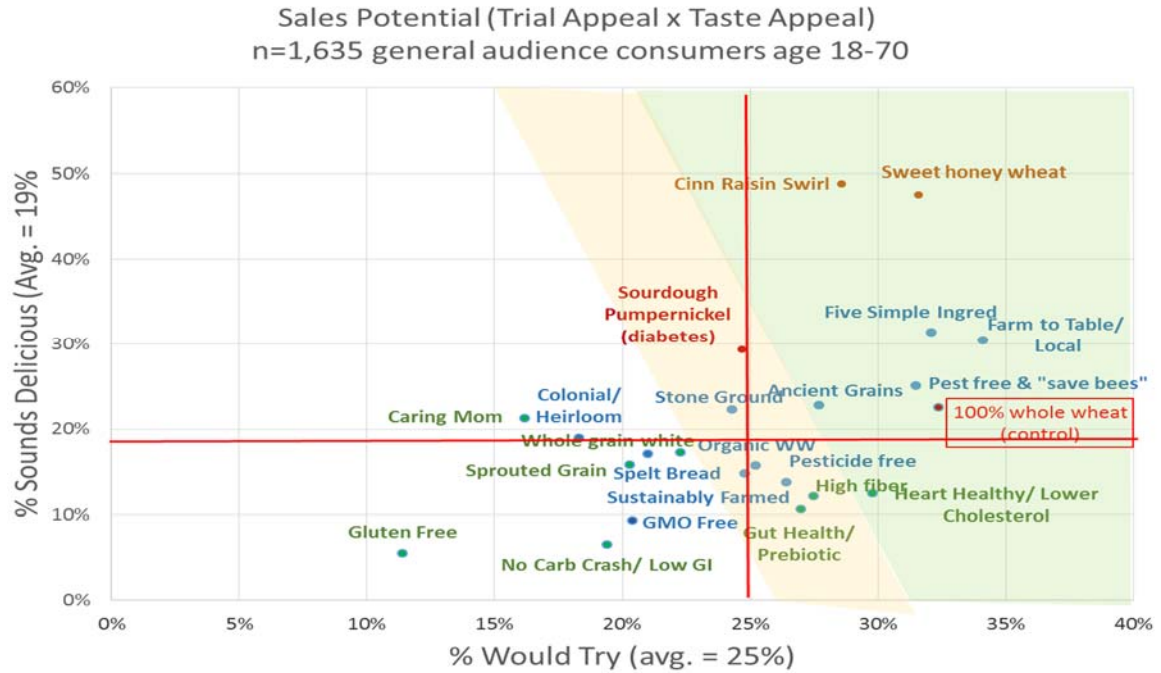
Source: (Sheluga 2016b)

Another study on the sales of wheat-related food categories sales showed similar

results (Table 2.1). The number of pounds sold of wheat related food over the last five

years decreased by an average 1.3% per year. All included categories show a decrease,

with the only exception being the cookies and pretzels category. This category increased

by an average 2.1% per year over the same time period. This indicates that the major

growth is in the sweets and cracker industries.

Table 2.1: Wheat-Related Food Category Sales Trend 2012-2016

Annual Pound Sales (millions)	52 wks Ending July 07 2012	52 wks Ending July 06 2013	54 wks Ending July 05 2014	52 wks Ending July 04 2015	52 wks Ending July 02 2016	Average Annual lb change 2012 to 2016	Actual lb change 2012 to 2016	Total % Pound change 2012 to 2016
TOTAL WHEAT RELATED CATEGORIES	28,141	27,839	27,504	27,021	26,668	-1.3%	(1,473)	-5.2%
Fresh Baked Goods	9,577	9,378	9,363	9,344	9,312	-0.7%	(265)	-2.8%
Frozen Meals/ Pizza	3,022	2,993	2,948	2,847	2,834	-1.6%	(188)	-6.2%
Cookies/ Pretzels	2,558	2,597	2,765	2,765	2,778	2.1%	220	8.6%
Pasta- Dry and Canned	3,132	3,086	2,966	2,881	2,759	-3.1%	(373)	-11.9%
RTE & Hot Cereal	3,027	2,961	2,836	2,738	2,693	-2.9%	(334)	-11.0%
Crackers	1,809	1,803	1,689	1,665	1,665	-2.0%	(143)	-7.9%
Mixes	1,405	1,393	1,364	1,304	1,234	-3.2%	(171)	-12.1%
Flour	1,186	1,172	1,166	1,132	1,100	-1.9%	(86)	-7.3%
Refrigerated Dough	849	868	865	829	807	-1.2%	(42)	-5.0%
Shelf Stable/ Dry Grocery	838	848	821	806	799	-0.8%	(39)	-4.6%
Frozen Baked Goods	738	739	720	709	686	-1.8%	(52)	-7.1%

SOURCE: Nielsen Scantrack, Total US, XAOC definition of stores, 52 weeks ending early July

Source: (Sheluga 2016c)

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CHAPTER III: METHODS

3.1 Introduction

Flour milling is a highly competitive industry. Ardent Mills is constantly looking to increase profits and become more valuable to its customers. Specialty products have created a new opportunity for growth, but the opportunity costs must also be considered. The production capacity of a flour mill is determined by its equipment, and not easily adjusted. Adding additional capacity for new products requires a large capital investment. Often, existing capacity is redesigned to produce specialty products, requiring less investment. This must all be considered when determining what new products to develop, where to manufacture them, and whether to create new capacity or convert existing capacity. The purpose of this analysis is to determine the tradeoff between white flour and specialty product production and what role price plays. The methods used are defined in the following sections.

3.2 Regression Analysis

Regression is a technique for determining the statistical relationship between variables. This is done by determining the amount of change in a dependent variable caused by a change in independent variable(s) (Business Dictionary n.d.). While this does not prove causation, it does indicate correlation between the variables. This correlation can be positive, if the independent variable increases it causes the dependent variable to increase, or negative, if the independent variable increases it causes the dependent variable to decrease.

The regression equation is represented as $Y_i = \beta_0 + \beta_1 x_1 + \varepsilon$. The Y_i represents the dependent variable, and β_0 is the intercept value, or the value of the dependent variable

if all the independent variables are zero. The β_1 is the coefficient of the independent

variable, if the independent is changed the change to the dependent variable is multiplied

by this amount. The equation can have as many independent variables included in the

equation as needed. The ε represents the regression residual, or the difference between the

predicted value of the dependent variable and its actual value.

3.3 Market Trend Analysis

A market trend analysis is the process of evaluating changes in the market over

time. The analysis investigates where a firm started in the market, where it is currently,

and then helps predict where it is expected to go in the future. Common trends, customer

needs and interests, and technological advancements can impact the market trend (What is

Market Trend Analysis: Definition and Examples n.d.). Since Ardent Mills manufactures

products to meet customer orders, and not merely to maintain an inventory, any volume

data from Ardent Mills provides a representation of the demands of their customers and

allow for analysis of the market.

CHAPTER IV: DATA

4.1 Objective

The objectives of this thesis are to use regression models and market trends to determine whether the changing product mix of Ardent Mills has an impact on volume, sales dollars, and margin dollars. The results will be used to build a market analysis of Ardent Mills' product mix strategy.

4.2 Data Collection

The data used in this analysis were collected from Ardent Mills' sales records in their ERP system. The ERP system is the computer system that tracks all business sales, orders, billing, and more. A report was constructed that contained all sales records from June 1, 2014 through December 31, 2016. The type of product, sales volume, sales dollars, and margin dollars were collected for each month to be analyzed. Sales volume represents the number of hundredweights (cwts) that were invoiced to customers during the month. Sales dollars represent the total dollar amount that was invoiced to customers during the month. Margin dollars were obtained from taking the sales dollars less the cost of inputs, production, and transportation. The ERP system automatically invoices all customers as soon as the order has been shipped.

Since Ardent Mills manufactures to and order, and not to maintain an inventory, the quantities used are exogenous from the other variables. Additionally, since Ardent Mills is not running at full capacity, that will not impact the variables studied. Ardent Mills was formed on May 29, 2014, so data from before that date were not available.

4.3 Product Categories

Different types of products were grouped into broader categories with similar products. These groups are shown in Table 4.1.

Table 4.1: Product Categories

White Flour	Whole Wheat	UltraGrain	Wheat-Based Specialty	Non-Wheat Based Specialty
Durum	Red Whole Wheat	UltraGrain	Bran/Germ/ Nufiber	Ancient Grain/ Gluten Free
Hard Wheat Flour	Soft Whole Wheat		Farina	Rye
Soft Wheat Flour	White Whole Wheat		Organic	Sustagrain
			Ready to Eat	

The first category is white flour (Table 4.1). This category represents what most people think of when they think of flour. The outer bran layer and germ are removed from the wheat kernel and the endosperm is ground into a fine power. Ardent Mills uses several different types of wheat to make white flour, each with their own properties. Durum is very hard and is high in protein, it is most commonly used to produce noodles. Hard wheat is slightly lower in protein and is used to make breads, pizzas, and other items. Finally, soft wheat has the lowest protein content and is used to make crackers, cookies, cakes, biscuits, and additional products.

The next category is whole wheat flour (Table 4.1). When producing whole wheat flour, the entire wheat kernel is ground to produce flour. This gives the flour the darker color. Due to the coarseness of the bran, the particle size is larger than white flour. Red whole wheat flour is made from Hard Red Winter and Hard Red Spring wheats. It is used in similar products as hard wheat white flour. Soft whole wheat flour is made from Soft

Red Winter wheat and is comparable to soft wheat white flour. White whole wheat flour is made from Soft White Winter and is used in similar products as soft wheat white flour, but does not have as dark a color due to the bran of the kernel being lighter in color.

UltraGrain is a proprietary product owned by Ardent Mills (Table 4.1). The wheat is specially sourced and the milling process is patent protected. UltraGrain, similar to whole wheat flour, has the entire wheat kernel ground into flour. However, the final product has the appearance and taste of white flour. This is desirable for those who want the health benefits of whole wheat flour, but do not like the taste, texture, or appearance of products made with whole wheat flour.

