Essays on Agricultural Cooperative Membership and Markets for Local Produce

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Authorization to Submit Thesis

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Abstract

This work covers 1) declining membership in agricultural cooperatives and 2) regional market size for local produce. Chapter 2 utilizes logistic regression to identify characteristics of agricultural producers that identify them as probable agricultural cooperative members. Individuals with high income from their agricultural operation, whose values align with that of cooperatives, are likely candidates for membership. These results help cooperatives combat declining membership by identifying ways to increase marketing efficiency and communication with members and potential members.

Chapter 3 shows a method of calculating the market size for a local produce item within a given region. Total available market, serviceable available market, and serviceable obtainable market estimate the total annual consumption of the item. Threshold population, demand threshold, and the number of acres required to supply the market help business owners and producers decide if selling local produce will be profitable in their area.

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Chapter 1. Introduction to Essays

This thesis features two papers. The first paper provides direction for agriculture cooperatives to build efforts designed to grow membership and strengthen member commitment. The second paper helps develop a method to quantify the potential market size for local produce within specific geographical areas.

Membership is vital to the success of agricultural cooperatives. However, the agricultural industry has been rapidly changing over the last decade and cooperative membership is declining. Membership is declining for two reasons. 1) increasing farm size is making cooperative membership less vital for farm survival and 2) members are unhappy with operational changes that cooperatives are being forced to make.

Chapter 2 includes the results of a survey of agricultural producers that provided data about producers' views, usage, and preferences regarding agricultural cooperatives. The survey data is used in a logistic regression that determines the likelihood of an agricultural producer being a member of an agricultural cooperative given 14 demographic and cooperative specific variables. The model helps identify characteristics of agricultural producers that agricultural cooperatives should target for membership growth. This study is a stepping stone to helping cooperatives gain new members and retain them.

Chapter 3 provides a method for estimating the retail market size for local produce. There is a strong movement for buying local foods in the United States. Consumers are willing to pay a premium for local foods because they see local purchases as having a positive impact on personal, community, and environmental health. Although the consumption of local foods has increased significantly over the last two decades, the exact size of markets for local goods through retail channels is often unknown.

The research on local foods focuses on calculating the market size for local produce that is sold through indirect markets. It provides a calculator that can be used by any party interested in their area's market size for a local produce item. The calculator shows the total annual consumption, firms supported, and acres required for any produce item and geographical area given specific information about the good and the area. This study helps agricultural producers, and other sellers of local goods, better understand the market for local produce in their areas so they can decide if producing and selling local goods is worthwhile.

Chapter 2. An Analysis of Characteristics of Agricultural Cooperative Members

2.1 Introduction

Cooperatives exist widely throughout the United States and make up a large portion of its economy. In 2009 there were 29,285 cooperatives in the U.S. that provided 856,310 jobs (Deller et al 2009). These nearly 30,000 businesses generated over $500 billion in revenue, and paid their employees $25 billion in wages and benefits (Deller et al 2009). Of these cooperatives, 8.2% are in the agricultural industry. Agricultural related cooperatives employ 2.2 million members and are collectively worth $170.2 billion (USDA Rural Development 2011). Agricultural cooperatives are vital to the survival of many farming operations because they provide necessary products and services that producers cannot afford on their own. Agricultural cooperatives "enable the realization of advantages of hierarchical organization in agriculture while avoiding the need to incur its transaction costs, which are prohibitively high" (Vladislav Valentinov 2007). These cooperatives have also helped support the economies of rural communities throughout the United States for over 100 years (NCBA 2013).

Despite their importance and longevity, agricultural cooperatives have been struggling with declining membership over the past decade (USDA Rural Development 2011). Agricultural cooperative membership decreased by nearly 30% from 2000 to 2010 (USDA Rural Development 2011). Members of agricultural cooperatives share the costs of operating the business. The more agricultural cooperative membership decreases, the costlier membership becomes for those who are left (Nilsson, Svendsen and Svendsen 2012). This creates a vicious cycle of membership decline that can be fatal to cooperatives.

Agricultural cooperative membership is declining largely due to negative views by members (Anderson & Henehan 2005). Traditionally, cooperatives are democratically controlled by their members and operated under a set of principles that keeps community values at the forefront of their operations (University of California Cooperative Extension 2012). In recent years, agricultural cooperatives have been forced make operational and organizational changes to survive the increasing costs brought on by the globalization of the agricultural industry (USDA Rural Development 2011). These changes are intended to help

cooperatives run more efficiently so they can better serve their members. However, many members see these changes as an abandonment of the community centric principles that cooperatives are founded upon (Nilsson, Svendsen & Svendsen 2012). Agricultural cooperatives need to work to communicate that they still value traditional principles despite recent changes so they can recruit new members and retain those that remain.

The goal of this project is to help agricultural cooperatives increase their membership by targeting individuals that are most likely to join. Specifically, the researchers work to identify characteristics of agricultural producers that indicate they are likely to be members of an agricultural cooperative. These characteristics are determined by analyzing data collected from a survey of agricultural producers in the Northwest United States. The data is used to build a logit model that pinpoints traits which are common among members of agricultural cooperatives. This work will help agricultural cooperatives create marketing strategies that target individuals with these characteristics to increase their membership populations.

This project has three objectives.

1. Quantitatively identify the observable characteristics of producers who are most likely to be cooperative members.
2. Compare what agricultural cooperative members value in the principles and benefits offered by agricultural cooperatives to that of what non-members value.
3. Offer ideas for cooperatives to consider when targeting new members.

This chapter contributes to the current literature by providing agricultural cooperatives with demographic characteristics and values that are possessed by individuals who are most likely to be members of agricultural cooperatives. It consists of six sections. The second section reviews current literature on agricultural cooperatives and the methods used in this research. Section three examines the methodology used for collecting data and developing the logit model. An overview of the cooperative survey results is provided in section four. A discussion of the results of the logit model is presented in the fifth section. The sixth section provides conclusions and implications of the research.

2.2 Review of Literature

The following review of literature provides background information relevant to this research. The literature review begins with an overview of cooperatives, their goals, values and general structure. Next it reviews different types of agricultural cooperatives and their

challenges with declining member commitment in a rapidly changing industry. This section concludes with a discussion of literature that supports the methods used to complete the research.

2.2.1 What is a Cooperative?

Cooperatives have been in existence since the early 1800s (NCBA 2013). Their purpose is to help individuals collectively achieve a common goal (University of California Cooperative Extension 2012). They are private businesses that are owned by the people who use them (University of California Cooperative Extension 2012). Cooperatives are generally operated by two separate groups: 1) an elected board of directors that makes decisions effecting the cooperative in the long term, and 2) a group of employees that manage routine operations. In a well-managed cooperative, these entities communicate regularly to ensure that the business is operating efficiently and achieving its goals (Fulton & Gibbings 2004).

Cooperatives are different from traditional businesses in their values, goals, and structure. The International Co-operative Alliance (2015) defines seven traditional values held by cooperatives.

1. Cooperative membership is voluntary and open to anyone who can use the products or services being offered.
2. Cooperatives operate using a democratic process where members are involved in decision making and planning.
3. All members invest in the cooperative's capitol, typically through membership fees and sometimes though capital investment.
4. Cooperatives are independent, standalone entities who only do business with outside organizations in circumstances where the members can maintain their democratic control and freedom.
5. Cooperatives teach and train their members and employees to ensure that decisions are made and planning is done in an informed manner.
6. Cooperatives work together to benefit their members and strengthen the cooperative movement.
7. Cooperatives work to develop and improve their communities.

Unlike individually owned businesses, whose primary focus is profit maximization, cooperatives' main goal is providing benefits to their members (Schaars 1971). These benefits

come in two forms, economic and social. Economic benefits are business benefits. They include group selling, exclusive pricing, access to competitive markets, low costs, high efficiencies, high market power, and dividends (Barton 1989). Social benefits, which are less tangible but no less important, are value based benefits. Social Benefits include easy to access location, group lobbying power, and a community atmosphere that cannot be found anywhere else (Fulton 1999).

Cooperative structure places membership at the heart of the business. Membership is the most important part of a cooperative because "members share in both ownership and control" (Scharrs 1971, p17). Without members, a cooperative has no purpose or ability to operate as members own, finance, and manage their cooperative. Yet, membership is completely voluntary.

Most cooperatives are managed by an elected board of directors (Scharrs 1971). The board is typically elected using a one member one vote system that allows cooperative members to take part in the operations of their cooperative without introducing inefficacies that would arise if all cooperative members had direct control of management. (Holmström 1999; Barton 1989). Allowing each member one vote, regardless of their contribution, introduces a concept of equality into the cooperative structure that is in alignment with cooperative values.

2.2.2 Agricultural Cooperatives

Cooperatives are prevalent in many industries, but they are especially present in the agricultural industry. Agricultural cooperatives make up a significant portion of the United States' agricultural industry. In 2009 there were 2,389 agricultural cooperatives in the United States, serving 2,247,800 members (USDA Rural Development 2011). This section defines four different types of agricultural cooperatives, reviews the history of agricultural cooperatives, and explains challenges that agricultural cooperatives are currently facing.

2.2.2.1 Marketing Cooperatives

The first type of cooperative that will be explained in this section is the marketing cooperative. Marketing Cooperatives help agricultural producers sell their goods more effectively. They collect, package and sell commodities for agricultural producers (University of California Cooperative Extension 2012). When operating alone, agricultural producers have very little bargaining power against agribusinesses and food companies that purchase

from them (USDA Rural Development 2011). Small operations sometimes cannot sell to businesses because they do not have enough volume to meet their minimum purchase requirements. Marketing cooperatives allow producers to collectively market their products in bulk which increases their bargaining power with companies and allows them to access larger markets (USDA Rural Development 2011).

Some marketing cooperatives provide vital infrastructure to agricultural producers. For example, grain elevators are often owned by marketing cooperatives. They provide a place for product to be collected, stored, and distributed after it is sold (Top Flight Grain Cooperative 2016). Another benefit that marketing cooperatives can provide is professional merchandizing. Professional merchandizers find secure homes for cooperative members' products, taking away the hassle and worry that is present when producers must sell their own goods (California Center for Cooperative Development 2015).

Marketing cooperatives are commonly found in the dairy, tree nut, rice, and sugar beet sectors of agriculture. Dairy marketing cooperatives often combine milk from individual farmers to help increase efficiency for processing and transportation (Dairy Marketing Services 2016). Tree nut marketing cooperatives allow producers to collectively clean, package, market and transport their product (Miller et al. 2016). Rice marketing cooperatives allow growers to pool their rice and market it as one homogenous product (California Rice Commission 2016). Sugar beet marketing cooperatives help producers more efficiently process and sell sugar by providing processing plants for many producers to use (American Crystal Sugar Company 2016)

2.2.2.2 Service Cooperatives

The second type of agricultural cooperative explained in this section are service cooperatives. Agricultural services such as seed cleaning, ginning, hulling, and transportation are very expensive for individual agricultural producers. For example, hiring a company to transport product may be financially unobtainable for a single farmer. However, if that farmer pooled his resources with other farmers, all their products could be transported together and they could split the cost. Service cooperatives buy services such as transportation and chemical application for everyone to use, making it affordable for their members. The more services members can afford, the more they can increase the efficiency of their operations (University of California Cooperative Extension 2012). Service cooperatives are also

commonly used by cotton farmers. Sharing a gin allows multiple cotton producers to share the costs of harvesting and processing cotton (USDA Department of Agricultural Cooperative Service 1985).

2.2.2.3 Input Supply Cooperatives

The third type of agricultural cooperative outlined in this section are input supply cooperatives. Input supply cooperatives purchase materials such as fuel, seeds, fertilizers and crop protectants in bulk quantities, passing the savings on to their members (University of California Cooperative Extension 2012). These cooperatives reduce input costs for agricultural producers, increasing their profit margins. Service cooperatives are often used in the cotton industry.

2.2.2.4 New Generation Cooperatives

The fourth and final type of agricultural cooperative explained here is the new generation cooperative. New generation cooperatives process and market value-added products. Hackman (2001) explains that new generation cooperatives have a limited number of memberships because the processing plants for the value-added products have limited capacity. Membership in these cooperatives is purchased through delivery rights to the processing plants. Once all the delivery rights are sold, no new members are allowed. Agricultural producers who wish to leave new generation cooperatives can transfer their delivery rights to another agricultural producer, as long as the transfer is approved by the board of directors. The value of delivery rights fluctuates with the success of the cooperative, similar to a financial investment (Hackman 2001).

2.2.3 History of Agricultural Cooperatives

Agricultural cooperatives began to be widely used by agricultural producers in the late 1800s (University of California Cooperative Extension 2016). They increased agricultural producers' profits through collective marketing and vertical integration, allowing small operations to thrive (Schaars, 1971, Barton 1989). In 1890, Congress passed The Sherman Act, which jeopardized agricultural cooperatives. The act prohibits any action that restricts trade or involves monopolization or conspiracy to monopolize (Federal Trade Commission 2016). Agricultural producers worried that their cooperatives would be seen as monopolizing activity, causing them to be penalized and possibly shut down.