Products in the wheat-based specialty category come from wheat but have some additional attribute or processing that makes the different than the other flours produced (Table 4.1). Bran, germ, and Nufiber are all produced from the parts of the wheat kernel other than the endosperm. These are used as additives, fillers, or animal products. Farina is extracted from the endosperm of the wheat kernel, similar to white flour, but it is not ground into a fine powder. Instead it is left as coarse material that is often used in breakfast foods, such as Cream of Wheat. Organic flour is the same as white flour, only the wheat is sourced to ensure it is free from pesticides, no additives are used in the milling process, and it is segregated to ensure it is not contaminated by non-organic products. Ready to eat flour is white flour that has been through a process to make is safe to eat without additional cooking. Flour carries a risk of salmonella and other pathogens, so this flour is used in products that have a tendency to be eaten without being fully cooked, such as cookie dough and pot pies.

Finally, non-wheat based specialty products are any products produced by Ardent Mills that are not made from wheat (Table 4.1). Ancient grain and gluten free are whole-kernel flours made from amaranth, quinoa, sorghum, millet, teff, and multigrain blends. Rye is a whole-kernel flour made from rye. It has a unique texture and flavor that is most commonly recognized in pumpernickel bread. Sustagrain is a flour made from a proprietary high fiber barley variety. It is used in breads, cereals, and baked goods (Ardent Mills n.d.).

A summary of the business statistics for each of these categories is shown in table 4.2. Each category will be broken down into further detail later in the chapter.

Table 4.2: Category Breakdown, Average for June 2014 through December 2016

Category	Percent of Volume	Percent of Sales Dollars	Percent of Margin Dollars
White Flour	92.22%	90.57%	82.32%
Whole Wheat	3.38%	3.30%	5.02%
UltraGrain	2.45%	2.98%	6.39%
Wheat-Based Specality	1.52%	2.40%	4.64%
Non-Wheat Based Specality	0.44%	0.75%	1.63%

4.4 Data Description

The data were graphed and analyzed to see if there were any immediately noticeable trends. Figure 4.1 shows the total volumes for each month. While there are some highs and lows, there is not a consistent pattern. Figure 4.2 shows the total sales dollars for each month. Overall, total sales dollars has been on a downward trend for the

period analyzed. Figure 4.3 shows the total margin dollars for each month. Total margin dollars has been on an upward trend during this time.
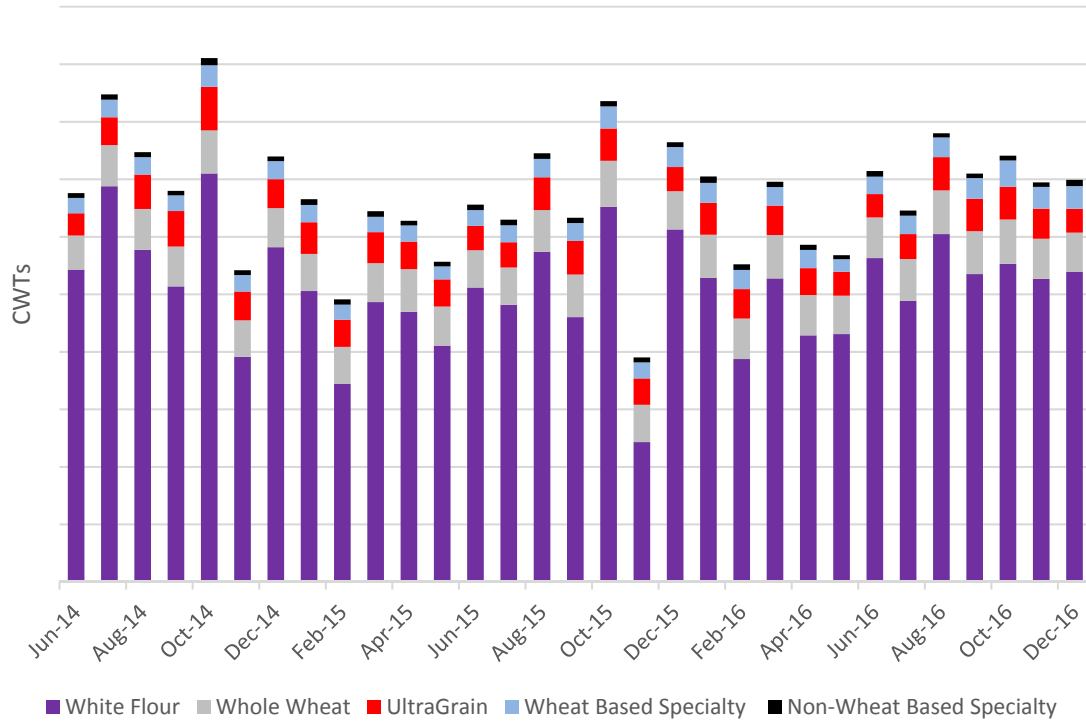
Figure 4.1: Total Sales Volume by Category

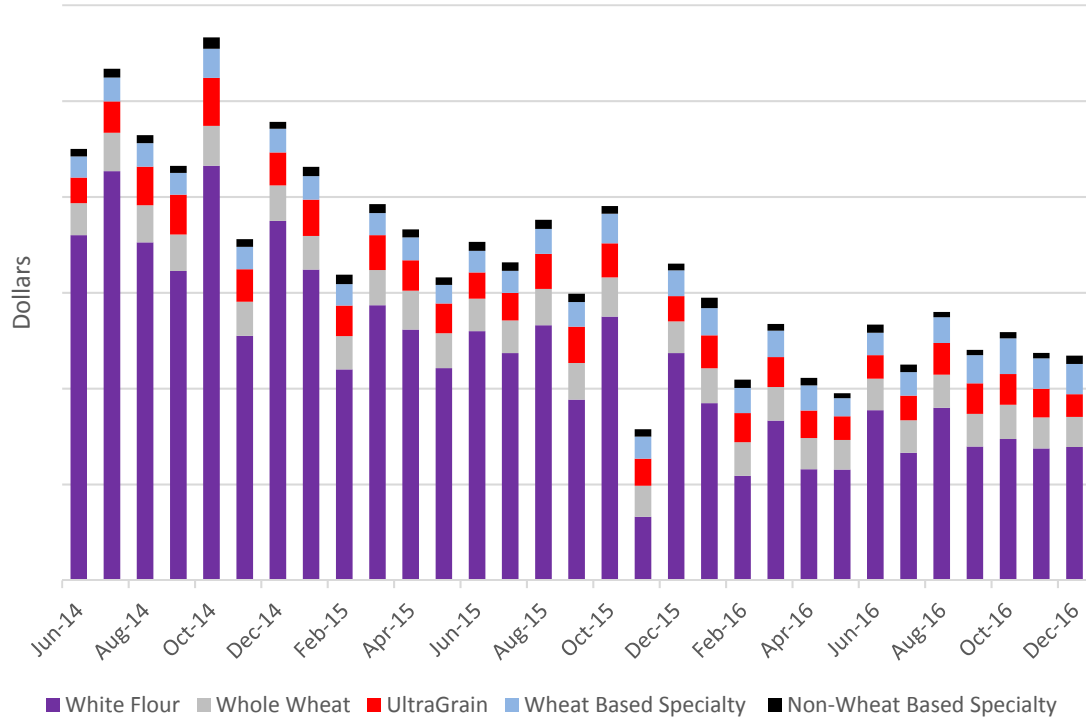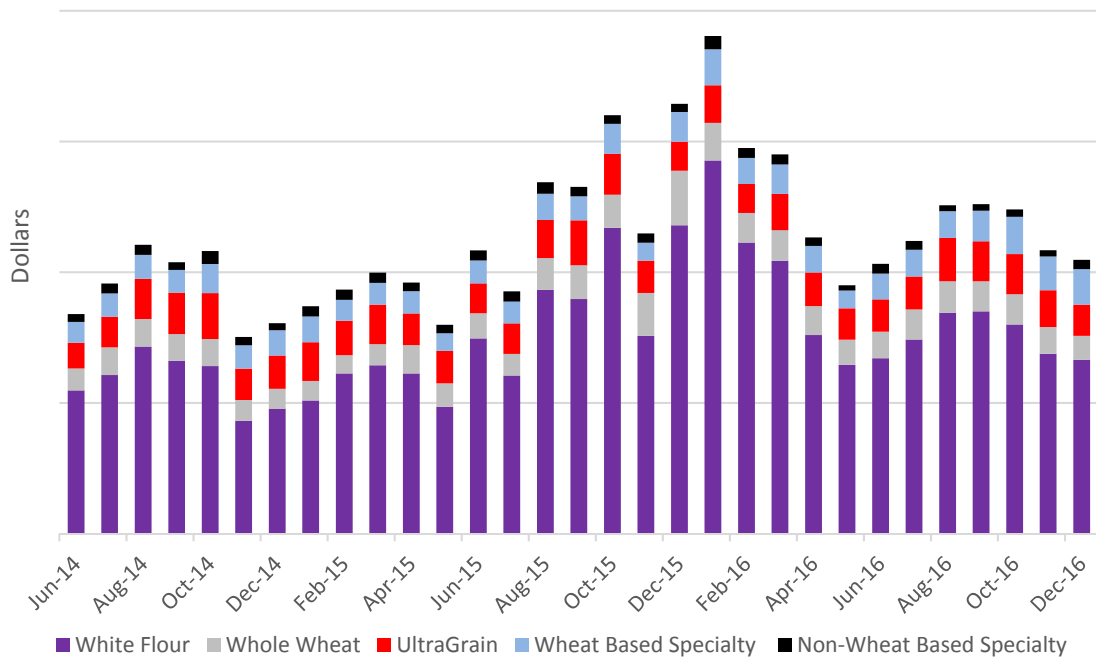**Figure 4.2: Total Sales Dollars by Category**

Figure 4.3: Total Margin Dollars by Category

The data were analyzed based of the percentage of total volume of sales, the percentage of the total dollar of sales, and the percentage of total dollar of margin from sales. Converting all data to percentage eliminates seasonality or external factors that may exist in the business (Figures 4.4, 4.5, and 4.6).

Figure 4.4: Percent of Total Sales Volume by Category

Figure 4.4 shows that white flour is by far the largest contributor of sales volume over this 31 month period, ranging from 91.2% to 93.6%. The category with the next largest volume varies depending on the month, whole wheat flour ranges from 2.8% to 3.7% while UltraGrain ranges from 1.8% to 3.3%. Specialty products with wheat-based products range from 1.1% to 2.1% and non-wheat based products range from 0.3% to 0.5%.

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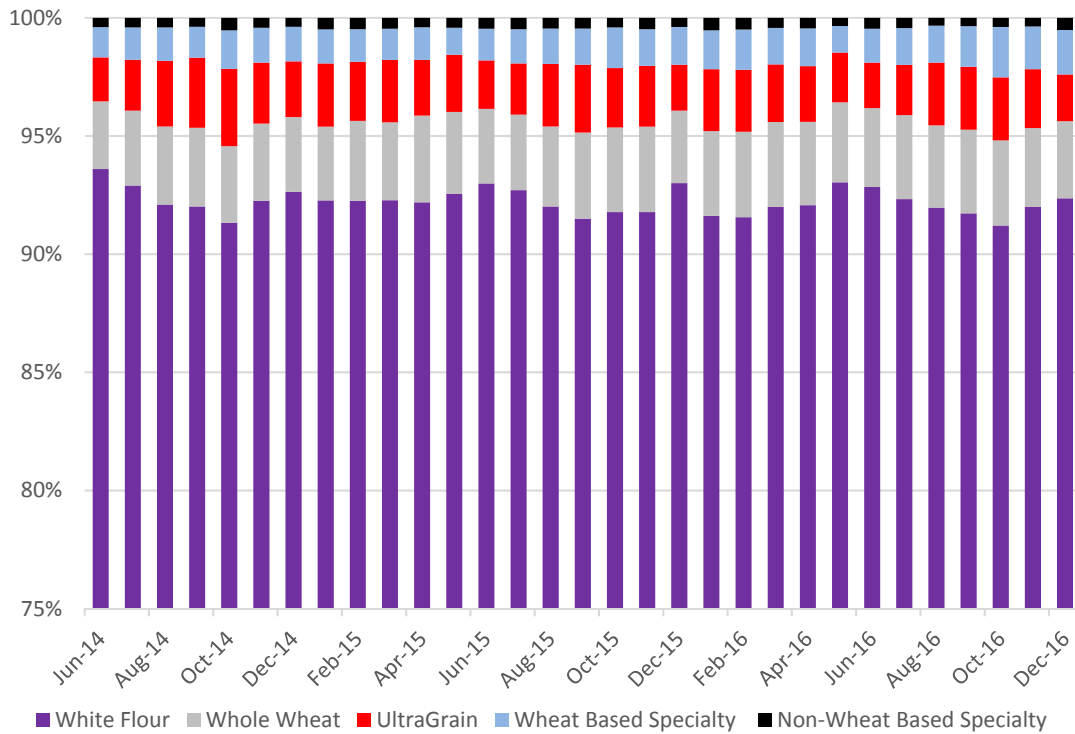**Figure 4.5: Percent of Total Sales Dollars by Category**
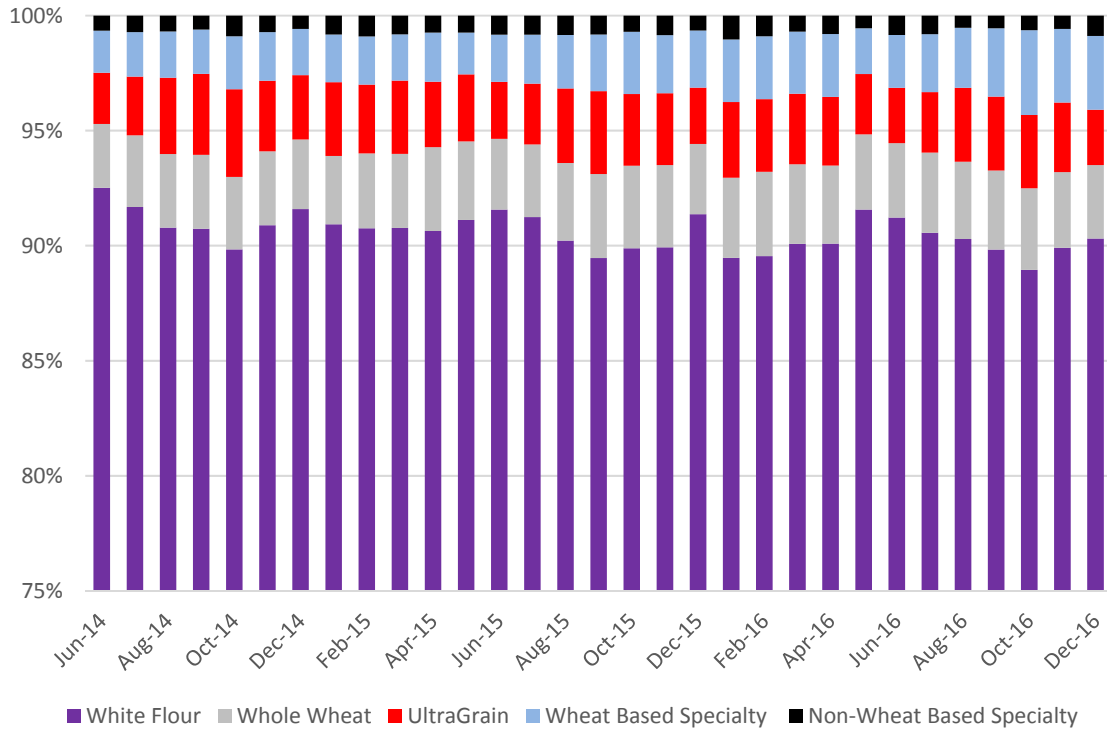
Figure 4.5 shows that white flour is also the largest contributor of sales dollars over this 31 month period, ranging from 88.9% to 92.5%. The category with the next largest sales dollars varies depending on the month, whole wheat flour ranges from 2.8% to 3.7% while UltraGrain ranges from 2.2% to 3.8%. Specialty products with wheat-based products range from 1.8% to 3.7% and non-wheat based products range from 0.5% to 1.0%.

Figure 4.6: Percent of Total Margin Dollars by Category
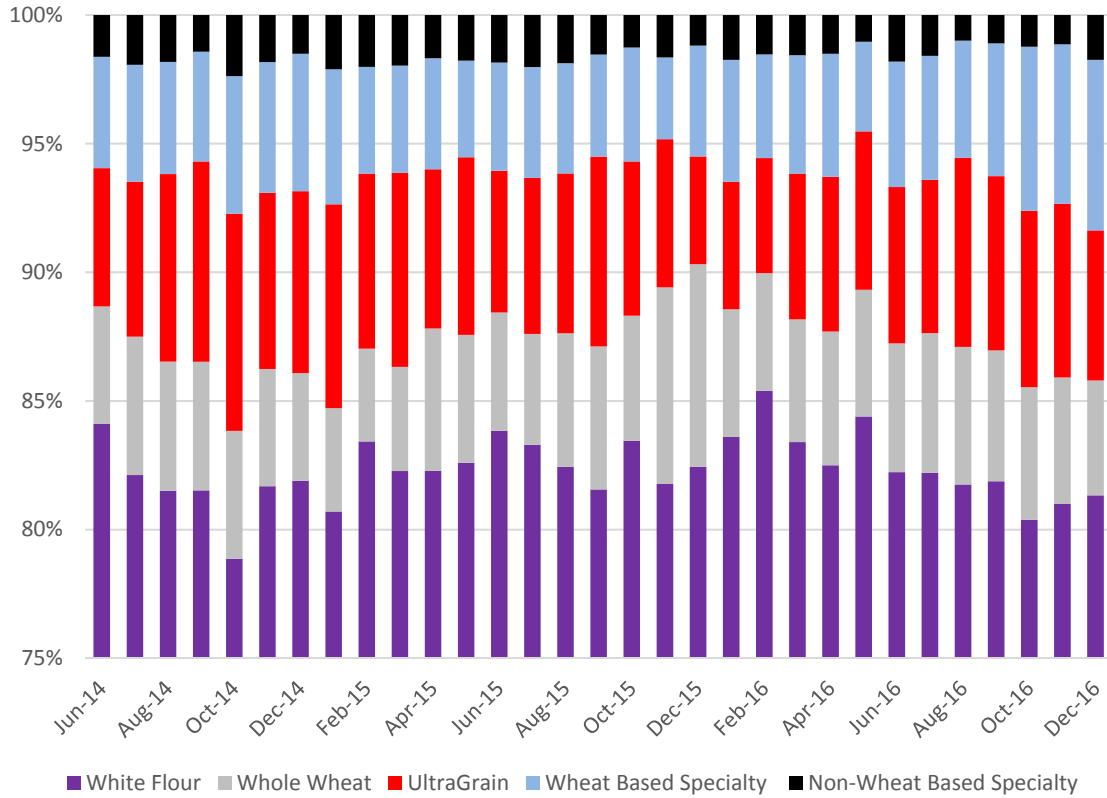
Figure 4.6 shows that white flour is the largest contributor of margin dollars over this 31 month period, ranging from 78.8% to 85.4%. The remaining categories overlap in terms of importance for margin dollars. Whole wheat flour ranges from 3.6% to 7.9%, UltraGrain ranges from 4.2% to 8.5%, wheat-based specialty products ranges from 3.1% to 6.7%, and non-wheat based specialty products ranges from 1.0% to 2.4%.