Some of these concerns were put to rest in 1914 when Congress passed the Clayton Act. It states that "antitrust laws shall not be construed to prohibit the existence and operation of agricultural organizations instituted for the purposes of mutual help, if not for profit and not having capital stock" (Varney 2010). The Clayton Act helped nonprofit cooperatives but cooperatives with the goal of selling goods for profit and paying members with dividends were still at risk.

In 1922, Congress passed the Capper-Volstead Act. This act protects for profit cooperatives, as well as nonprofit ones. It allows cooperative members to collectively market and distribute their goods without fear of being penalized (Varney 2010). The Capper-Volstead act is not an exemption from antitrust laws altogether. It has six limitations to prevent agricultural producers from taking advantage of it.

1. Agricultural producers can only act together when processing, preparing, handling and marketing their products and services.
2. Cooperative members must be agricultural producers.
3. Cooperatives must exist to collectively benefit all members.
4. Cooperatives must limit each member to one vote, regardless of their investment in the company and dividends must be less than eight percent annually.
5. Cooperatives cannot sell or buy products or services from nonmembers in larger amounts than such as are bought or sold by members.
6. The Secretary of Agriculture can bring an administrative action against any cooperative that monopolizes or restrains trade in a way that unreasonably inflates the price of any agricultural good or service.

In the 1990s industrialization of the agricultural industry posed new challenges to agricultural cooperatives. Hogeland (2006) explains how significant capital investment was required to keep up with the industry as it became increasingly commercialized. Cooperatives were not able to get all the capital they needed from agricultural producers so many brought in outside investors. This decreased the relative importance of producers and weakened the "symbiotic relationship between [agricultural producer] and cooperative" (Hodeland 2006). Agricultural producers began to lose site of the value of their membership as the meaning of their ownership in the cooperative was diminished.

2.2.4 Challenges for Agricultural Cooperatives

Agricultural cooperatives are still facing many challenges today. The agricultural industry is changing rapidly, creating an environment in which cooperatives are struggling to survive. The following sections provide details about how agricultural cooperatives are adapting to the industry with structural and financial changes that are not aligned with agricultural producers' wants, causing member commitment to decline and fostering negative attitudes towards cooperatives.

2.2.5 Rapidly Changing Industry

The agricultural industry is changing rapidly due to industrialization, globalization, farm concentration, and increased competition (Fulton & Gibbings 2004). Agricultural cooperatives are responding to these changes with mergers, introduction of value-added products, and entry into international markets (Chaddad & Cook 2004). These new ventures require significant startup capital which is becoming increasingly hard to come by as cooperative membership declines (USDA Rural Development 2011).

Agricultural industrialization creates an environment that goes against the "service culture" of cooperatives (Hodeland 2006). Industrialization results in cooperatives becoming outward looking, focusing more on their position in the market than benefiting their members (Hogeland 2006). This focus forces resource optimization to be a higher priority than serving members. Cooperatives are looking at producers as units to be optimized and taking away services that are vital to producers but financially inefficient for cooperatives. For example, in some area grain elevator costs are outweighing their revenues so cooperatives are taking them away. The farmers who rely on these grain elevators are leaving the cooperatives because their needs are not being met (Hodeland 2006). When cooperatives take away services that their members need, the members' incentive to stay is gone.

Increased globalization of the agricultural industry is creating new opportunities and expanding markets (Fulton & Gibbings 2004). However, the globalizing industry is also forcing agricultural cooperatives to compromise their community values to participate. While a privately-owned firm can simply make decisions based on financial outlook, cooperatives must keep their member's interests in mind. Traditional cooperative values are commonly centered on local communities. Globalization offers the possibility of operating parts of cooperatives overseas which significantly lowers costs but is not in alignment with

cooperative's community values (Cook 1997). Cooperatives who choose not to operate internationally are at a disadvantage because their costs will be higher than those who do making it difficult for them to offer competitive pricing.

Farm consolidation is occurring rapidly throughout the United States (Fulton & Gibbings 2004). The average farm size increased by 4% from 2007-2012 (USDA NASS Census of Agriculture 2012). Farm consolidation creates a concentrated industry that lessens the bargaining power of cooperatives. As farms consolidate, they grow, and their need for agricultural cooperatives decreases (Fulton & Gibbings 2004). Large farms have the capitol and volume needed to attain the benefits that cooperatives provide on their own causing cooperatives to become less efficient as consolidation leads farms to leave their cooperatives (Ollila 1989). Less memberships, especially from large operations, increases per member costs in the cooperative (Anderson & Henehan 2005). This puts cooperatives in a difficult position, trying to operate in inefficient conditions while vying for bargaining power with large companies in a concentrated industry.

Many agricultural cooperatives are engaging in mergers to be able to maintain strong bargaining power as the industry becomes increasingly concentrated. Cooperative mergers also allow cooperatives to integrate vertically and horizontally, lowering average costs to compensate for the loss of large-scale members (Nilsson, Svendsen & Svendsen 2012). Mergers create complicated and diverse organizations that are vastly different from traditional cooperatives. Members are becoming less and less involved as intricate business structures make it harder for them to understand what is going on within the cooperative (Fulton, Gibbings 2004; Fulton 1999).

Cooperative mergers and agricultural industrialization are decreasing the social benefits of cooperatives and allowing non-cooperative businesses to compete effectively for business from large-scale farms (Hartley & Burt 1989, Hodeland 2006). Industrialization is causing cooperatives to abandon their community values. Globalization is causing cooperatives to abandon their values of existing as standalone entities. Competition is forcing them to move some operations overseas and when outside organizations are involved, members lose some of their democratic control. Cooperative mergers are forcing cooperatives to abandon their values of teaching and training members. As cooperatives combine, their business portfolios become increasingly complex and diverse, making it difficult to keep

members informed. The abandonment of these values is causing member commitment to decline. This coupled with farm consolidation, is increasing the competitiveness in the environments that cooperatives operate in and making it difficult for them to survive.

2.2.5.1 Member Commitment

High member commitment creates an environment of active and involved members which reduces free riders and increases efficiency (Fulton 1999). The more that members perceive they participate in a cooperative's operations, the more committed they are, and the more they trust the cooperative's board of directors (Österberg and Nilsson 2009). Ample member commitment ensures that cooperatives have substantial social capital which allows them to differentiate themselves from other business forms. Unfortunately, member commitment is declining due to cooperative mergers and changes in cooperative operations as noted above.

Cooperative mergers create complex business structures that lead to uninformed members. Uninformed members cannot see the connection between the cooperative and the success of their operation causing declining member commitment. Cooperative mergers are a way of horizontally or vertically integrating to gain efficiency. Gained efficiency can come from a variety of sources. For example, service cooperatives can reduce their costs by merging with an input supply cooperative that provides materials for the services cooperative. Also, new generation cooperates could merge with marketing cooperatives to sell their products more efficiently.

Cooperative mergers create diverse organizations with members and operations spread across multiple countries (Nilsson, Svendsen & Svendsen 2012, Nilsson & Madsen 2007). These cooperatives have large heterogeneous member populations that make it difficult to build social capital and meet diverse member needs (Nilsson, Svendsen & Svendsen 2012). Large member populations also give individuals anonymity, creating an attitude that someone else will get involved and make decisions (Fulton & Gibbings 2004) When member's feel like their needs are not being met, and they think they are anonymous, overall member commitment declines.

Another reason for decreasing member commitment in agricultural cooperatives is sudden or large changes that occur within cooperatives in response to industry changes. Cooperative members are not receptive to changes that bring about new operational strategies

(Holmström 1999). These changes often cause tension among members when their opinions regarding the changes don't align (Holmström 1999). Tension among members can lead to a loss of the community values of the cooperative, decreasing member commitment.

A survey of agricultural cooperative members by Sibert (1994) shows that members are typically supportive of their cooperative but lack support for the cooperative's values and operations, caring more about selling their products and avoiding regulation than developing a successful cooperative for the long term. Members are not connecting the success of their cooperatives to increased profits and a secure market for their products. Cooperatives need to fix this knowledge gap as it threatens the long run survival of agricultural cooperatives and producers alike (Sibert 1994).

When member commitment deceases, producers leave their cooperatives. Agricultural cooperative membership in the United States decreased by 29% from 2000 to 2009 (USDA Rural Development 2011). Nilsson, Svendsen and Svendsen (2012) explain the deadly cycle of membership decline. When members leave a cooperative the cooperative has less people to provide goods and services too, causing their efficiency to decrease. The cooperative also has less capitol due to loss of membership fees or delivery rights. This causes costs to increase for remaining members which creates a cycle of more and more members becoming dissatisfied and leaving the cooperative.

2.2.5.2 Negative Attitudes and Miscommunications

Despite their widespread presence, cooperatives are often surrounded by a negative stigma. Agricultural producers have been recorded saying things like, "We do not want to organize as a cooperative because state law requires that we have the word cooperative in our name", or "I would quit farming before I would deal with a cooperative" (Anderson & Henehan 2005). A study by Anderson and Henehan (2005) found that about thirty percent of agricultural producers dislike cooperatives.

Negative attitudes towards cooperatives most often arise when the goals of cooperative managers and members do not align. A study by Sibert (1994) identifies a division between agricultural cooperatives and agricultural producers. Agricultural producers are more focused on their coop becoming an immediate low cost provider for their needs, while cooperatives are working to foster a healthy market that will provide a long-term home for producer's commodities.

A study by Burt and Wirth (1990) describes another misalignment, one between supply cooperatives and their members. Supply cooperatives will sacrifice lower cost inputs to maintain the cooperative values. Cooperative members disagree with this viewpoint wanting the lowest prices possible while willing to sacrifice dividends and other benefits as long as quality is not affected.

Older agricultural producers are more likely to have a negative attitude toward their cooperative than younger members because they have less trust in the board of directors (Österberg and Nilsson 2009). Older members see the performance of the cooperative over a long period of time and economic struggles in later years causes a loss of trust regardless of whether it is the fault of the cooperative (Österberg and Nilsson 2009). Lessened trust leads to negative feelings towards cooperatives and their management. This is a significant issue due to the fact that the majority of agricultural producers in the U.S. are over 50 years old (USDA NASS Census of Agriculture 2012).

Differing opinions among cooperatives and members like the ones described above can cause a rift between cooperatives and their members. When cooperatives make changes that members do not understand members feel that their cooperative does not care about them. This fosters negative attitudes towards which reduces member commitment.

2.2.5.3 Misconceptions

Research by Anderson and Henehan (2005) identifies five commonly held beliefs about agricultural cooperatives (listed in italics) and explains why they are misconceptions:

1. *Agricultural cooperatives strive for monopolistic power in the market.* While it can seem that way, cooperatives try to provide members with secure market space while operating as efficiently as possible. This often happens through vertical integration that appears as an attempt to monopolize.
2. *New generation agricultural cooperatives are abandoning their original purpose by catering to large-scale members.* Most cooperatives were not formed to serve small-scale farms. Early cooperatives served small farms because most farms in the United States were small. The number of farms in the United States 2,000 acres or larger increased by over 4,000 between 1997 and 2012 (USDA census of Agriculture). Membership from large-scale

members is vital to cooperative survival because larger members provide cooperatives with enough capital to stay in business.

3. *Cooperatives operate like traditional businesses and only want to make money.* This misconception occurs when cooperatives' actions stray from the best interests of their members in order to stay afloat. In reality, cooperatives are looking ahead and making sacrifices to ensure they will be able to benefit their members in the long run.
4. *Cooperatives do not care about their members.* This is usually stated after a large change within cooperatives that disrupts normal operations. Members are usually the motivation for all proposals and decisions made by cooperatives. In fact, decisions that are disagreeable with members are often delayed to the point of sacrificing efficiency to avoid unhappy members.
5. *Cooperatives are favored by the government through tax breaks and "anti-trust legislation" (Anderson, Henehan, 2005).* The purpose of cooperatives is to benefit members and help them collectively market and produce their commodities. There is legislation in place that helps cooperatives reach this goal. The Capper-Volstead act, discussed above, allows agricultural producers to work together without worry of violating antitrust laws. However, the act has constraints that prevent cooperatives from taking advantage of it. Cooperatives are taxed once at the member level to prevent double taxation from falling on the shoulders of agricultural producers. Nonprofit cooperatives are tax exempt (Deller et al. 2009).

2.2.6 Steps for Success

Despite the challenges discussed above, agricultural cooperatives can still be successful if they implement proper practices. Successful cooperatives implement the following list of methods to assure they thrive in difficult times. (1) Provide a differentiated product (Fulton, 1999), (2) educate members (Anderson, Henehan, 2005), (3) foster member democracy and loyalty (Anderson, Henehan, 2005), and (4) understand members' needs (Dunn 1988). This segment provides a discussion of these methods.

The first method that successful cooperatives implement is offering a differentiated product. Fulton (1999) explains how the more a cooperative can differentiate itself from

traditional firms the better it can retain its market share as globalization occurs. Privately owned companies do not offer the social capital that cooperatives do and cooperatives can utilize this to differentiate themselves. Competitive prices are not sufficient motivation for member commitment. A large and welcoming community of knowledgeable, committed members who are involved in the cooperative is the best differentiated product an agricultural cooperative can offer (Fulton 1999).