Figure 4.7: Average Price of Categories and Average Wheat Price
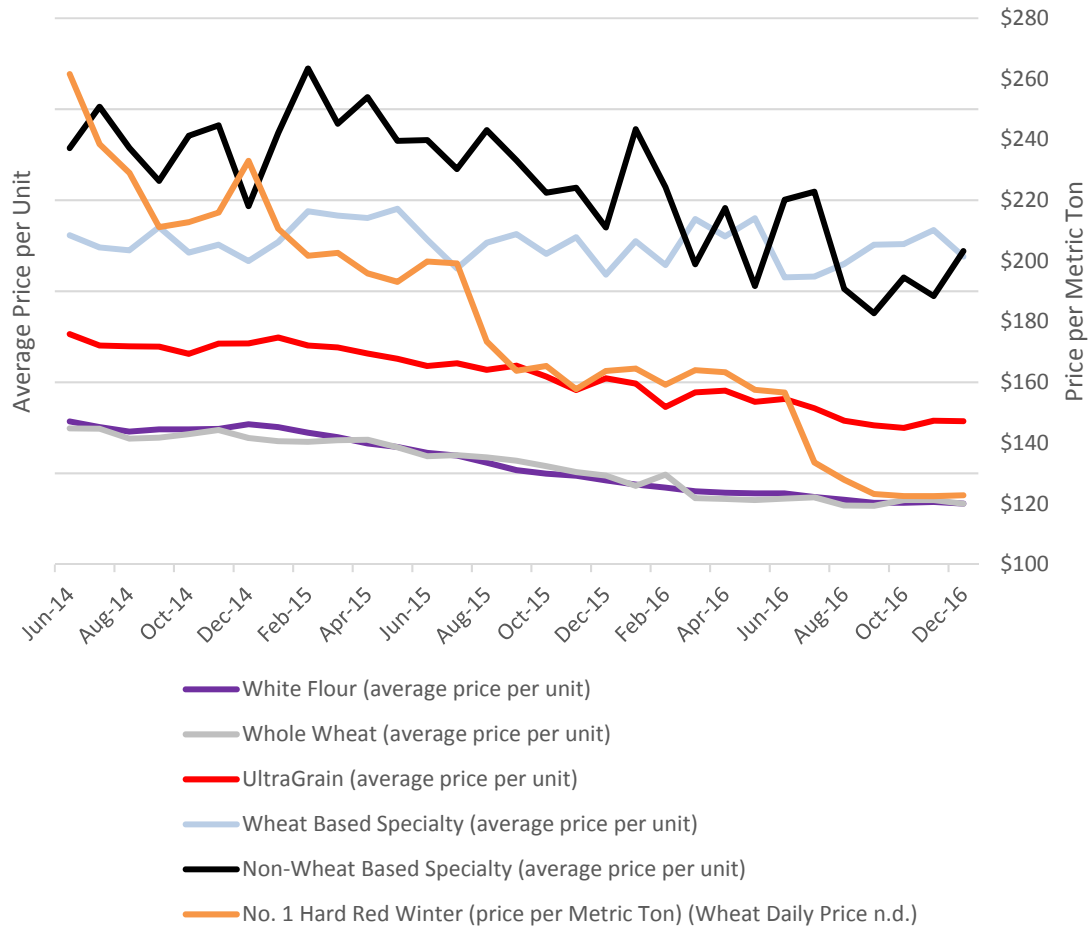
Figure 4.7 shows the average price per unit of each category for the 31 month period, as well as the price of Hard Red Winter wheat over the same time. There is a steady trend of a declining prices for all the product categories as well as the price of wheat.

Figure 4.8: Average Margin by Category
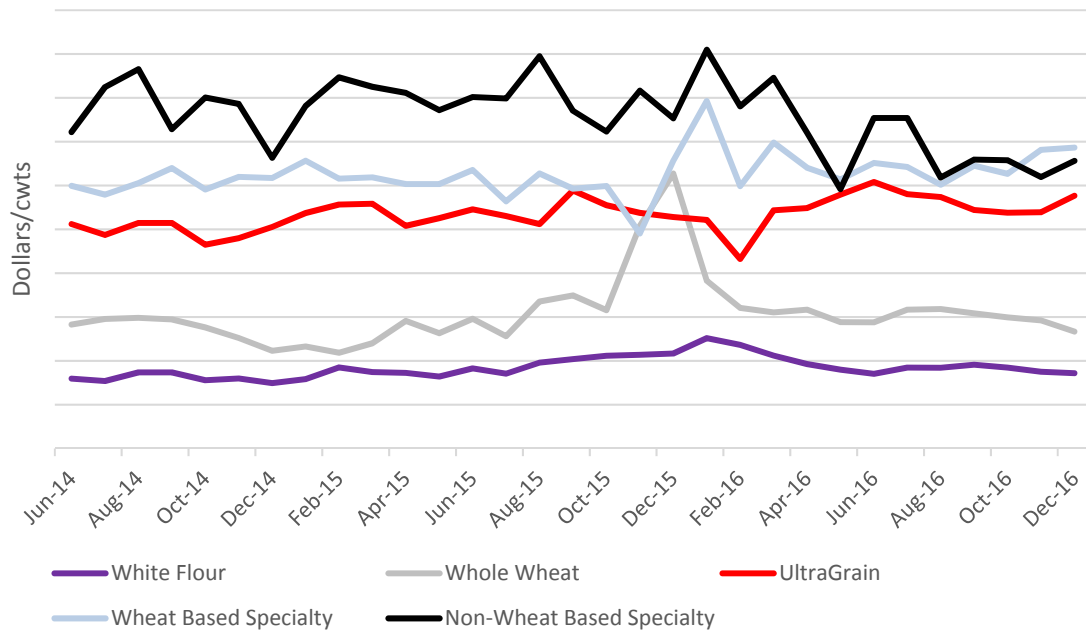
Figure 4.8 shows the average margin per unit of each category for the 31 month period. The average margins has been either been flat or increasing over this time.

4.4.1 White Flour

Figures 4.9 and 4.10 show a summary of the white flour category. The data show that white flour has the highest volume, highest sales dollars and highest margin dollars of all the categories. The percent of sales dollars is slightly lower than the percent of volume, while the percent of margin dollars is significantly lower than the other two measurements. White flour is important to Ardent Mills to guarantee facilities run as much as possible to ensure profitability. These data reflect the high-volume, low-margin aspect of the flour milling industry.

Figure 4.9: White Flour Category Summary

Figure 4.10: White Flour Category Average Price and Average Margin

Table 4.3 shows the breakdown of all the products that make up the white flour category and their average percent relative to the category.

Table 4.3: White Flour Category Breakdown, Average for June 2014 through December 2016

Product	Percent of Category Volume	Percent of Category Sales Dollars	Percent of Category Margin Dollars
Durum	3.00%	4.05%	3.78%
Hard Wheat Flour	84.22%	84.59%	85.21%
Soft Wheat Flour	12.78%	11.36%	11.01%

4.4.2 Whole Wheat Flour

Figures 4.11 and 4.12 show a recap of the whole wheat flour category. The data show that whole wheat flour has a consistent volume close to three percent, and a percent of sales dollars that is closely related. The percent of margin dollars stays higher than the other two measurements across this entire period. While not a premium specialty product, whole wheat flour is a lower-volume, higher-margin product than white flour.