The second method that agricultural cooperatives implement is educating their members. Members are educated on two subjects. First, members need to be taught how being a member of the cooperative benefits them. Cooperatives need to be able to quantifiably demonstrate how they improve their member's economic position to show members the benefits that membership offers (Anderson and Henehan, 2005). Providing social benefits is also important but if it is not financially feasible for members to stay they become significantly harder to hold onto.

The second thing agricultural cooperatives must educate their members about is their goals and values. This ensures decisions made by users, owners, and controllers are in line with the cooperative's objectives as well as member's needs (Dunn 1988). Properly educated members can mitigate many of the reasons for poor cooperative performance such as, conflicting goals and ineffective management. (Anderson, Henehan, 2005, Fulton, Gibbings 2004). When all parties involved in the cooperative are educated and working towards the same goal miscommunications and conflict between members and managers is much less likely.

The third method for success is having strong member democracy. This is essential, especially in large cooperatives where members can feel like they don't matter (Österberg and Nilsson 2009, Anderson, Henehan 2005). When members are unhappy with their cooperative they can either voice their displeasure through exercising democracy or leave (Feng et al 2011, Anderson, Henehan, 2005). Exit is less effective when a cooperative has many loyal members because loyal members are less likely to follow. Thus, it is important for agricultural cooperatives to foster a large population of loyal members who readily speak up when unsatisfied to retain membership in volatile times.

Agricultural cooperatives should foster member loyalty as well as democracy. Anderson and Henehan, (2005) show that member loyalty is higher when communication

between members and the board of directors is easily accessible. Live communication from the board of directors and management can be the best way to mitigate members feeling insignificant in large cooperatives. This can be achieved through large group question and answer sessions as well as regionally elected officials who regularly connect with members in their area.

The fourth method that successful cooperatives practice is understanding members' needs (Dunn 1988). Cooperatives need to have a solid understanding of the social and economic structures of the industries in which they operate (Fulton and Gibbings 2004). This understanding allows cooperatives to identify areas where they can help their members and solve problems that are unique to the industry. Cooperatives can then create business strategies and operational plans that work within the industry and ensure member needs are being met (Dun 1988).

2.3 Methods

Researchers use a variety of methods to identify characteristics of likely candidates for agricultural cooperative membership. The data for the study is collected through an internet survey. The data is analyzed with statistical testing and a logit model is created to predict an individual's membership of an agricultural cooperative. Each phase is detailed below.

2.3.1 Data

The data for this study is collected using a survey of agricultural producers. The researchers decided to distribute the survey over the internet instead of through the mail. This decision was made because the internet is becoming widely accessible to most people in the United States Eighty-four percent of adults in the United States use the internet and seventy-three percent of them can access it in their home (Innacchione 2011, Pew Internet & American Life Project 2013b, 2013c). In addition, a web based survey can be easily answered in minutes from a mobile phone, is returned to the data collectors as soon as it is complete, and is cheaper than a mail survey.

2.3.2 Analysis

The methods for data analysis used in this research are factor analysis and logistic regression. Factor analysis is a method of data reduction that examines underlying patters of relationships identified with multiple variables and condenses the variables into smaller sets.

(Hair et al, 1998). Logistic regression is a regression analysis where the dependent variable is nonmetric (Hair et al, 1998).

2.3.2.1 Logistic Regression

Logit and probit models are the two most common forms of data analysis for binary outcomes as dependent variables. Dependent variables for binary data can come in many forms, for example, yes/no, blue/red, college degree/no college degree. For binary data analysis, dependent variables are assigned the values of 0 or 1. For example $no = 0$ and $yes = 1$. The logit or probit model predicts the probability of the outcome. Using *Equation 2.1*. For the binary outcome yes/no, y^* is the probability of a "yes" outcome (Moore, 2013). α is the coefficient of the constant, B is the coefficient on the independent variables, x is the independent variables, and e is the error term. A $y^*$of .95 would indicate a 95% probability of a yes outcome.

Equation 2.1 Modeling a Binary Outcome

$$y^* = \alpha + \beta x + e$$

Equation 2.2 shows how to decide which outcome is indicated by the results of the model. Continuing with the yes no example, if the threshold is equal to .5, and $y_i = .95$ then y_i is a yes outcome. If $y_i = .35$ then y_i is a no outcome.

Equation 2.2 Binary Outcome Threshold

$$y_i = \{\frac{1 \; if \; y_i^* > \tau}{0 \; if \; y_i^* \leq \tau}$$

Where τ is the threshold deciding 0 or 1

The generalized equations for logit and probit models can be seen in Equation 2.3 and Equation 2.4 below. p_i represents the probability of an outcome happening and β_k is the coefficient for the independent variable, x_{ik} (Moore, 2013). Logit models determine the probability of an outcome occurring by dividing the natural log of the probability of an outcome occurring by the probability of the event not occurring. Probit models multiply Φ^{-1} by the linear equation of independent variables to determine the probability of an outcome occurring (O'Halloran 2008).

Equation 2.3 Probit Model

$$\Phi^{-1}(p_i) = \sum_{k=0}^{k=n} \beta_k x_{ik}$$

Equation 2.4 Logit Model

$$\ln\left(\frac{p_i}{(1-p_i)}\right) = \sum_{k=0}^{k=n} \beta_k x_{ik}$$

The key difference between logit and probit models is their assumption of error distribution. y^* cannot be observed, and therefore an assumption regarding the distribution of errors must be made when choosing between a probit and logit model. (Moore, 2013). Probit models assume a normal distribution of errors, while. logit models assume a standard logistic distribution of errors (Park 2009).

Over the past ten years, logit models have become a standard method of analysis for data with a binary outcome variable, (Hosmer & Lemeshow 2004). Logit models are preferred over probit models when sample sizes are large (Horowitz & Savin 2001). The researchers use a logit model in this study because it is a better match for the data than a probit model. The sample size for the model is 628 individuals. In addition, there is no reason for the researchers to assume that the errors in the data are normally distributed. Therefore, a logit model is preferred over a probit model.

2.3.2.2 Factor Analysis

A factor analysis is used in this research to condense 11 highly correlated variables that come from the same subsection of the to one variable that represents the structure of the 11 variables. Factor analysis is a method of defining the underlying structure in a data matrix (Hair, et al 1998). It condenses multiple observed variables into smaller sets of latent variables, called factors (Garrett-Mayer 2006). Latent variables are variables that are not directly observed, but are present in an underlying structure of the data, therefore can be represented by a factor. For example, multiple survey questions about someone's diet and exercise habits can have an underlying latent variable of how healthy their lifestyle is. Factor analysis can be used to reduce those multiple survey questions to one factor, a rating of the healthiness of the person's lifestyle.

While factor analysis sometimes results in the loss of specific information, its goal is to preserve the main idea of the data while reducing problems that arise from having many

similar variables that risk having a high degree correlation. Simply put, factor analysis allows variables that are highly correlated with each other to be included in statistical models without introducing high levels of multicollinearity (Garrett Mayer 2006). This allows variables to be included that without a factor analysis would have been dropped from the model.

2.4 Sampling Procedures

The data for this research is primary data collected from surveying agricultural producers via an internet survey. The survey data is used to create a logit model that calculates the probability of an agricultural producer being a member of an agricultural cooperative. This section outlines the methods and practices used to gather the data for this study. It includes the survey sample, the survey questions, procedures used when conducting the survey, and response results.

2.4.1 Survey Sample and Questions

The survey sample came from a list of agricultural producers provided by Farm Market iD, a commercial data supplier. The survey targets currently active agricultural producers in Idaho, Washington, and Oregon. By targeting a specific region, the researchers' goal is to be able to make direct comparisons between Northwest agricultural producers and Northwest agricultural cooperatives. It is worth noting that the list provided by Farm Market iD was not as geographically accurate as originally thought because many agricultural producers do not have email addresses and use family member's when they are required to have one. Due to this, some of the data may be from areas outside of the Northwest United States. The researchers corresponded with survey respondents who had questions as to why they were selected to participate. Some of these individuals were in areas outside of the survey's target area. The researchers assume that some of those who took the survey without any correspondence were located outside the target area as well.

The survey was developed by Hannah Hallock and Aaron Johnson. This segment reviews Hallock's (2015) method of designing the survey questions. The questions were developed in "four sections: demographics, perceptions and use of agricultural cooperatives, member value of agricultural cooperatives, and potential value of agricultural cooperatives" (Hallock 2015 p 46).

The demographic questions help the researchers identify any existing correlations between agricultural cooperative members and the demographics of producers. This helps

researchers understand characteristics that are common among agricultural cooperative members. The questions about perception and use allow the researchers to understand three things: (1) how agriculture producers view agricultural cooperatives, (2) the elements of agricultural cooperatives that are most important to agricultural producers, and (3) agricultural producers' use of agricultural cooperatives. Only respondents were members of an agricultural cooperative were asked the member value questions. These questions help the researchers understand members' relationships within their cooperative. Only respondents who are not members of an agricultural cooperative were asked questions about the perceived value of agricultural cooperatives. These questions help determine why agricultural producers are not members of agricultural cooperatives and how agricultural cooperatives are viewed by nonmembers. A flow chart of the survey questions is in *Figure 2.1*. The survey is presented in full in *Appendix A*.

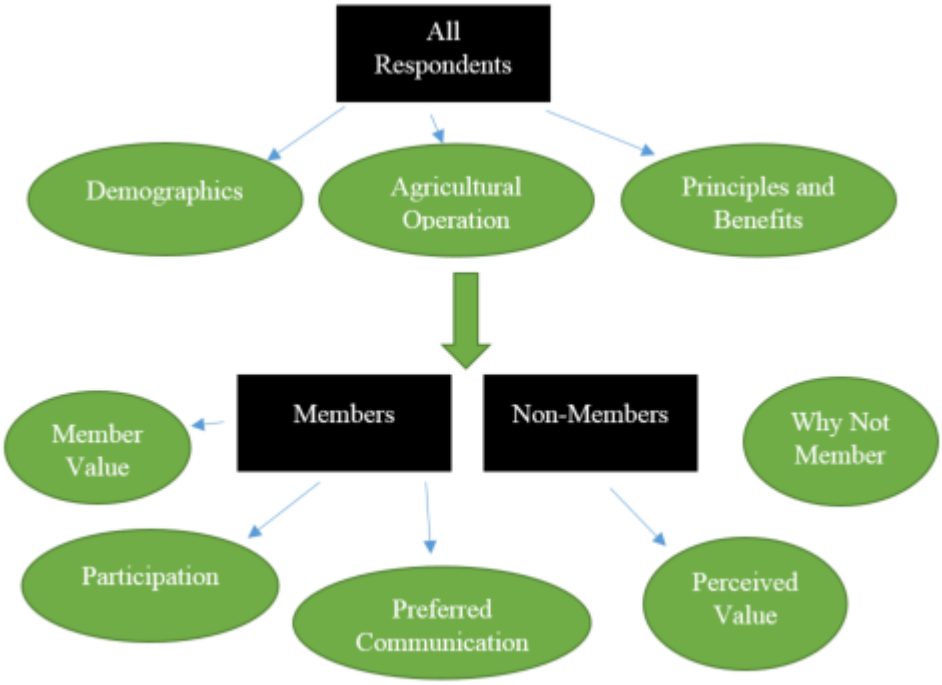


Figure 2.1 Flow Chart of Survey Questions

2.4.2 Survey Distribution and Data Collection

This section discusses the process of distributing the survey and collecting responses. The following subsections provide detailed information about each round of the survey. The survey was distributed over email in four rounds, the first round utilized SurveyMonkey, and

the following rounds used Qualtrics. Both SurveyMonkey and Qualtrics are computer programs designed for creating and distributing internet surveys. The researchers chose to utilize an internet survey because it is significantly cheaper than mail or telephone and saves time, allowing the survey to reach as many agricultural producers as possible. The survey was distributed in four rounds, each round consisting of multiple waves.

The first wave of each round of the survey invited sample members to participate and informed them what the survey is about, what is being asked of them, who is conducting the survey, and how it will benefit them to participate. It also included information about who to contact with questions, how to access the survey, and assured recipients that their responses were kept confidential.

After each invitation, the researchers sent waves of follow up emails to those who had not responded to the survey. Each email contained slightly different information about what the survey is for and how it benefits producers to participate. Dillman et al (2014) suggests sending waves of the survey until they no longer create significant increases in the response. The researchers followed this practice, sending waves until the response rate showed it would be useless to continue.

Each wave of the survey was sent using individualized emails to the recipients. This kept the recipient's emails private, and also solved the problem of sending a bulk email which can often end up in a spam folder instead of the recipient's inbox. Individual emails also allowed the researchers to address recipients by their first name which helps establish a personal connection with respondents, increasing the chances of them participating (Dillman et al 2014). The emails contained individualized links to the survey so the researchers could keep track of who had responded.

Following each time the survey was deployed, the researchers removed anyone who completed the survey, unsubscribed, did not fit the critera for the survey, or had an undeliverable email address. Then they calculated the response rate using Equation 2.5.

Equation 2.5 Survey Response Rate

$$Response\ Rate = \frac{C + P}{(C + P) + (R + NC + O) + (UH + UO)}$$

$$Where\ C = Completes$$
$$P = Partials$$
$$R = Refusals$$
$$NC = Non\ Contact$$
$$O = Other$$
$$UH = Unknown\ Household$$
$$UO = Unknown\ Other$$

(Source: American Association for Public Opinion Research, 2010)

In Equation 2.5 "the 'Completes' indicates competed surveys. 'Partials' are the surveys that were started but not completed. The 'Refusals' indicated those who unsubscribed. 'Non-contact' is the number of emails that were undeliverable and those producers that did not reply. 'Other' refers to those respondents that did not meet the researchers screening criteria for this study. Finally, there were no potential respondents classified under 'Unknown Household' or 'Unknown Other'" (Hallock 2015 p48).

2.4.2.1 Round One - SurveyMonkey

The first round of the survey was deployed by an email merge conducted by Farm Market iD, the commercial data vendor that provided the sample list. The survey was hosted by Survey Monkey, a survey specific software. Researchers received 25 responses out of 6,935 emails that were sent (0.4% response rate). Twenty-one of these responses were complete, with 4 incomplete. Nearly 2% of the emails sent were undeliverable and 7% of respondents unsubscribed. This amounted to a response rate of 0.36%. The number of observations from the first round was too small to perform a conclusive analysis on.

At the end of this first wave, it became known by the research team that SurveyMonkey is unfavorable in the eyes of many agricultural producers because of its charitable donations to the Humane Society of the United States (Humane Watch Team 2013). Agricultural producers see the HSUS unfavorably because the HSUS "is trying to end all animal agriculture [and has] compared farms to Nazi concentration camps" (Humane Watch Team 2013). The researchers switched to Qualtrics after the first round of the survey hoping to increase responses from agricultural producers.

2.4.2.2 Round Two – Qualtrics

Round two was deployed by Aaron Johnson and Hannah Hallock in the spring of 2015. It was sent as a mail merge from Aaron Johnson's University of Idaho email account. The researchers provided legitimacy to the survey with an informative subject line and the University of Idaho name confirming that the survey was for research and not a for profit entity. The tables below summarize the distributions and responses from round two. Table 2.1 shows the number of emails sent, day they were sent, and time they were sent for each wave Table 2.2 shows the responses from round two.

Table 2.1 Round Two Email Distribution Number and Time

Wave	Total Sent	Date	Time
One	6,743	Monday, March 16th 2015	12:40 am PST
Two	6,540	Monday, March 23rd 2015	2:40 pm PST

Table 2.2 Round Two Response Rates

Response Type	Wave 1	Wave 2	Total	Cumulative Total
Complete	74 (1.1%)	68 (1.0%)	142 (2.1%)	163 (2.4%)
Incomplete	49 (0.7%)	40 (0.6%)	89 (1.3%)	93 (1.4%)
Undeliverable	57 (0.8%)	14 (0.2%)	71 (1.1%)	202 (3.1%)
Unsubscribe	48 (0.7%)	45 (0.7%)	93 (1.4%)	578 (8.4%)
No Fit	21 (0.3%)	9 (0.1%)	30 (0.4%)	30 (0.4%)
Other	0 (0%)	0 (0%)	0 (0%)	0 (0%_
Total Responses	123 (1.8%)	108 (1.6%)	231 (3.4%)	256 (3.76%)

Note: Complete = completed surveys; Incomplete = incomplete surveys; Undeliverable = emails that could not be delivered to recipients; Unsubscribe = respondent asked to be removed from the mailing list; No Fit = Respondent was the wrong person or did not fit the criteria for participation; Other = Other nonresponses Total Responses = Summation of complete and incomplete responses. Total responses for that category across rounds.

Round two of the survey contained two mistakes from when it was transferred from SurveyMonkey. The "important" scale factor was left off the question asking agricultural producers to rate different factors on importance. The researchers corrected this error by assigning the question a four-point scale with the "important" factor having a rating of 3.5.

The second mistake occurred in the same question. "Patronage" was supposed to be included as one of the factors to be rated for importance but was left out. On April 9th, 2015 at 2:38 pm PST the researchers emailed 224 agricultural produces who had started the survey asking them their importance rating for patronage. One hundred and five producers responded with an answer. A second wave asking about patronage was sent on April 19th at 9:32 pm PST

to those who did not respond to the first wave. Thirty-six more agricultural producers responded amounting to 141 total responses to the patronage question.

2.4.2.3 Round Three – Qualtrics

Round three of the survey was sent by Laura Griffing and Aaron Johnson from a University of Idaho email account created specifically for sending the survey. Dillman et al (2014) emphasizes the importance of building the legitimacy of email surveys to avoid being ignored or flagged as junk mail. The researchers created the email account from the University of Idaho, for the third and fourth rounds to appear professional and get the attention of recipients while keeping correspondence with respondents separate from the researchers' personal University emails.

Round three was sent in January and February of 2016. The errors from round two were corrected before the survey was deployed. The researchers sent round three in the beginning of the year because it is typically the least busy time for agricultural producers and they hoped that by sending the survey at a less busy time they would get an improved response rate over rounds one and two.

The tables below summarize the distributions and responses from round three. Table 2.3 shows the number of emails sent, day they were sent, and time they were sent for each wave. *Table 2.4* shows the responses from round three.

Table 2.3 Email Distribution Number and Time

Wave	Total Sent	Date	Time
One	6288	Monday, Jan 11th 2016	6:54 am PST
Two	5942	Thursday, Jan 14th 2016	6:57 am PST
Three	5818	Wednesday, Jan 20th 2016	5:53 am PST
Four	5694	Friday, Jan 29th 2016	9:50 am PST
Five	5622	Monday, Feb 8th 2016	6:56 am PST

Table 2.4 Round Three Response Rates

Response Type	Wave 1	Wave 2	Wave 3	Wave 4	Wave 5	Total	Cumulative Total
Complete	67 (1.1%)	34 (0.6%)	33 (0.6%)	13 (0.2%)	43 (0.8%)	190 (3.0%)	353 (5.4%)
Incomplete	52 (0.8%)	13 (0.2%)	22 (0.4%)	12 (0.2%)	19 (0.3%)	118 (1.9%)	211 (3.3%)
Undeliverable	198 (3.1%)	25 (0.4%)	25 (0.4%)	31 (0.5%)	11 (0.2%)	290 (4.6%)	492 (7.7%)
Unsubscribe	57 (0.9%)	31 (0.5%)	16 (0.3%)	13 (0.2%)	13 (0.2%)	130 (2.1%)	708 (10.5%)
No Fit	24 (0.4%)	13 (0.2%)	13 (0.2%)	4 (0.1%)	9 (0.2%)	62 (1.0%)	92 (1.4%)
Other	1 (0%)	1 (0.0%)	1 (0.0%)	0 (0.0%)	0 (0.0%)	3 (0.0%)	3 (0%)
Total Responses	119 (1.9%)	47 (0.8%)	55 (0.9%)	25 (0.4%)	62 (1.1%)	308 (4.9%)	564 (8.7%)

Note: Complete = completed surveys; Incomplete = incomplete surveys; Undeliverable = emails that could not be delivered to recipients; Unsubscribe = respondent asked to be removed from the mailing list; No Fit = Respondent was the wrong person or did not fit the criteria for participation; Other = Other nonresponses. Total Responses = Summation of complete and incomplete Cumulative Total = Total responses for that category across rounds.

2.4.2.4 Round Four – Lottery Incentive

The researchers were not satisfied with the response rate from rounds 1-3 so they included an incentive in an attempt to increase response rates in round four. Laguilles, Williams, & Saunders (2010) performed an analysis on four different surveys with lotteries and found that lottery incentives positively impact response rates in web surveys. Agricultural producers who chose to participate were entered into a drawing for one of five $100 gift certificates to Cabela's.

The researchers added two questions to the fourth round of the survey. The first question was at the beginning of the survey. It asked participants if their business was directly involved in production agriculture. Respondents who answered no to this question were directed out of the survey. This question was developed to stop people who were not involved in production agriculture from taking the survey just to be entered into the lottery. The mailing list for the survey was purchased from a commercial data provided under the assumption that the individuals on the list were agricultural producers. It became increasingly apparent that this was not true during the first three rounds. The second question was at the end of the survey and asked respondents for their ten-digit phone number. The phone numbers were used to draw the lottery winners. The phone numbers were not associated with names, were kept confidential, and were destroyed after the winners were chosen.

The tables below summarize the distributions and responses from round four. *Table 2.5* shows the number of emails sent, day they were sent, and time they were sent for each wave. *Table 2.6* shows the responses from round three.

Table 2.5 Round Four Email Distribution Number and Time

Wave	Total Sent	Date	Time
One	5557	Wednesday, Feb 17th 2016	6:54 am PST
Two	5483	Monday, Feb 29th 2016	5:49 am PST
Three	5453	Wednesday, March 9th 2016	5:20 am PST
Four	5437	Monday, March 21st 2016	5:24 am PST

Table 2.6 Round Four Response Rates

Response Type	Wave 1	Wave 2	Wave 3	Wave 4	Total	Cumulative Total
Complete	31 (0.6%)	7 (0.1%)	2 (0.0%)	2 (0.0%)	42 (0.8%)	395 (6.2%)
Incomplete	7 (0.1%)	2 (0.0%)	2 (0.0%)	3 (0.1%)	14 (0.3%)	225 (3.6%)
Undeliverable	15 (0.3%)	4 (0.4%)	2 (0.0%)	2 (0.0%)	23 (0.4%)	515 (8.1%)
Unsubscribe	8 (0.1%)	5 (0.1%)	5 (0.1%)	3 (0.1%)	21 (0.4%)	729 (10.9%)
No Fit	15 (0.3%)	10 (0.2%)	5 (0.1%)	1 (0.0%)	31 (0.6%)	123 (2%)
Other	1 (0.0%)	1 (0.0%)	0 (0.0%)	0 (0.0%)	2 (0.0%)	59 (1%)
Total Responses	38 (0.7%)	9 (0.2%)	4 (0.1%)	5 (0.1%)	56 (1.1%)	628 (9.8%)

Note: Complete = completed surveys; Incomplete = incomplete surveys; Undeliverable = emails that could not be delivered to recipients; Unsubscribe = respondent asked to be removed from the mailing list; No Fit = Respondent was the wrong person or did not fit the criteria for participation; Other = Other nonresponses. Total Responses = Summation of complete and incomplete. Total responses for that category across rounds.

Combining all rounds of the study brings the total response rate to 9.76%. This is a significant improvement upon the first study performed with this survey that had a 3.76% response rate. However, an ideal response rate for an internet survey is at least 20% (Nulty 2008). To determine if analysis can still be performed the researchers calculate the ideal sample size for the target population using Equation 2.6.

Equation 2.6 Sample Size

$$Sample\ Size = \frac{\frac{z^2 * p(1-p)}{e^2}}{1 + \frac{z^2 * p(1-p)}{e^2 N}}$$

Where:

$$z = z - score$$
$$p = p - value$$
$$e = Margin\ of\ Error$$
$$N = Population\ Size$$

(Source: Survey Monkey, 2016)

The population size is the number of agricultural producers in the United States, 3,180,074 (USDA NASS Census of Agriculture 2012). The margin of error is 5%, the p-value is the standard .05 significance, and the corresponding z-score is 1.96. The ideal sample size for the target population with a 95% confidence level and 5% margin of error is 385 agricultural producers. The survey sample is 628 so the researchers conclude that the sample size is adequate to complete the project with. It should be noted that this sample size was calculated for the entire U.S., and the sample came from just the Northwest United States, meaning that even less responses were needed to justify an adequate sample size.

2.5 Cooperative Survey Results

This section explains the researchers' process of statistical testing and examination of the summery statistics of the survey data. The statistical testing helps the researchers evaluate if the data from all the rounds of the survey can be pooled and if non-response bias is present. The summery statistics allow the researchers to draw conclusions about characteristic of agricultural cooperative members and nonmembers.

2.5.1 Data Testing

Before performing any analysis, the researchers examined the data from 2015 (rounds one and two) and from 2016 (rounds three and four) to determine if it can be combined and used as a singular data set, and to determine if non-response bias exists. The survey for each of these groups was the same, but the testing is to statistically determine that collecting data at two separate intervals did not result in different data. Three methods of analysis are used to determine if the two groups are the same. A Wilcoxon signed-rank test is used for non-normally distributed scale variables, and examination of cross-tabulation is used for nominal, binary variables. Independent Sample T-tests are used to test for non-response bias.

The survey was distributed to a total of 6,943 people. Of those that received the survey 628 responded. Of those who responded, 402 people completed the survey, and 226 stopped before reaching the end. In addition, some of the completed surveys were missing answers in some questions but the respondent kept going until reaching the last question. Most respondents who did not complete the survey stopped before answering the questions concerning the traits and characteristics that the researchers focus on in this section. Because of this, only the 402 completed responses were used in the data testing analysis. The

researchers decided that testing the variables gathered from questions asked to all of the respondents would be sufficient for this analysis.

2.5.1.1 Data Pooling

The Wilcoxon signed-rank test is a non-parametric test for comparing the medians of two groups (LaMorte 2016). The researchers use it to compare the medians of the non-normally distributed data. The results of the test are in Table 2.7.