Figure 4.11: Whole Wheat Flour Category Summary
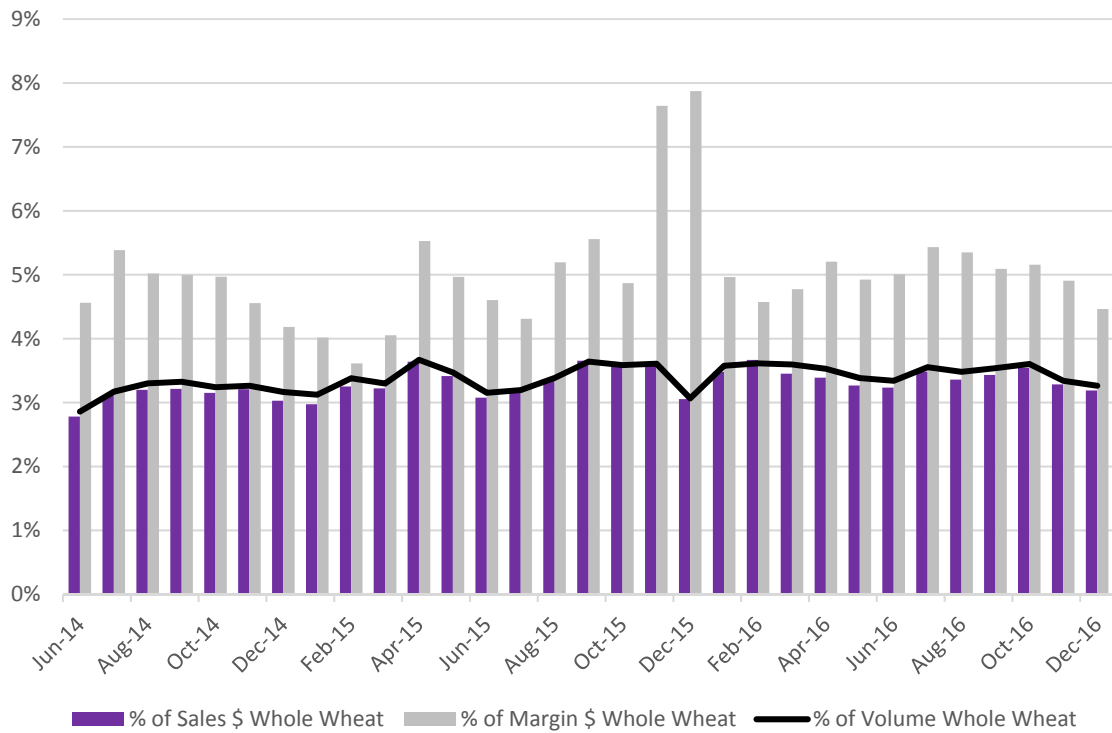
Figure 4.12: Whole Wheat Flour Category Average Price and Average Margin
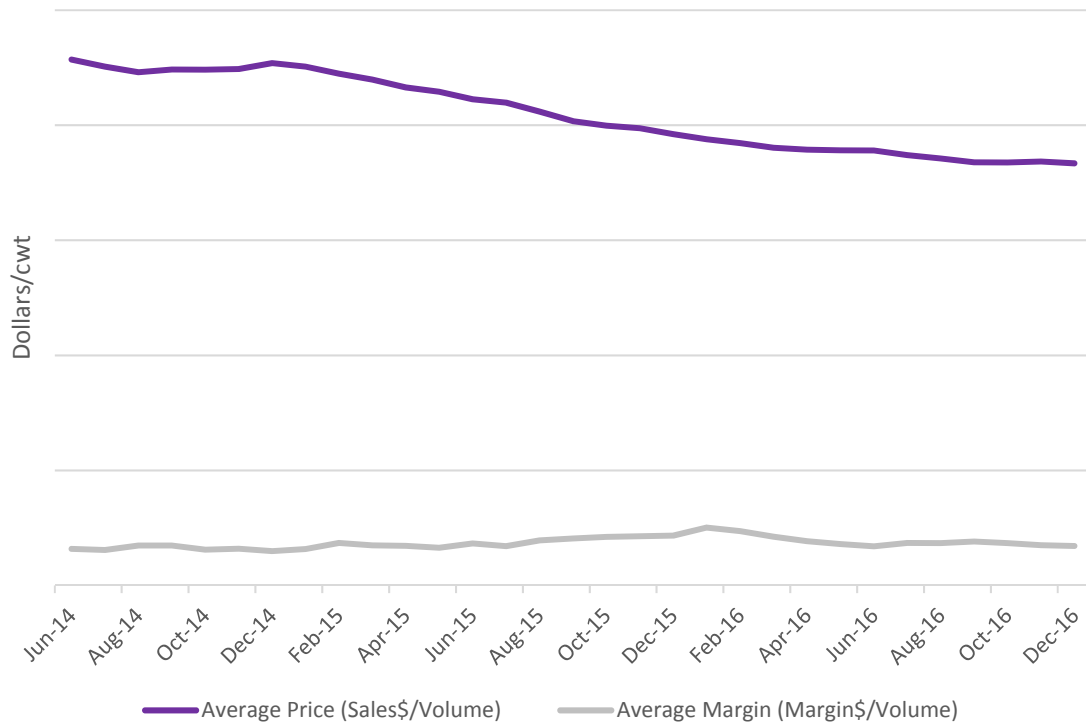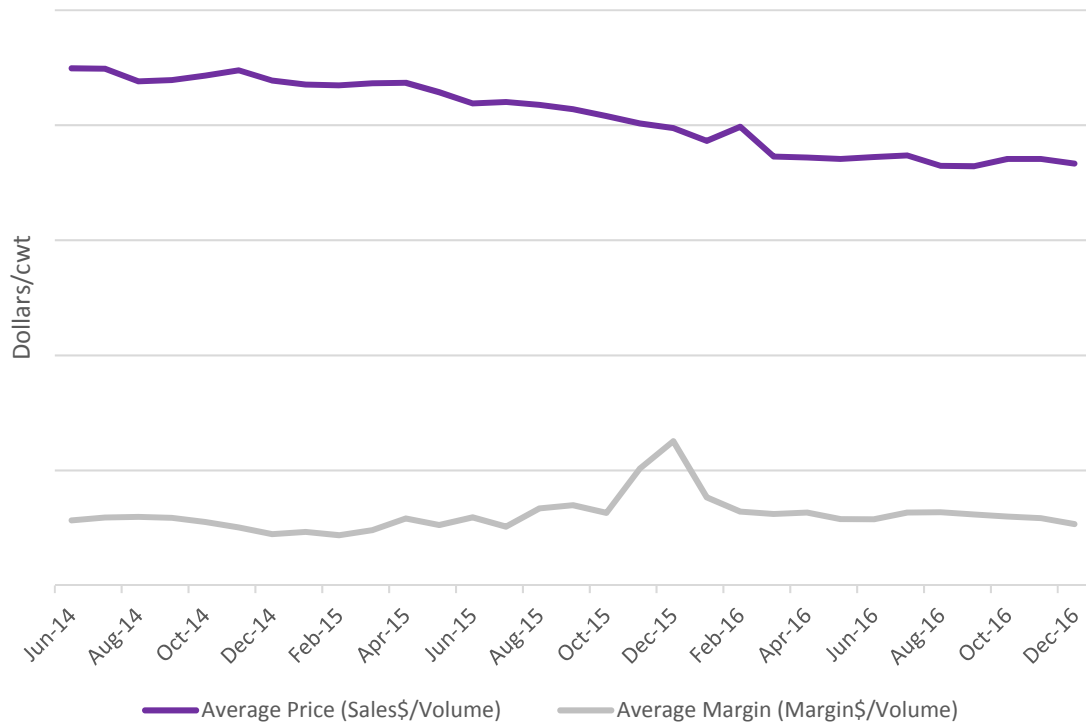

Table 4.4 shows the breakdown of all the products that make up the whole wheat

flour category and their average percent relative to the category.

Table 4.4: Whole Wheat Flour Category Breakdown, Average for June 2014 through December 2016

Product	Percent of Category Volume	Percent of Category Sales Dollars	Percent of Category Margin Dollars
Red Whole Wheat	58.52%	57.02%	49.71%
Soft Whole Wheat	1.48%	1.42%	1.50%
White Whole Wheat	39.99%	41.56%	48.80%

4.4.3 UltraGrain

Figures 4.13 and 4.14 show a summary of UltraGrain. The data show that UltraGrain has a volume that varies from around two to three percent. Sales dollars follow volume closely, but stay slightly higher. Margin dollars are significantly higher than the other two measurements. UltraGrain's low-volume and high-margin makes it more profitable per unit than white flour and whole wheat flour.

Figure 4.13: UltraGrain Category Summary
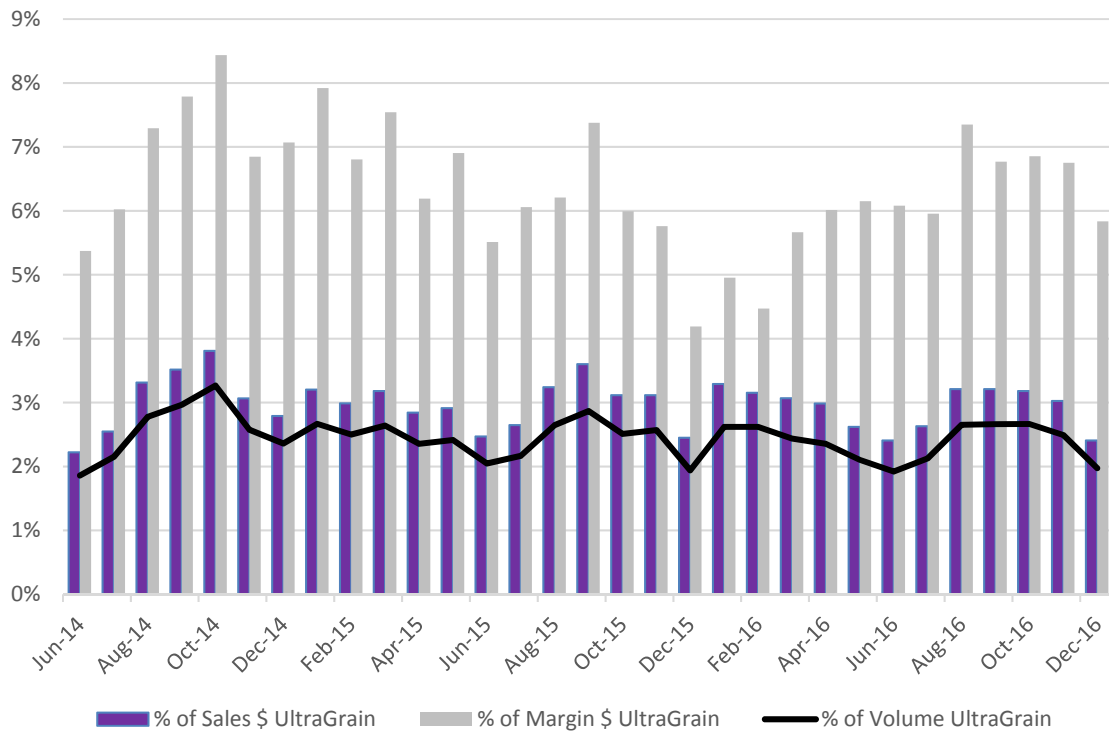
Figure 4.14: UltraGrain Category Average Price and Average Margin