The level of significance for this test is 0.10 because it is a two-tailed significance level, but the Wilcoxon test is a one tailed (nonparametric) test. However, the significance is calculated based on the two tailed Man Whitney U statistic that is also displayed in the results. When looking for significant results in the table, the significance level is divided by two to convert it from the two-tailed significance of the Man Whitney U, to the one tailed significance of the Wilcoxon test. The second column of the table is the Man-Whitney U statistic that is used to test for equality of variance. The third column is the Wilcoxon W statistic. The fourth column is the z-score that determines the significance of the test in the fifth column.

Of the questions asked to all the survey respondents, 21 of them are ordinal or interval scaled and non-normally distributed. The variables are: the highest level of education the respondents' have completed, the respondents' age, how many years the respondents' have worked in agriculture, the respondents' annual income from agriculture, the respondents' opinion of agriculture cooperatives, the value that respondents place on ownership, control, benefit, price, quality, and relationship, and the respondents' rating of the importance of ten value factors provided by agricultural cooperatives.

Table 2.7 Wilcoxon Signed-Rank Test

Variable	Man-Whitney U	Wilcoxon W	Z	Asymp. Sig (2-tailed)
Education	29391.5	73942.5	-1.28	.201
Age	29594	73874	-0.85	.379
Experience	31691.5	74762.5	1.30	.194
Ag Income	29922.5	69543.5	-1.27	.205
Opinion	26392.5	64342.5	-0.62	.532
Ownership	18745	46475	-0.16	.877
Control	18928.5	46658.5	0.01	.991
Benefit	18870	46365	-0.08	.940
Price	17973	45703	-0.85	.395
Quality	19187.5	46917.5	0.24	.808
Relationship	18359.5	4600089.5	-0.50	.616
Importance Pride	26166	61411	0.53	.596
Importance Access	23882.5	58598.5	-1.15	.251
Importance Community	27308	62553	1.58	.115
Importance Ownership	26693.5	61409.5	0.87	.383
Importance Control	28109.5	63089.5	2.36	.018
Importance Relationship	24331	58522	-0.56	.573
Importance Price	24759	59475	-0.61	.545
Importance Quality	24137	58853	-0.80	.425
Importance Reputation	24093	59338	-1.05	.295
Importance Patronage	23480	57671	4.83	.000

*Importance Patronage and Importance Control significant at 0.05 level

It should be noted that the Wilcoxon Signed-Rank test assumes homogeneity of variance. To test this assumption the researchers calculated ranks for each variable using the Man-Whitney U statistics and subtracted these ranks from the mean rank for each variable. Researchers then performed a One-Way ANOVA on the absolute values of the calculated ranks for each variable.

The results of the one-way ANOVAs on the rank testing are in Table 2.8. The significance column shows that age, control, importance access, importance community, importance ownership, importance relationship, importance price, importance quality, importance reputation, and importance patronage violate the assumption of homogeneity of variance with a p-value of less than 0.05. Therefore, the Wilcoxon Signed-Rank Test's results for these variables is inconclusive.

Table 2.8 Variable Rank Difference ANOVA

Variable		Sum of Squares	df	Mean Square	F	Sig.
Education	Between Groups	3848.7	1	3848.7	.836	.361
	Within Groups	2333240.0	507	4602.1		
	Total	2337088.6	508			
Age	Between Groups	21737.5	1	21737.5	4.299	.039
	Within Groups	2543604.1	503	5056.9		
	Total	2565341.6	504			
Experience	Between Groups	9088.6	1	9088.6	2.085	.149
	Within Groups	2153765.1	494	4359.8		
	Total	2162853.6	495			
Ag Income	Between Groups	628.6	1	628.6	.156	.693
	Within Groups	1930868.6	479	4031.0		
	Total	1931497.3	480			
Opinion	Between Groups	14.7	1	14.7	.010	.920
	Within Groups	680797.7	471	1445.4		
	Total	680812.4	472			
Ownership	Between Groups	60.3	1	60.3	.019	.890
	Within Groups	1245808.7	394	3162.0		
	Total	1245869.0	395			
Control	Between Groups	12666.8	1	12666.8	4.117	.043
	Within Groups	1212340.3	394	3077.0		
	Total	1225007.2	395			
Benefit	Between Groups	153.9	1	153.9	.048	.826
	Within Groups	1257211.5	394	3190.9		
	Total	1257365.3	395			
Price	Between Groups	4918.5	1	4918.5	1.589	.208
	Within Groups	1219942.8	394	3096.3		
	Total	1224861.4	395			
Quality	Between Groups	639.8	1	639.8	.194	.660
	Within Groups	1300152.3	394	3299.9		
	Total	1300792.1	395			
Relationship	Between Groups	4861.9	1	4861.9	.943	.332
	Within Groups	2345526.1	455	5155.0		
	Total	2350388.1	456			
Importance Pride	Between Groups	4861.9	1	4861.9	.943	.332
	Within Groups	2345526.1	455	5155.0		
	Total	2350388.1	456			
Importance Access	Between Groups	55337.4	1	55337.4	23.300	.000
	Within Groups	1078259.2	454	2375.0		
	Total	1133596.6	455			
Importance Community	Between Groups	33756.2	1	33756.2	6.549	.011
	Within Groups	2334925.5	453	5154.4		
	Total	2368681.7	454			
Importance Ownership	Between Groups	53721.5	1	53721.5	14.830	.000
	Within Groups	1648250.2	455	3622.5		
	Total	1701971.7	456			
Importance Control	Between Groups	4752.9	1	4752.9	1.172	.280
	Within Groups	1829370.5	451	4056.3		
	Total	1834123.4	452			
Importance Relationship	Between Groups	55339.2	1	55339.2	26.841	.000
	Within Groups	929844.5	451	2061.7		
	Total	985183.8	452			
Importance Price	Between Groups	6381.3	1	6381.3	4.067	.044
	Within Groups	713914.7	455	1569.0		
	Total	720296.0	456			
Importance Quality	Between Groups	8997.4	1	8997.4	5.806	.016
	Within Groups	700501.1	452	1549.8		
	Total	709498.4	453			
Importance Reputation	Between Groups	33721.2	1	33721.2	17.885	.000
	Within Groups	857873.1	455	1885.4		
	Total	891594.3	456			
Importance Patronage	Between Groups	17694.6	1	17694.6	4.613	.032
	Within Groups	1530459.2	399	3835.7		
	Total	1548153.8	400			

*Age, Control, Importance Access, Importance Community, Importance Relationship, Importance Price, Importance Quality, Importance Reputation, and Importance Patronage Significant at the 0.05 level.

The results above in Table 2.7 and Table 2.8 indicate that there is a statistically significant difference in the 2015 and 2016 data for the respondent's importance rating of control. This is shown by the statistically significant p-value of the Wilcoxon Signed Rank Test coupled with the statistically insignificant p-value of the ANOVA suggesting that the Wilxocon Signed Rank test shows a difference in the median between the years and it meets the assumption of homogeneity of variance. In addition, the results for the following variables are inconclusive because they violate the assumption of homogeneity of variance: age, importance access, importance community, importance reputation, importance patronage, importance price, importance relationship, importance ownership, and importance quality (Table 2.8) It can be concluded that the remaining 11 variables have no statistically significant differences between the two collection periods.

Of the questions asked to all survey respondents, 14 of them are binary. The binary variables are:

1. The respondent's gender
2. Whether or not the respondent is
    a. an owner of their operation
    b. an operator of the operation
    c. a family employee
    d. a standard employee
3. Whether or not the respondent's operation is family owned
4. Whether or not previous generations of the operations were involved with agricultural cooperatives
5. Whether or not the respondent is a member of
    a. an ag input cooperative
    b. ag marketing cooperative
    c. food cooperative
    d. federal credit union
6. Whether or not the respondent does business with an agricultural cooperative
7. Whether or not the respondent is a member of an agricultural cooperatives.

The researchers looked at cross tabs of each binary variable to look for differences in the data sets. The cross tabulations can be seen in Table 2.9 below. Five of the variables have

a less than 1% difference in response distribution between 2015 and 2016. Two variables have between 1.1% and 2% difference, two between 2.1 and 3% difference, three between 3.1 and 4% difference, and only two variables have a difference of over 4% in response distribution between 2015 and 2016.

Table 2.9 Binary Variables Cross-Tabulation

Gender		Male	Female	Total
Source	2015	72.7%	27.3%	100.0%
	2016	74.1%	25.9%	100.0%
Difference		1.4%	1.4%	N/A
Owner		No	Yes	Total
Source	2015	28.7%	71.3%	100.0%
	2016	28.6%	71.4%	100.0%
Difference		0.8%	0.8%	N/A
Operator		No	Yes	Total
Source	2015	70.5%	29.5%	100.0%
	2016	69.7%	30.3%	100.0%
Difference		0.8%	0.8%	0.8%
Family Employee		No	Yes	Total
Source	2015	89.9%	10.1%	100.0%
	2016	90.3%	9.7%	100.0%
Difference		0.4%	0.4%	N/A
Employee		No	Yes	Total
Source	2015	95.7%	4.3%	100.0%
	2016	93.0%	7.0%	100.0%
Difference		2.7%	2.7%	N/A
Over $50,000 From Non-Ag		No	Yes	Total
Source	2015	61.5%	38.5%	100.0%
	2016	62.3%	37.7%	100.0%
Difference		0.8%	0.8%	N/A
Family Owned		No	Yes	Total
Source	2015	4.9%	95.1%	100.0%
	2016	7.8%	92.2%	100.0%
Difference		2.9%	2.9%	N/A
Generation Coops		No	Yes	Total
Source	2015	22.8%	77.2%	100.0%
	2016	27.0%	73.0%	100.0%
Difference		4.2%	4.2%	N/A
Input Coop		No	Yes	Total
Source	2015	75.2%	24.8%	100.0%
	2016	79.2%	20.8%	100.0%
Difference		4.0%	4.0%	N/A
Ag Marketing Coop		No	Yes	Total
Source	2015	74.8%	25.2%	100.0%
	2016	73.8%	26.2%	100.0%
Difference		1.0%	1.0%	N/A
Food Coop		No	Yes	Total
Source	2015	98.4%	1.6%	100.0%
	2016	94.9%	5.1%	100.0%
Difference		3.5%	3.5%	N/A
Credit Union		No	Yes	Total
Source	2015	86.0%	14.0%	100.0%
	2016	87.8%	12.2%	100.0%
Difference		1.8%	1.8%	N/A
Ag Coop Business		No	Yes	Total
Source	2015	22.1%	77.9%	100.0%
	2016	25.5%	74.5%	100.0%
Difference		3.4%	3.4%	N/A
Ag Coop Membership		No	Yes	Total
Source	2015	34.2%	65.8%	100.0%
	2016	39.3%	60.7%	100.0%
Difference		5.1%	5.1%	N/A

The variable “Cooperative Member or Not” has the biggest difference between the two years out of all the other variables. 2016 shows over 5% less agricultural cooperative

members than 2015. The researchers argue that the 2016 data is more realistic, and by combining it with the smaller sample from 2015 it makes the entire data set a better representation of reality.

After performing the Wilcoxon W and Man Whitney U tests as well as the cross tabs, the researchers tally the variables to see how many differ from 2015 to 2016. The researchers conclude that 22 of the variables have no statistically significant difference, three variables are statistically different and ten have inconclusive results. These results show that 91 percent of the variables have either no difference or are inconclusive. Based on this high percentage of the large number of variables, the rescuers pool the data sets for the analysis of the results.

2.5.1.2 Non-Response Bias Test

As standard practice dictates, a test for non-response bias was conducted before analyzing the survey results. Nonresponse bias is present when the survey respondents are not representative of the target population (Ferber 1948). The researchers use a response time based method to test for non-response to examine the responses over the year that they were collected. The response time based method is performed by dividing responses into groups based on when they were received. Next the group results are tested for differences. Bias is assumed to be present if the tests show statistically significant differences between groups (Ferber 1948).

The researchers test for non-response bias by comparing the data from rounds one and two (collected in 2015), to rounds three and four (collected in 2016). The researchers compare these groups first by analyzing basic statistics and then by using an independent samples t-test performed with the statistical software, SPSS.

Table 2.10 shows the summary statistics of the variables being tested for non-response bias. Again, only the variables that include responses from all individuals are used. The grouping indicates which time series is being measured. N is the number of valid responses in each grouping. The mean shows the average for that variable of each group, and the standard deviation and standard error of the mean show those values respectively. Although the values for each variable are not identical between groups, they are very similar throughout each comparison. The t-tests are necessary to determine if these slight differences between groups are statistically significant.