Average Price (Sales$/Volume)   Average Margin (Margin$/Volume)
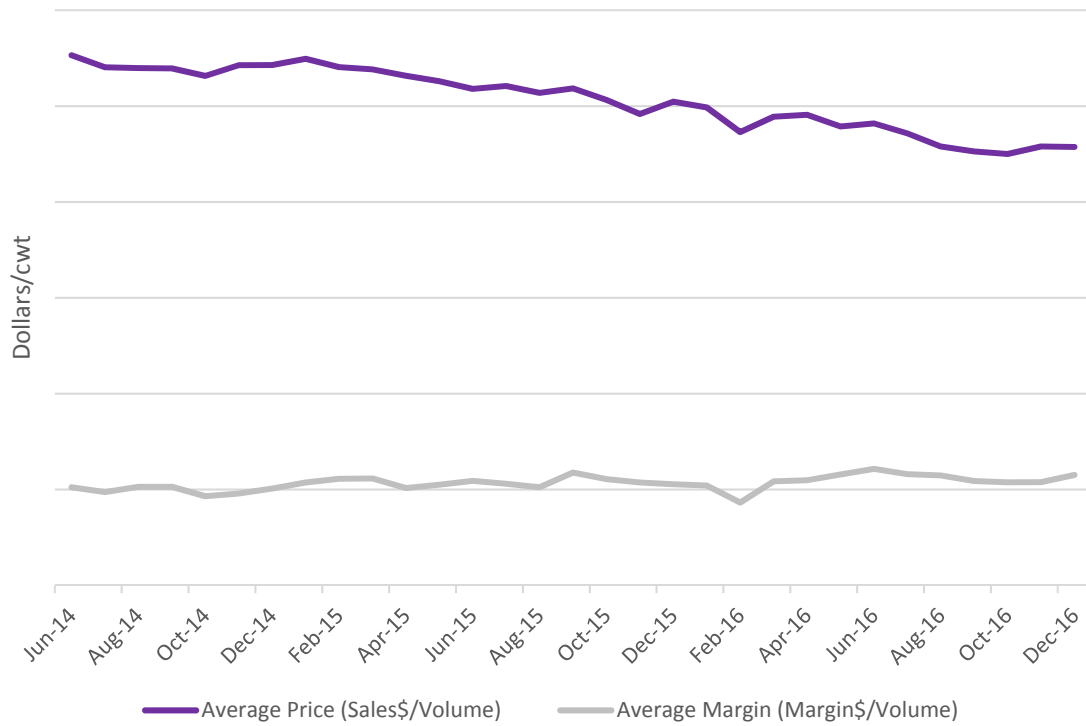
Table 4.5: UltraGrain Breakdown, Average for June 2014 through December 2016

Product	Percent of Category Volume	Percent of Category Sales Dollars	Percent of Category Margin Dollars
UltraGrain	100.00%	100.00%	100.00%

4.4.4 Wheat-Based Specialty Products

Figures 4.15 and 4.16 show a summary of the wheat-based specialty products category. This category shows trends similar to the UltraGrain category. Sales dollars are slightly higher than volume, while margin dollars are significantly higher. This is another low-volume, high-margin category.

Figure 4.15: Wheat-Based Specialty Products Category Summary

**Figure 4.16: Wheat-Based Specialty Products Category Average Price and Average Margin**
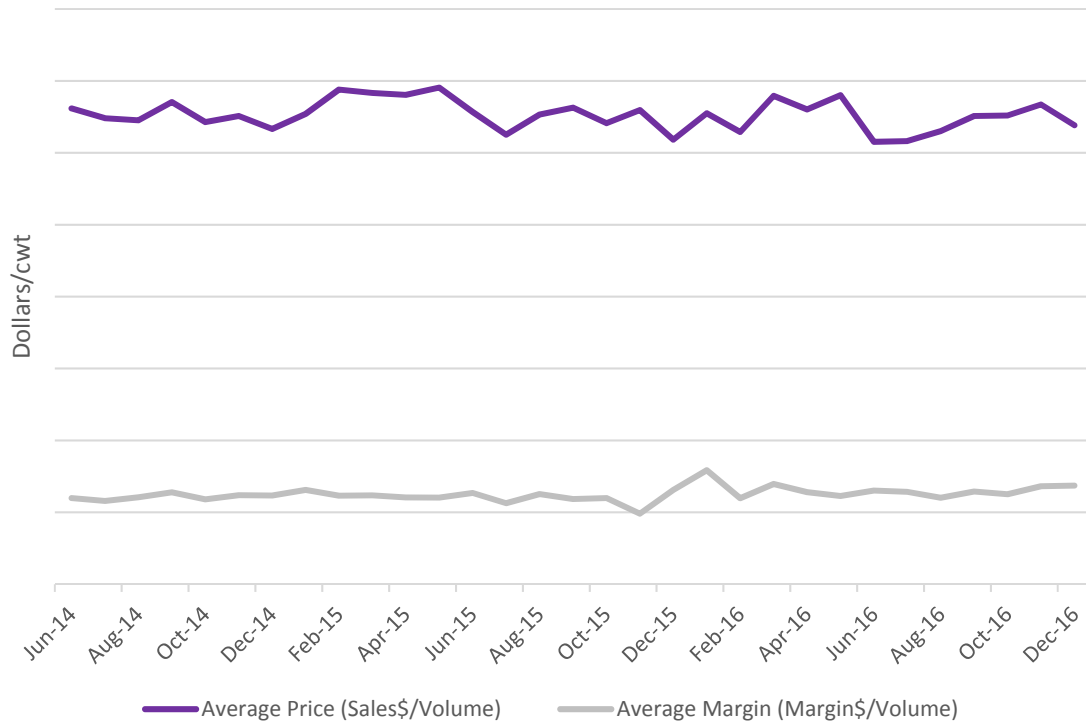
Table 4.6 shows the breakdown of all the products that make up the wheat-based specialty products category and their average percent relative to the category

Table 4.6: Wheat-Based Specialty Products Category Breakdown, Average for June 2014 through December 2016

Product	Percent of Category Volume	Percent of Category Sales Dollars	Percent of Category Margin Dollars
Bran/Germ/ NuFiber	12.49%	7.90%	12.92%
Farina	23.31%	18.94%	22.26%
Organic	17.81%	30.91%	14.88%
Ready to Eat	46.39%	42.24%	49.93%

4.4.5 Non-Wheat Based Specialty Products

Figures 4.17 and 4.18 show a recap of the non-wheat based specialty products category. The volume and sales dollars follow the same trends as UltraGrain and wheat-based specialty products. However, the margin dollars are much higher than any other category with compared to the other two measurements. This category accounts for one to two and a half percent of margin dollars while being less than one percent of volume. This is the true representation of low-volume, high-margin products.

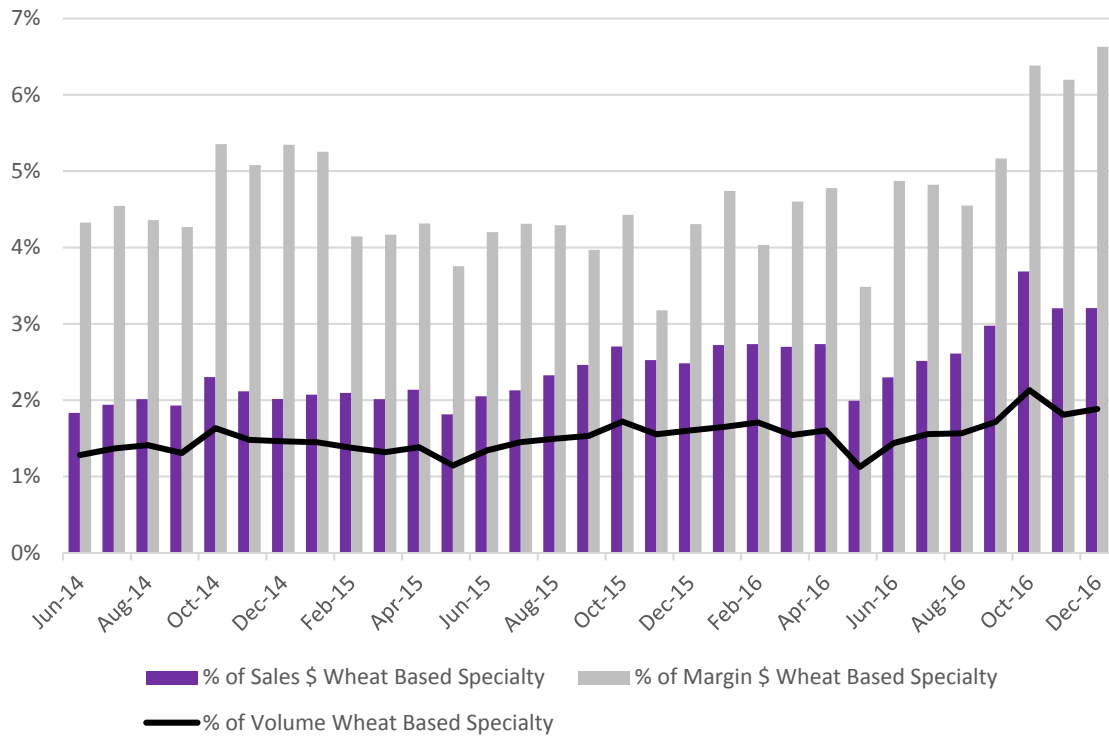**Figure 4.17: Non-Wheat Based Specialty Products Category Summary**
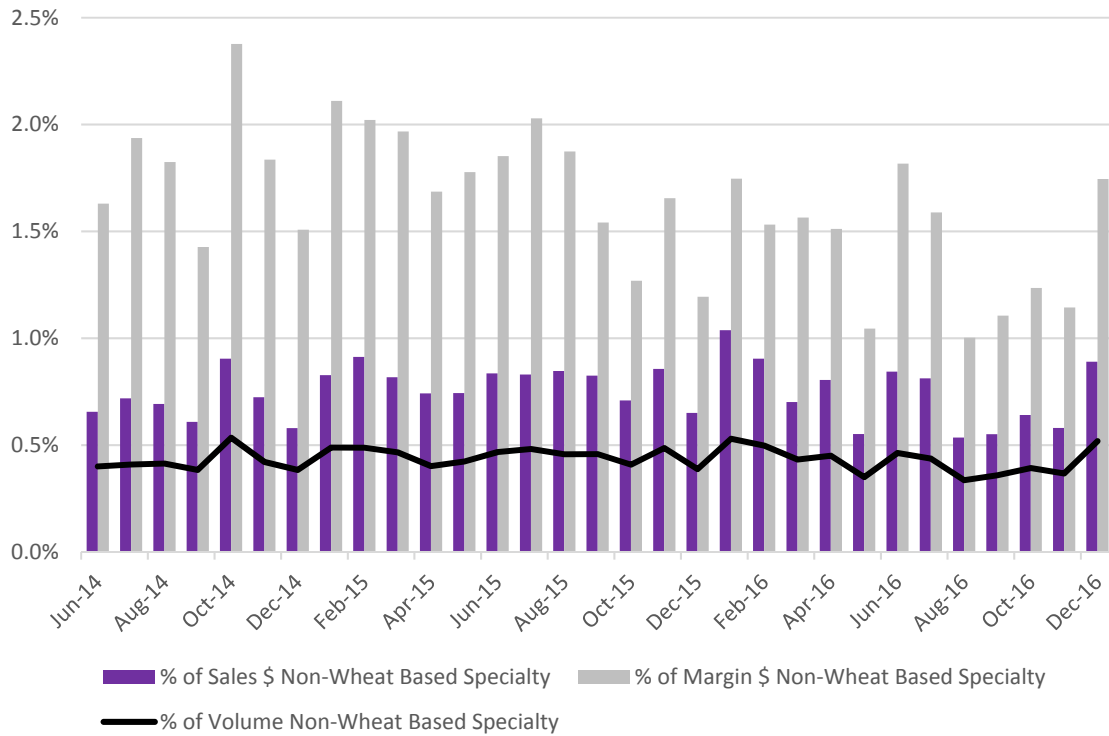
Figure 4.18: Non-Wheat Based Specialty Products Category Average Price and Average Margin
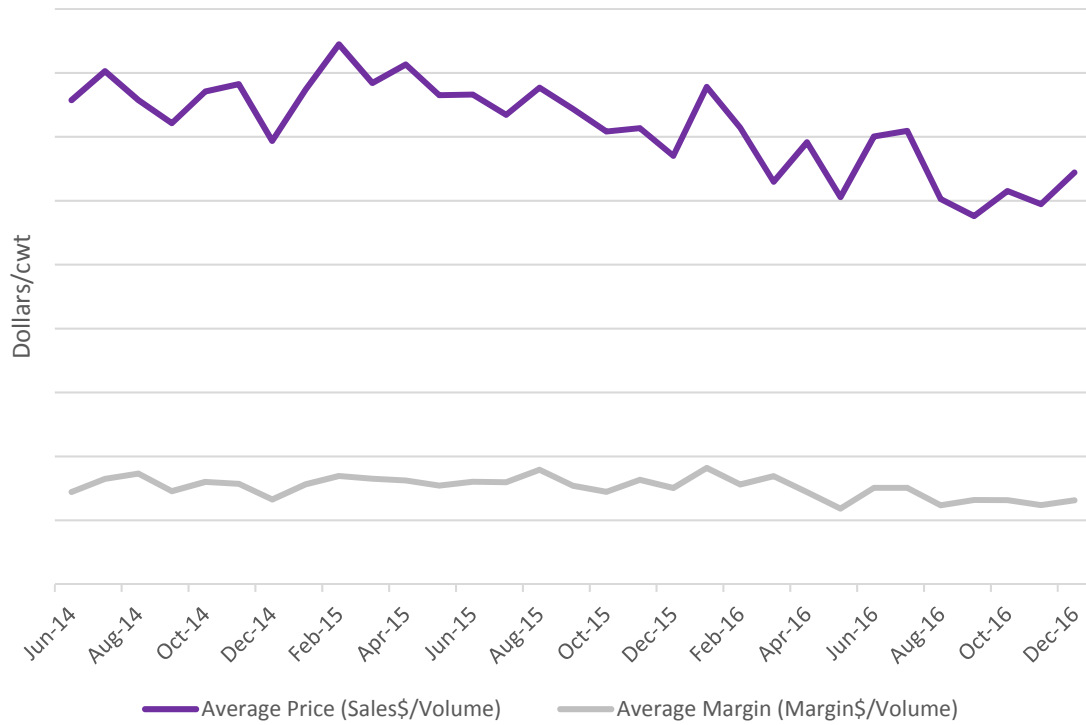
Table 4.7 shows the breakdown of all the products that make up the non-wheat based specialty products category and their average percent relative to the category.