Table 2.10 Statistics on Select Variables for Early and Late Responding Groups 2015 and 2016

	Grouping	N	Mean	Std. Dev.	Std. Error
What is the highest level of education you have COMPLETED?	2015	164	4.48	1.500	.117
	2016	298	4.23	1.609	.093
How many years have you been working in agriculture?	2015	160	4.63	1.474	.116
	2016	293	4.64	1.570	.092
Approximately, what was your GROSS INCOME from AGRICULTURE in 2014?	2015	157	2.34	1.342	.107
	2016	281	2.34	1.367	.082
Is your agricultural operation family owned?	2015	161	1.96	.205	.016
	2016	296	1.92	.268	.016
Were previous generations involved with agricultural cooperatives?	2015	152	1.81	.411	.033
	2016	267	1.73	.445	.027
How many active partners do you have in your operation?	2015	154	2.62	1.378	.111
	2016	265	2.88	1.556	.096
Do you share equipment with other farmers/ranchers?	2015	154	1.34	.563	.045
	2016	268	1.27	.516	.032
Are you the owner?	2015	161	.91	.292	.023
	2016	370	.71	.453	.024
Are you a member of a (Federal) Credit Union?	2015	161	.19	.396	.031
	2016	370	.12	.327	.017

Independent sample t-tests assume that the variance between groups is equal. The researchers use Levene's Test to see if this assumption is met before the t-test is performed. SPSS uses an alpha level of 0.05. If the p-value of Levene's Test is greater than 0.05 then the variances are equal and the assumption for the t-test is met. Three variables in *Table 2.10* have a significance level of less than 0.05 meaning they violate the assumption of equality of variance for an independent sample t-test. These variables are education, previous generation's involvement in cooperatives, and equipment sharing.

The assumption of the t-test is met determines the type of T-statistic to be analyzed for each variable. If the assumption of equal variances is met, the t-statistic for equal variances is used. If the assumption of equal variances is not met the t-statistic for not equal variances is used. Next each t-statistic is compared to its respective p-value to determine if the means between groups are equal.

Table 2.11 below contains the statistics and p-values of for Levene's Test and the Independent T-test for equality of means. The two-tailed significance level for each variable is above 0.05 leading researchers to conclude that there is not a statistically significant

difference in means between groups and non-response bias does not appear to be present in the survey.

Table 2.11 Independent Variable Levene's Test and T-Test 2015 vs. 2016 Data

		Levene's Test		t-test for Equality of Means				
		F	Sig.	t	df	Sig. (2-tailed)	Mean Diff.	SE Diff.
Highest level of education COMPLETED	Equal variances[1]	4.10	.044	1.150	395	.251	.186	.161
	Not equal			1.168	369	.244	.186	.159
Previous generations and agricultural cooperatives	Equal variances	6.47	.011	1.465	368	.144	.066	.045
	Not equal			1.482	338	.139	.066	.045
Share equipment with other farmers/ranchers	Equal variances	5.14	.024	.867	370	.387	.049	.056
	Not equal			.853	309	.394	.049	.057
Family owned?	Equal variances	3.13	.078	.877	393	.381	.021	.024
	Not equal			.907	379	.365	.021	.023
Years worked in agriculture	Equal variances	1.09	.297	-.284	389	.777	-.044	.155
	Not equal			-.286	351	.775	-.044	.154
How many active partners do you have in your operation	Equal variances	3.09	.080	-1.682	368	.093	-.263	.156
	Not equal			-1.716	351	.087	-.263	.153
Gross income from agriculture in 2014	Equal variances	0.01	.944	-.422	377	.673	-.059	.139
	Not equal			-.421	335	.674	-.059	.140
Owner	Equal variances	0.07	.796	.129	396	.897	.004	.030
	Not equal			.129	348	.897	.004	.030
Member of a (federal) credit union	Equal variances	2.73	.099	.832	396	.406	.032	.039
	Not equal			.820	327	.413	.032	.039

Note* Equal variances results are used when Levene's significance is 0.05 or above. Not Equal is used otherwise.

2.5.2 Summary Statistics of Survey Respondent Demographics

After testing for non-response bias the researchers examine the demographics of survey respondents to identify notable differneces between the survey respondentes and the populationm, as well as any differences between demographic groups. Summery statistics for education, age, and gender are presented first in Figure 2.3 and Figure 2.5, followed by respondent's role in the operation Table 2.12, years of expirence
and annual gross income (Table 2.13). Next the summery statistics for the history of the respondent's operation, partners involved in the resondent's operation, and if the resondent particiates in equipment sharing are reported. Finally Table 2.14 presents the types of cooperatives that respondents are members of.

The education distribution of respondents is similar to national data, that reports 51% of producers have at least some college education (USDA ERS 2016). *Figure 2.2* shows the education distribution of the respondents. Fifteen percent of the survey respondents completed high school and another 15% completed a two-year college program. About 13% of respondents attended a four-year college but did not complete it. About one third graduated from a four-year college, and 22% completed some form of graduate work.

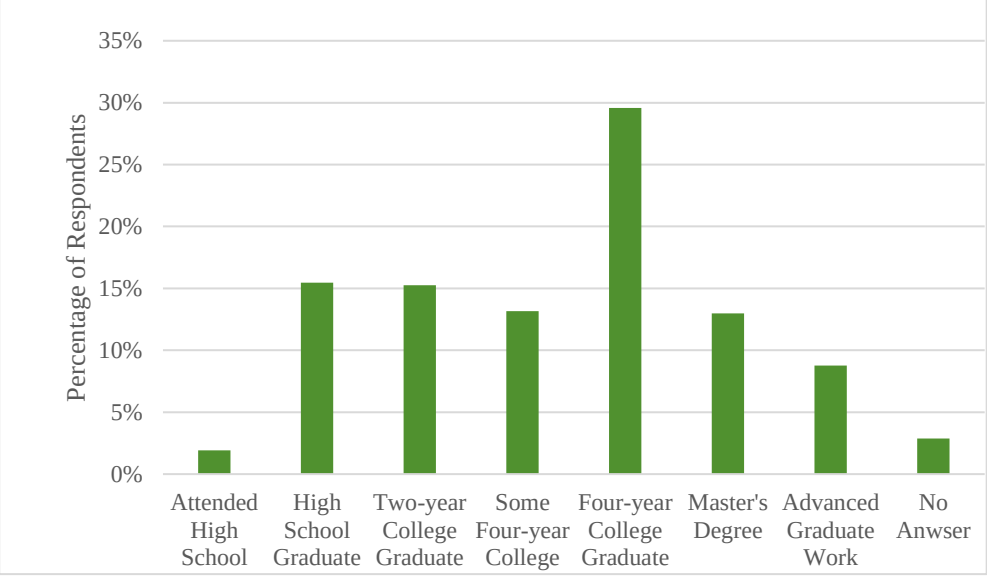


Figure 2.2 Highest Level of Education Respondent has Completed

This age distribution of respondents is slightly different from the one seen in the 2012 USDA NASS Census of Agriculture. The census shows that under 30% of agricultural

producers were between 55 and 64 years old while this survey shows about 45% in a similar age group.

Figure 2.3 shows the age and gender distribution of the survey respondent's. Nearly 45% of the survey respondents were between 56 and 70 years old. Twenty percent were between 45 and 55 and over 15% were over 70 years old. This difference is explainable by the grouping in this survey going up to 70 while the census stops at 64. Therefore, the wider range of the group can be used to explain the higher percentage in this survey. The gender distribution shows that nearly 75% of the respondents were male. A population of mostly males as expected as the 2012 USDA NASS Census of Agriculture reports that 70% of farm operators are male (Figure 2.4).

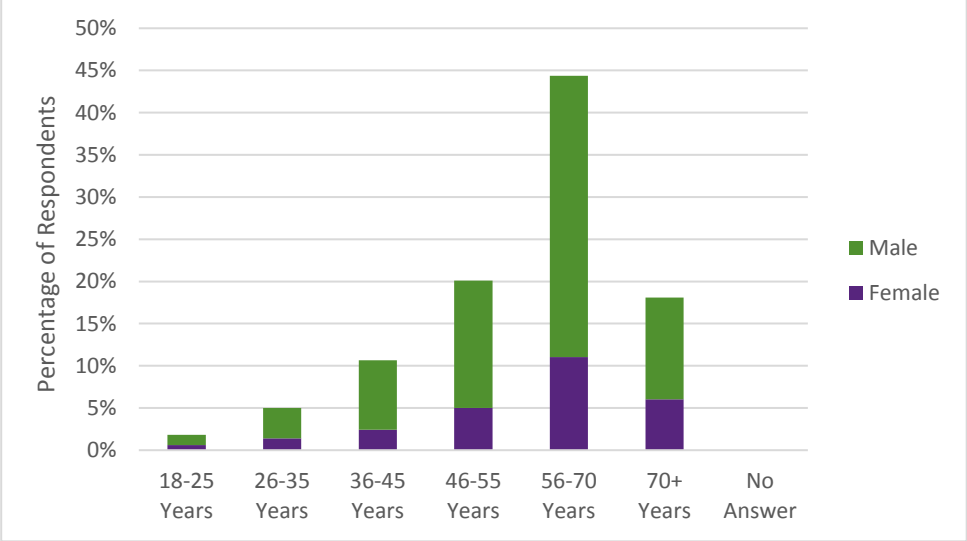


Figure 2.3 Age Group and Gender of Survey Respondents

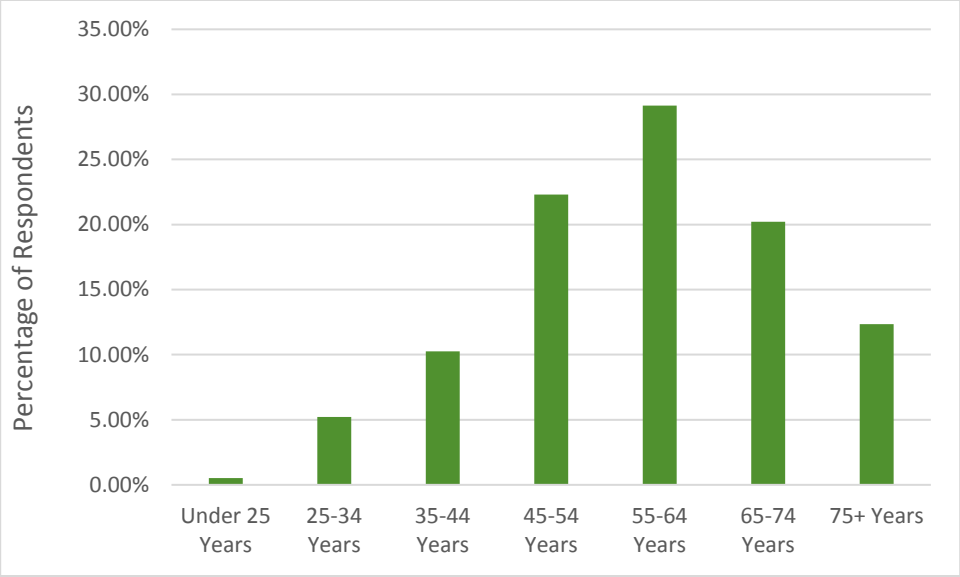


Figure 2.4 USDA Census of Agricultural Age of Producers

The survey asked respondents to disclose their role in their agricultural operation. Respondents chose between: owner, operator, family employee, or employee. It is possible for respondents to have more than one role in the operation so the researchers asked them to check all that apply. For this reason, the total percent does not add up to 100%. Sixty percent of respondents said they were an owner of their operation and 25% claimed to be an operator. Only 8% answered that they were a family employee and 5% replied employee.

Table 2.12 shows the number of respondents that fit into each category in the first column of the table. The "responses" column is calculated by dividing the number of responses per selection by the total number of selections for that question, and therefore sums to 100%. The "percent of responses" column is calculated by dividing the number of actual responses per selection by the number of total respondents for that question, and therefore sums to over 100%.

Table 2.12 Role of Respondents

What is your role in the operation (check all that apply)?-	Responses		Percent of Respondents
	N	Percent	
Owner	448	60.9%	71.4%
Operator	188	25.6%	29.9%
Employee	62	8.5%	9.8%
Family Employee	37	5.0%	5.9%
Total	735	100.0%	117.0%

The 2012 USDA NASS Census of Agriculture, reports that the number of new agricultural producers decreased by 23.3% from 2007 to 2012, and that 36% of agricultural producers have over 40 years of experience. The survey results agree with the national data with almost 50% of the survey respondents have more than 30 years of experience in agriculture while under 10% have been in agriculture for less than 10 years.

A notable correlation exists between experience and gross income from agriculture. Respondents with more years' experience reported a higher gross income from agriculture than those with less years. This correlation is illustrated in Table 2.13. Note that less than 1% of respondents with less than 5 years' experience made over $100,000 and nearly 20% of farms with over 40 years' experience made over $100,000. The proportion of these responses are consistent with the USDA Ag Census that reports the majority of farms make under $50,000, more farms make between $100,000-$499,999 than $50,000-$99,999 and few make over $500,000 (USDA Census of Agriculture 2012).

Table 2.13 Percentage of Respondents by Amount of Gross Income from Agriculture and Years of Experience in Agriculture

Years	Under $50,000	$50,000-$99,999	$100,000-$499,999	$500,000-$999,999	$1M-$4.9M	+$5M	Total
Under 5	6.8%	0.8%	0.2%	0.0%	0.0%	0.0%	7.8%
5-9	3.2%	0.6%	0.0%	0.4%	0.2%	0.0%	4.4%
10-19	7.0%	2.1%	2.7%	0.4%	0.2%	0.0%	12.4%
20-29	2.7%	3.8%	4.9%	0.6%	1.9%	0.2%	14.1%
30-39	5.9%	4.4%	5.1%	2.5%	2.3%	0.6%	20.9%
40+	13.7%	8.4%	11.0%	2.7%	3.2%	1.3%	40.3%
Total	39.2%	20.3%	23.8%	6.8%	7.8%	2.1%	100.0%

The survey also asked respondents how much gross income they receive from non-agricultural sources. Twenty-one percent answered that they make no additional income. Thirteen percent reported up to $10,000, 27% between $10,000 and $50,000 and almost 40% of respondents reported making over $50,000 annually from non-agricultural activities. These frequencies are congruent with the united states average farm operational household income

making over $50,000 in off-farm income (USDA 2005). the researchers to understand that many agricultural producers do not rely solely on their agricultural operations for income.