Table 4.7: Non-Wheat Based Specialty Products Category Breakdown, Average for June 2014 through December 2016

Product	Percent of Category Volume	Percent of Category Sales Dollars	Percent of Category Margin Dollars
Ancient Grain/ Gluten Free	3.23%	11.50%	11.83%
Rye	81.83%	67.00%	65.89%
Sustagrain	14.94%	21.50%	22.28%

<center>**CHAPTER V: MODEL AND RESULTS**</center>

5.1 Regression Model

The collected data were analyzed using linear regression. A total of six regressions were estimated using the equation

(1) $Y_i = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \varepsilon.$

The independent variables remained constant for all six regressions, while the dependent variable was changed. The variables included in the regressions are outlined in Table 5.1. The results from the regressions are outlined in Tables 5.2 and 5.3.

Table 5.1: Linear Regression Variables

Model	Dependent Variable (Y_i)	Independent Variables
1	White Flour Volume	Whole Wheat Percent of Volume (x_1)
2	White Flour Sales Dollars	
3	White Flour Margin Dollars	UltraGrain Percent of Volume (x_2)
4	Total Flour Volume	Wheat-Based Specialty Products Percent of Volume (x_3)
5	Total Flour Sales Dollars	Non-Wheat Based Specialty Products Percent of Volume (x_4)
6	Total Flour Margin Dollars	
White Flour Percent of Volume was excluded from the regression to prevent over-identification. The intercept value from the regression results represents the impact of white flour on the dependent variable.		

These regressions were also estimated, using the equation below, with qualitative (0-1) variables representing the quarters of the year to identify any seasonality to the business.

(2) $Y_i = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 Q_2 + \beta_6 Q_3 + \beta_7 Q_4 + \varepsilon.$

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None of the qualitative variables were statically significant, so those regressions were not included in these results. This is likely due to too few observations or quarters being too long a time period to capture the seasonality of the business.

5.2 Regression Results

Table 5.2: Regression Results, Models 1-3

Independent Variable	Dependent Variable		
	(1) White Flour Volume	(2) White Flour Sales Dollars	(3) White Flour Margin Dollars
Intercept	12,941,875.05 (8.7233)***	396,975,306.88 (9.0591)***	-2,209,212.60 (-0.3149)
Whole Wheat Percent of Volume	-130,121,160.20 (-2.9006)***	-7,025,419,118.02 (-5.3021)***	428,874,055.53 (2.0217)*
UltraGrain Percent of Volume	27,631,538.95 (1.0496)	2,858,158,505.35 (3.6759)***	-77,289,585.68 (-0.6209)
Wheat-Based Specialty Products Percent of Volume	89,211,942.69 (2.1897)**	-1,968,082,611.76 (-1.6354)	348,591,435.97 (1.8094)*
Non-Wheat Based Specialty Products Precent of Volume	-233,277,356.9 (-1.5403)	-884,567,293.21 (-0.1977)	436,398,158.87 (0.6094)
R^2	0.3144	0.6153	0.3046
Adjusted R^2	0.2090	0.5561	0.1976
Number of Observations	31	31	31

In model 1, the intercept is statistically significant at the one percent level (Table 5.2). If all the other categories have a value of zero and white flour makes up 100% of production, then this value would represent the volume of white flour produced. Whole wheat percent of volume is statistically significant at the one percent level and negatively correlated to the dependent variable. This implies that as the percent of whole wheat flour purchased increases the amount of white flour they are purchasing decreases, showing that

they are substitute goods. As a customer increases the production of products that require whole wheat flour, they are reducing the production of products that require white flour. The wheat-based specialty products percent of volume is statistically significant at the five percent level and positively correlated to the dependent variable. This implies that as the percent of wheat-based specialty products purchased increases the amount of white flour they are purchasing increases, showing that they are complementary goods. This means that customers are using wheat-based specialty products in goods that may also require white flour. As the demand for these goods increases, the demand for both white flour and wheat-based specialty products increases. UltraGrain percent of volume and the non-wheat based specialty products percent of volume were not statistically significant when related to white flour volume. This is likely due to their small size in relation to the other independent variables.

In model 2, the intercept is statistically significant at the one percent level (Table 5.2). If all the other categories have a value of zero and white flour makes up 100% of production, then this value represents the sales dollars of white flour produced. Whole wheat percent of volume is statistically significant at the one percent level, and negatively correlated to the dependent variable. This implies that as the percent of whole wheat flour purchased by customers increases, the amount of sales dollars from white flour decreases, further showing that they are substitute goods and that as customers move to producing more goods that require whole wheat flour, they are producing fewer goods that require white flour. UltraGrain percent of volume is statistically significant at the one percent level, and positively correlated to the dependent variable. This implies that as the percent of UltraGrain flour purchased by customers increases, the amount of sales dollars from

white flour would increase, showing that they are complementary goods. This suggests that customers are using UltraGrain in goods that also require white flour, so as the demand for these goods increases the demand for both white flour and UltraGrain increases. The wheat-based specialty products category percent of volume and the non-wheat based specialty products percent of volume were not statistically significant when related to white flour sales dollars. This is likely due to their small size in relation to the other independent variables.

Model 3 did not reveal any useful information (Table 5.2). Whole wheat percent of volume and the wheat-based specialty products percent of volume are statically significant at the 10% level, and all the other variables are not statically significant. It would appear that since white flour has a very low margin when compared to its volume, using the percent of volume changes is not accurate in predicting the margin dollars from white flour.