The survey also asked respondents several questions regarding the family history of their operation. Six percent of respondents answered no to working on a family farm, while almost 93% answered yes. Of the 468 respondents with a family farm, 5% of have been owned for 6 or more generations, 15% for five, 25% for four, over 30% for three, 12% for two, and 7% for one generation. One percent of respondents didn't know how long their operation have been family owned.

The respondents who worked on a family farm were asked what generation they were. 36% of those who responded were the third generation, 23% the fourth, 17% the second, 12% the first, 6% the fifth, and 1% the sixth or more. One half percent of the respondents didn't know what generation they were. The survey also asked if previous generations of the family farm were involved in agricultural cooperatives. Seventy-five percent of respondents answered that previous generations of their operation were members of an agricultural cooperative.

The final demographic statistics calculated by the researchers examines the types of cooperatives of which respondents are members. Since many agricultural producers are members of multiple types of cooperatives, the survey question was structured to allow respondents to make multiple selections from the following choices: agricultural input cooperative, agricultural marketing cooperative, food cooperative, credit union, none and other. Twenty-two percent of respondents are members of an agricultural input cooperative, 26% an agricultural marketing cooperative. Only 4% of respondents reported being a member of a food cooperative while nearly 13% reported being a member of a federal credit union. Twenty-eight percent reported no cooperative membership at all. Table 2.14 displays the number of respondents who were members of each type of cooperative (N Column), the percent of all memberships captured by the type of cooperative, (sums to 100%) and the percent of total respondents for of each type of agricultural cooperative (sums to less than 100% because not all respondents answered the question).

Table 2.14 Respondents' Memberships in Different Types of Cooperatives

Are you a member of any of the types of cooperatives listed (check all that apply)?	Responses		Percent of Total Survey Respondents (628)
	N	Percent of Total Responses	
Agricultural Input Cooperative	141	22.9%	22.5%
Agricultural Marketing Cooperative	162	26.3%	25.8%
Food Cooperative	23	3.7%	3.6%
Federal Credit Union	81	13.2%	12.9%
None	177	28.8%	28.2%
Other	31	5.1%	4.9%
Total	615	100.0%	97.9%

2.5.3 Agricultural Producer's Perspective on Cooperatives

Each survey respondent, regardless of their cooperative membership, was asked questions to help the researchers understand agricultural producers' perspective on agricultural cooperatives. The questions asked respondents to rate their knowledge and opinion of agricultural cooperatives, as well as their importance of specific value factors offered by agricultural cooperatives.

2.5.4 Knowledge and Opinion

Survey respondents were asked to rate their knowledge of agricultural cooperatives on the following five anchor scale: not at all knowledgeable, slightly knowledgeable, moderately knowledgeable, very knowledgeable and extremely knowledgeable. The distribution of responses is presented in Figure 2.3. Of the respondents who answered the question, 3% claimed to be extremely knowledgeable, 14% very knowledgeable, 40% moderately knowledgeable, 29% slightly knowledgeable, and 13% of respondents claimed to be not at all knowledgeable about agricultural cooperatives.

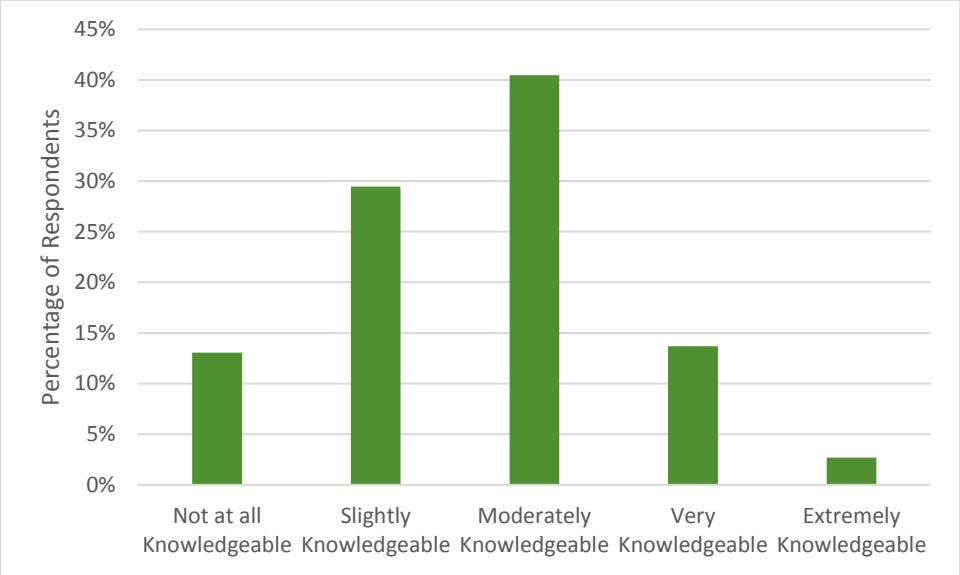


Figure 2.5 Agricultural Producer Knowledge of Agricultural Cooperatives

After analyzing the distribution of agricultural cooperative knowledge for all respondents, the respondents were split into members and non-members. This allowed the distribution of knowledge between members and non-members to be examined separately (*Figure* 2.6). When knowledge level is split into groups of membership and non-membership, the 291 agricultural cooperative members report higher knowledge of agricultural cooperatives than non-members. Only 5% of the 172 non-members reported being extremely knowledge or very knowledgeable of agricultural cooperatives. Most non-members (40%) reported being slightly knowable. Twenty-eight percent are moderately knowable, and 27% not at all knowledgeable. The distribution of knowledge ratings for cooperative members is slightly more normal than that of non-members with 49% of respondent's answering moderately knowledgeable, 26% slightly knowledgeable, 19% very knowledgeable, 4% extremely knowledgeable, and 2% not at all knowledgeable

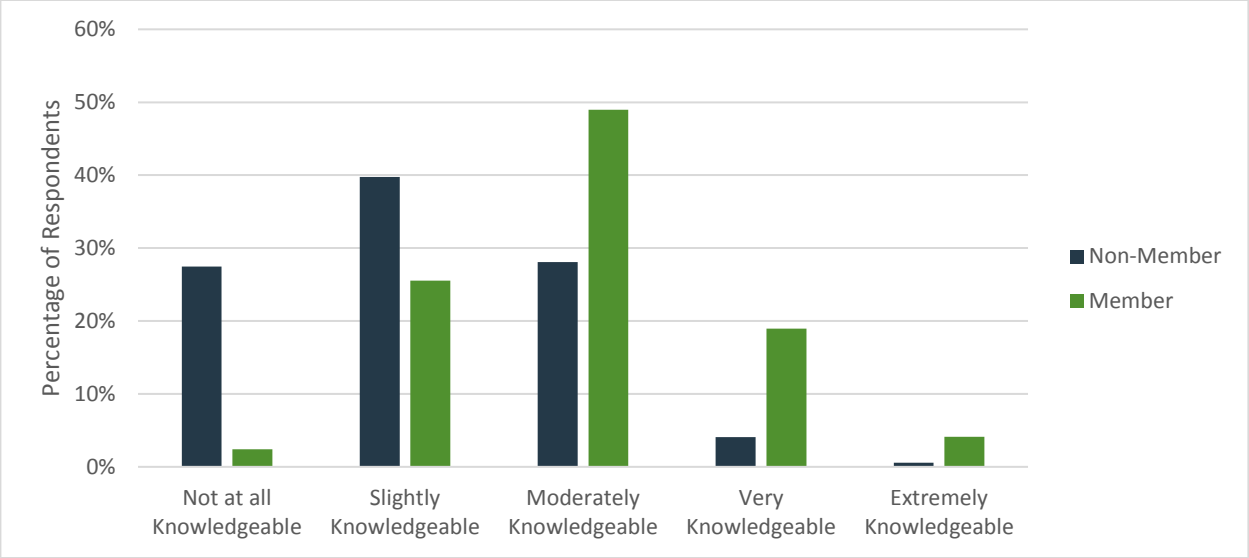


Figure 2.6 Agricultural Cooperative Knowledge across Members and Non-members

Opinions of agriculture cooperatives were rated on a five-point scale: very unfavorable, unfavorable, neutral, favorable, and very favorable. As seen below in *Figure 2.7*, over 80% of the survey respondents are either neutral or favorable towards agricultural cooperatives. Eight percent answered very favorable and only 4% said they feel unfavorable or very unfavorable towards agricultural cooperatives.

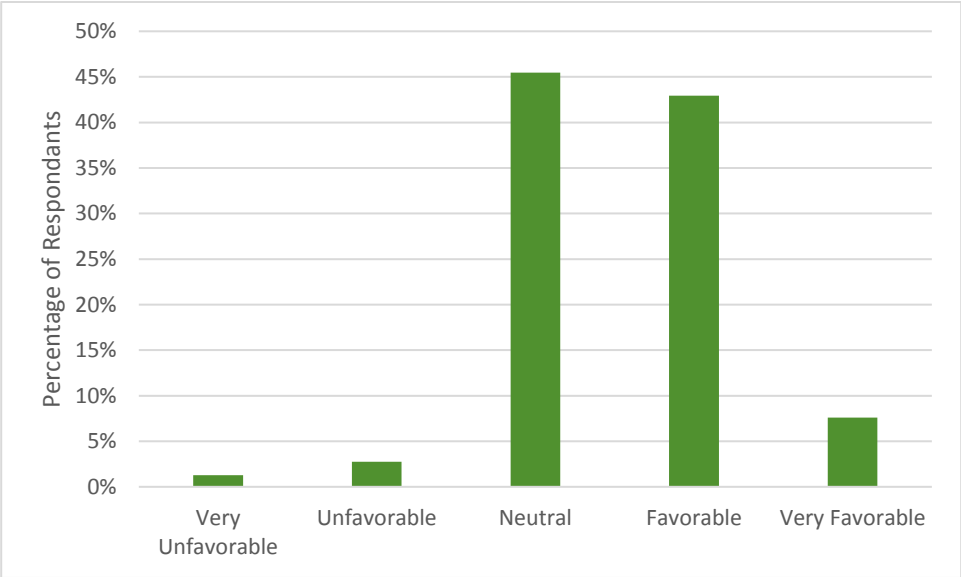


Figure 2.7 Agricultural Producer Knowledge of Agricultural Cooperatives

When split into the two groups, (*Figure 2.8*) it is easy to see that members have a higher opinion of agriculture cooperatives than do non-members. Over 70% of non-members feel neutral towards agricultural cooperatives while over 50% of members feel favorably

towards them. These results suggest that cooperatives have a problem with a negative image among non-members.

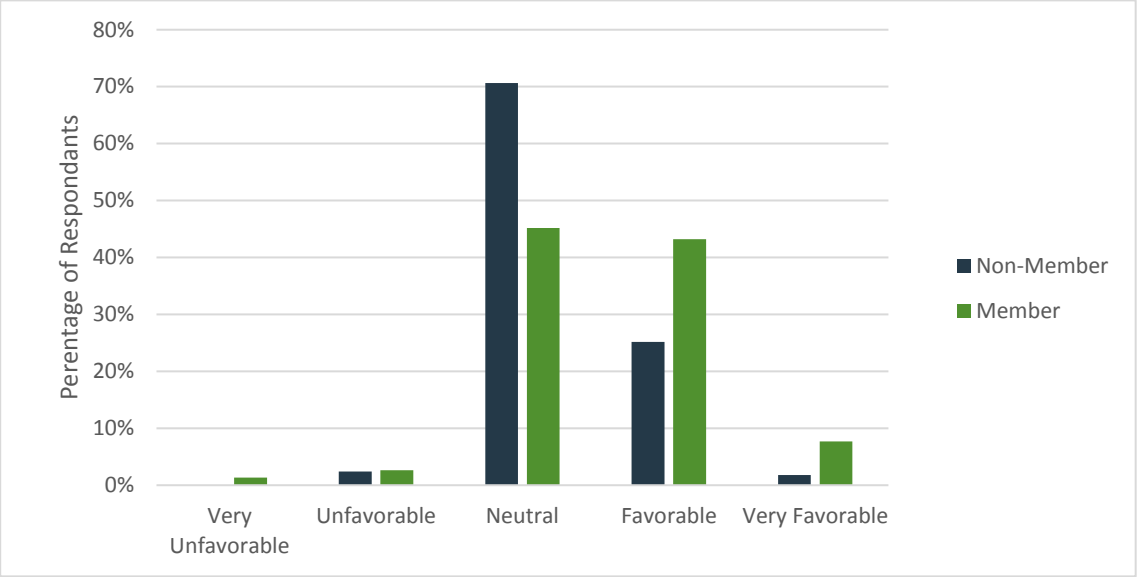


Figure 2.8 Opinions of Agricultural Cooperatives Across Members and Non-members

2.5.5 Importance Ratings of Agricultural Cooperative Value Factors

The survey asked respondents to rate the importance of a set of value factors offered by agricultural cooperatives. The factors are pride/loyalty, access to market, community involvement, reputation of cooperative, ownership of the cooperative, patronage, control of the cooperative, relationship or trust, price competitiveness, and quality of products and services. The importance of the factors was rated by respondents on a four-point scale, four being very important and one being not at all important.