Table 5.3: Regression Results, Model 4-6

Independent Variable	Dependent Variable		
	(4) Total Flour Volume	**(5) Total Flour Sales Dollars**	**(6) Total Flour Margin Dollars**
Intercept	13,157,451.82 (8.1594)***	408,488,240.37 (8.5728)***	-1,611,338.08 (-0.2013)
Whole Wheat Percent of Volume	-130,115,890.96 (-2.6685)**	-7,285,812,980.94 (-5.0568)***	421,411,735.33 (1.7414)*
UltraGrain Percent of Volume	41,624,270.19 (1.4547)	3,363,086,150.30 (3.9777)***	-22,215,724.43 (-0.1564)
Wheat-Based Specialty Products Percent of Volume	108,061,461.41 (2.4402)**	-1,738,540,141.83 (-1.3286)	46,060,0816.45 (2.0957)**
Non-Wheat Based Specialty Products Precent of Volume	-241,923,868.79 (-1.4697)	-480,407,416.15 (-0.0988)	816,395,948.99 (0.9993)
R^2	0.3164	0.5949	0.3354
Adjusted R^2	0.2113	0.5326	0.2331
Number of Observations	31	31	31

In model 4, the intercept is statistically significant at the one percent level (Table 5.3). Whole wheat percent of volume is statistically significant at the five percent level, and negatively correlated to the dependent variable. This implies that as the percent of whole wheat flour purchased by customers increases the amount of total flour sold by Ardent Mills decreases. This result is the opposite of what would be expected. This could be caused by customers moving from another category to whole wheat flour and changing the formulas of the product to require less flour. The wheat-based specialty products percent of volume is statistically significant at the five percent level and positively correlated to the dependent variable. This implies that as the percent of wheat-based specialty products purchased by customers increases, the amount of total flour sold by

Ardent Mills increases. This shows that customers are purchasing this category is addition to the flour they already purchase, or Ardent Mills is acquiring new customers that are purchasing from this category. UltraGrain percent of volume and the non-wheat based specialty products percent of volume are not statistically significant when related to total flour volume. This is likely due to their small size in relation to the other independent variables.

In model 5, the intercept is statically significant at the one percent level (Table 5.3). Whole wheat percent of volume is statistically significant at the one percent level, and negatively correlated to the dependent variable. This implies that as the percent of whole wheat flour purchased by customers increases, the amount of total sales dollars generated by Ardent Mills decreases. Similar to model 4, this result is the opposite of what would be expected and shows that as customers that are moving to whole wheat flour they are spending less on flour by either reducing production or changing their recipes to include less flour. UltraGrain percent of volume is statistically significant at the one percent level, and positively correlated to the dependent variable. This implies that as the percent of UltraGrain flour purchased by customer increase the amount of sales dollars generated by Ardent Mills increases. Ardent Mills is benefiting from the higher prices on UltraGrain when customers move from another category to this one, or Ardent Mills is acquiring new customers that are focused on purchasing from this category. Wheat-based specialty products percent of volume and the non-wheat based specialty products percent of volume are not statistically significant when related to total sales dollars. This is likely due to their small size in relation to the other independent variables.

Model 6 did not reveal much additional information (Table 5.3). Whole wheat percent of volume was statistically significant at the 10% level, wheat-based specialty products percent of volume was statistically significant at the five percent level, and all the other variables are not statistically significant. Since the dependent variables with the highest percent of volume contribute the lowest amount of margin per unit, and the variable with the lowest percent of volume contribute the highest amount of margin per unit, a reliable result is not found from this regression.

5.3 Trend Analysis

The data collected were graphed and analyzed for any trends. Figure 4.1 shows that Ardent Mills has had some volatility in volume, but overall volume, and in turn demand, has remained flat. Figure 4.2 shows that total sales dollars over this period has steadily decreased. This is mostly driven by the cost of the major input, wheat, and its lower cost. Figure 4.3 shows that Ardent Mills has increased margin dollars over this time period. The decreasing cost of wheat allowed for customers to receive a lower price and for Ardent Mills to capture more margin.

Figures 4.7 and 4.8 show that the average price per unit of the categories has been decreasing, while the average margin per unit has seen a slight increase. White flour, Figure 4.10, average price per unit has decreased while the average margin per unit has seen a slight increase. Whole wheat flour, Figure 4.12, and UltraGrain, Figure 4.14, have seen the average price per unit decrease while the average margin per unit has increased. Wheat-based specialty products, Figure 4.16, has seen the average price per unit remain flat while the average margin per unit has seen a slight increase. Finally, the non-wheat based

specialty products, Figure 4.18, has seen the average price per unit decrease while the average margin per unit has remained flat.

An interesting observation is the difference between the percent of volume, sales dollars, and margin dollars for white flour. Figures 4.4, 4.5, and 4.6 shows that white flour makes up about 92.2% of the volume, 90.6% of sales dollars, but only 82.3% of margin dollars. White flour is a high-volume, low-margin product and can only be profitable if a milling facility has substantial throughput.

Figure 4.8 shows a spike in the margin dollars for whole wheat in December 2015. It appears that perhaps the sales team attempted to increase the margin on whole wheat flour and the result was a drop in volume for the following month. In January the margin decreased back to its previous level and volume returned to normal as well. Wheat-based specialty products and non-wheat based specialty products experienced a similar spike in margin dollars in January 2016. However this did not result in the same volume impact and must have been the result of circumstances not evident in the data available.

CHAPTER VI: CONCLUSIONS

6.1 Brief Summary

There are several important and interesting results that were obtained from this thesis. Ardent Mills has increased margin dollars for all categories, while being able to decrease the price charged to customers. Since wheat is the major input and the largest driver of price, as the price of wheat has continued to decrease Ardent Mills has been able to lower the price they charge customers. However, this price decrease has not entirely matched the decrease in wheat prices, resulting in an increased margin.

The white flour category and the whole wheat flour category are substitute goods. When the percentage of volume of the whole wheat flour category increases the volume of white flour decreases. Also, when the percentage of volume of whole wheat flour increases the sales dollars from white flour decrease. This implies if that if Ardent Mills wants to expand its whole wheat flour sales, it will have to expect to give up white flour volume and sales dollars in return. With the higher margin that whole wheat flour provides, this trade-off might be worth it.

The white flour category is complementary with the wheat-based specialty products category and UltraGrain. When the percentage of volume of the wheat-based specialty products category increases the volume of white flour increases. When the percentage of volume of UltraGrain increases the sales dollars of white flour increases. If Ardent Mills expects to increase sales in these two categories, it should do so without sacrificing white flour production capability.

Whole wheat is also inversely related to total flour and total sales dollars. When the percentage of volume of whole wheat flour increases, the volume of total flour decreases.

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Also, when the percentage of volume of whole wheat flour increases, total sales dollars decrease. This shows that if Ardent Mills makes a push to expand whole wheat flour sales it will see an overall drop in volume and sales dollars, especially white flour as noted above. If the benefits of the higher margin that whole wheat flour provides outweigh the costs of reduced white flour sales, the substitution out of white flour and into whole wheat flour might be worth it.

Wheat-based specialty products and UltraGrain are positively related to total flour. When the percentage of volume of the wheat-based specialty products category increases the volume of total flour increases. When the percentage of volume of the UltraGrain category increases the total sales dollars increases. This shows that increasing the volume of UltraGrain and wheat-based specialty products will increase the volume and sales dollars of not only white flour, as stated above, but total volume and total sales dollars.

The non-wheat based specialty products category is small compared to the other categories that it does not have a statistically significant effect on any of the tested dependent variables. Also, the percent of volume for each category is not a good indicator of white flour margin dollars or total margin dollars.

6.2 Future Studies

In the future, if this study is replicated, there are a few changes that could be taken into consideration. Due to the data available, this study focuses entirely on Ardent Mills. Expanding to include the entire industry would give results that are meaningful to a wider audience. Due to the age of Ardent Mills, this study was done with a limited number of observations. Repeating the study with a larger number of observations would likely

produce more robult results. Finally, expanding the analysis to examine all the products, instead of the larger categories, would give more useful results.

6.3 Final Summary

Based on the results of this study, there are a few strategies that Ardent Mills could undertake to improve profitability. First, evaluate if moving away from expanding whole wheat flour sales would be beneficial. Increasing the volume of whole wheat flour reduces white flour volume, total flour volume, white flour sales dollars, and total flour sales dollars. The higher margin provided by whole wheat flour may justify the decrease in these areas. Second, incentivize the sales team to increase sales of UltraGrain and look to expand UltraGrain production capacity, if needed. Increasing the volume of UltraGrain increases the white flour sales dollars and total flour sales dollars. Third, incentivize the sales team to increase sales of wheat-based specialty products and look to expand production capacity, if needed. Increasing the volume of wheat-based specialty products increases the volume of white flour and the volume of total flour. Fourth, as Ardent Mills expands capacity for UltraGrain and wheat-based specialty products, it should do so without converting existing white flour production capacity. As the demand for UltraGrain and wheat-based specialty products increases, the demand for white flour increases as well. Finally, Ardent Mills should continue to focus on increasing margin dollars. The decreasing wheat prices have allowed for additional margin to be captured.

WORKS CITED

n.d. *Ardent Mills.* http://www.ardentmills.com/index.html.

n.d. *Business Dictionary.* http://www.businessdictionary.com/definition/regression.html.

Goodwin, Neva, Julie Nelson, Frank Ackerman, and Thomas Weisskopf. 2009. *Microeconomics in Context, Second Edition.* M.E. Sharpe.

2016. *Per capita U.S. flour use dops to lowest level in 18 years.* April 15. http://www.world-grain.com/articles/news_home/World_Grain_News/2016/04/Per_capita_US_flour_use_dips_t.aspx?ID=%7B2A89C6B8-152D-4D0D-AD49-DD23CC8F4231%7D&cck=1.

Sheluga, David. 2016a. "Consumer Insights Executive Summary: Enlightened Eating 2.0."

Sheluga, David. 2016b. "Consumer Insights Executive Summary: Predicting Successful New Bread Ideas."

Sheluga, David. 2016c. "Consumer Insights Executive Summary: Wheat Related Food Categories Sales Trend 2012-2016."

n.d. *What is Market Trend Analysis: Definition and Examples.* http://study.com/academy/lesson/what-is-market-trend-analysis-definition-examples.html.

n.d. *Wheat Daily Price.* http://www.indexmundi.com/Commodities/?commodity=wheat&months=60.

2016. *Wheat's Role in the U.S. Diet.* October 26. https://www.ers.usda.gov/topics/crops/wheat/wheats-role-in-the-us-diet.aspx.

World Grain Milling and Baking News. 2016. "2016 Grain and Milling Annual." 109.