Table 2.15 below shows the number of respondents who rated each factor and the mean and standard deviation of each factor's ratings.

Table 2.15 Descriptive Statistics of Importance Ratings of Cooperative Value Factors

	N	Mean	Std. Deviation
Quality (goods and services)	454	3.30	1.235
Price Competitiveness	457	3.27	1.253
Reputation	457	3.23	1.222
Relationship	453	3.19	1.217
Access	456	3.15	1.249
Ownership	457	2.98	1.185
Control	453	2.90	1.198
Patronage	401	2.88	1.172
Community	455	2.67	1.207
Pride/loyalty	457	2.56	1.29
Other	107	0.75	1.345

* The ratings are as follows: “not very important” is one, “somewhat important” is two, “moderately important” is three, important (which is not included in round two) is 3.5, and “extremely important” is four.

The mean values show that the quality of goods and services is the most important factor followed by price competitiveness, reputation, relationship, and access to market. Pride/loyalty, community, and patronage are the least important factors.

Once again the researchers examine the differences between members and non-members (Table 2.16). Non-members and members both rate pride/loyalty and community as the least important value factors. Members rate quality and price as the most important value factors while non-members rate relationship and quality as most important.

Table 2.16 Member vs Non-member Descriptive Statistics of Importance Ratings of Cooperative Value Factors

	N		Mean		Std. Deviation	
	Non-Member	Member	Non-Member	Member	Non-Member	Member
Pride/loyalty	155	285	2.07	2.85	1.508	1.039
Access	155	285	2.56	3.50	1.594	.810
Community	153	285	2.20	2.95	1.492	.896
Reputation	155	285	2.70	3.52	1.585	.803
Ownership	156	285	2.50	3.27	1.546	.774
Patronage	130	246	2.45	3.13	1.506	.845
Control	154	282	2.45	3.15	1.573	.796
Relationship	153	284	2.72	3.46	1.581	.827
Price Competitiveness	156	284	2.68	3.60	1.620	.795
Quality (goods and services)	154	284	2.73	3.62	1.631	.760
Other	60	41	.44	1.32	1.005	1.657

2.5.6 Business with Agricultural Cooperatives

Another question the survey respondents were asked was if they do business with an agricultural cooperative. Although business and membership often go hand in hand it is possible to do business with an agricultural cooperative without being a member of one, and membership does not require that the member does business with the cooperative. *Table 2.17* shows that 21% of respondents were non-members who do not do business with an agricultural cooperative and 61% were members who do business with an agricultural cooperative. Fifteen percent of respondents are nonmembers who do business with agricultural cooperatives and only 2% were agricultural cooperative members who do not do business with their cooperative.

Table 2.17 Agricultural Cooperative Membership and Business

Row Labels	Non-member	Member	Grand Total
No Business	21.8%	2%	23.7%
Business	15.3%	61%	76.3%
Grand Total	37%	63%	100%

2.5.7 Member and Non-Member Perspective of Agricultural Cooperatives

If the respondent answered they were of member of an agricultural cooperative they were presented with questions dealing with why they joined as well as their loyalty, participation, the importance of their cooperative's benefits and values, and the methods used by the cooperative to communicate with its members. If the respondent answered they were not a member of an agricultural cooperative they were presented with questions regarding why they weren't a member and the importance of cooperatives' benefits and values. *Table 2.17* shows that 63% of respondents are members and 37% are non-members.

In this subsection, the importance of cooperative benefits and values are compared with agricultural cooperative members and non-members. Loyalty, member participation, and how members receive communication from their cooperative are also analyzed.

2.5.7.1 Member Loyalty

Only members of agricultural cooperatives were asked questions regarding loyalty. The respondents were asked how loyal they are to the cooperative model as well as how loyal they are to their agricultural cooperative. The respondents were decidedly more loyal to their

specific cooperative. Fifty-two percent were very or extremely loyal to their specific cooperative while only 36% were very or extremely loyal to the cooperative idea (*Figure 2.9*).

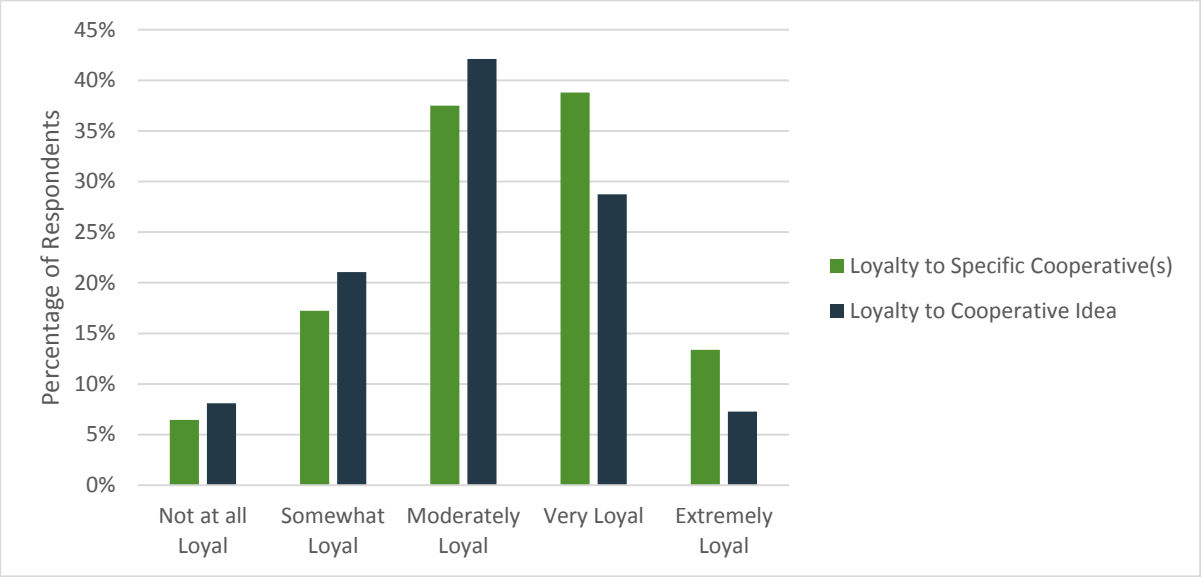


Figure 2.9 Agricultural Cooperative Member Loyalty

2.5.7.2 Member Participation

Agricultural cooperative members were also asked to rate their cooperative participation on a five-point scale: not at all involved, somewhat involved, moderately involved, very involved, and extremely involved. Sixty-nine percent of those who responded to the question answered somewhat involved or moderately involved,6% answered extremely involved, and just under 20% answered not all involved.

The survey asked the respondents a few questions pertaining to their specific participation in their agricultural cooperative. Respondents were asked if they have ever served on their cooperative's board of directors (16%), voted for their board of directors in the last election (61%), and attended their cooperative's last annual meeting (44%). Based on the responses to these questions, the researchers conclude that member's perceived participation is accurately representative of their actual participation.

2.5.7.3 Communication Channels

Additionally, the survey asked members of agricultural cooperatives to rate the importance of the following communication methods used by agricultural cooperatives: face to face, newsletter, website, phone, email, social media, texts, annual meetings, and non-annual meetings. The importance of these communication methods was rated on a five-point scale: not very important (1), somewhat important (2), moderately important (3), important

(4), and extremely important (5). Face to face communication has the highest mean followed by phone, and email. All three of these methods were rated between moderately important and important. Social media and texts have the lowest means, not very important and somewhat important respectively (*Table 2.18*). These results are not surprising considering the average age of agricultural producers is over 50 and individuals in this demographic prefer personal or phone communication.

Table 2.18 Descriptive Statistics of Agricultural Cooperative Members' Importance Ratings of Agricultural Cooperatives' Communication Methods.

		Agricultural cooperative member ratings of communication channels used by cooperatives			
	N	Minimum	Maximum	Mean	Std. Dev.
Face-to-face	263	0	5	3.60	1.38
Phone	268	0	5	3.29	1.34
Email	262	0	5	2.97	1.34
Website	266	0	5	2.92	1.37
Newsletter	267	0	5	2.84	1.23
Annual Meeting	264	0	5	2.75	1.43
Non-Annual Meeting	252	0	5	2.43	1.36
Texts	263	0	5	2.25	1.39
Social Media	261	0	5	1.74	1.12

2.5.7.4 Reasons for Not Being a Member

Survey respondents who answered they are not a member of an agricultural cooperative were asked if they have ever been a member of an agricultural cooperative. Eighty percent of non-members answered no, they have never been a member of an agricultural cooperative.

Non-members of agricultural cooperatives were also asked to rate the importance of the following factors of why they are not members: Loss of independence, dislike of the cooperative idea, pricing, switching costs, other business relationships, inconvenience, unawareness, and feeling undervalued. The scale non-members were asked to rate the factors on was from one to five with the following associations: not very important (1), somewhat important (2), moderately important (3), important (4), and extremely important (5).

The mean for all the factors are just above or under 2.0 (*Table 2.19*). Due to this, the researchers believe that none of the factors are particularly important reasons why these survey respondents are not members of agricultural cooperatives. The researchers speculate that the negative stigma surrounding agricultural cooperatives is more socially driven than

caused by a specific reason and because of that the factors were given low importance ratings. Inconvenience has the largest mean, followed by prices. Dislike cooperative idea has the lowest average. This does not mean that non-members like the cooperative idea, it simply indicates that dislike of it is not an important reason why they are not a member.

Table 2.19 Descriptive Statistics of Importance Ratings of Why Non-members Are Not Agricultural Cooperative Members

	N	Minimum	Maximum	Mean	Std. Deviation
Inconvenience	104	0	5	2.03	2.00
Prices	103	0	5	1.64	1.78
Other Business Relationships	101	0	5	1.59	1.70
Unawareness	104	0	5	1.49	1.64
Lose Independence	105	0	5	1.44	1.62
Switching Costs	102	0	5	1.26	1.52
Undervalued	102	0	5	1.22	1.47
Dislike Cooperative Idea	103	0	4	0.96	1.15

2.5.7.5 Member vs Non-Member Principles and Benefits

Both agricultural cooperative members and non-members were asked to distribute 100 points between three agricultural cooperative principles and three agricultural cooperative benefits based on their importance. *Figure 2.10* below shows the difference in point allocation for principles between members and non-members. Both groups allotted the points in the same order, benefit being the most important, followed by ownership and then control. However, ownership seems to be more important to non-members than members and benefits are more important to members than non-members.

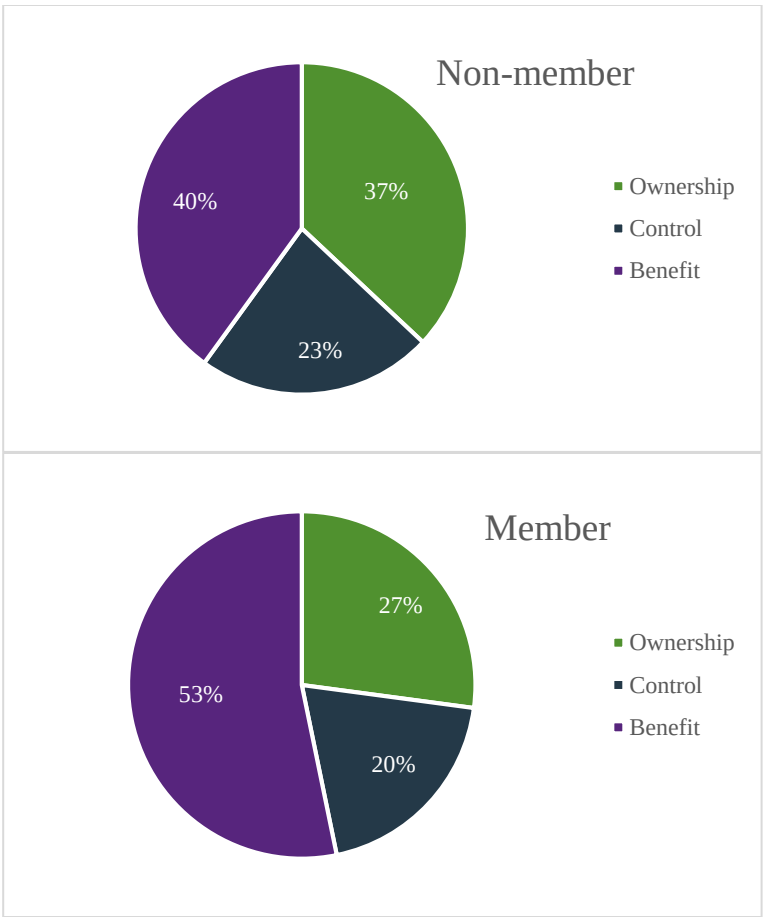


Figure 2.10 Member vs Non-Member Principle Rating

Figure 2.11 below shows the difference in point allocation for benefits between members and non-members. Both groups allotted the points in the same order, price being the most important, followed by quality and then relationship. The groups allocated the benefits points very similarly and had no notable differences.

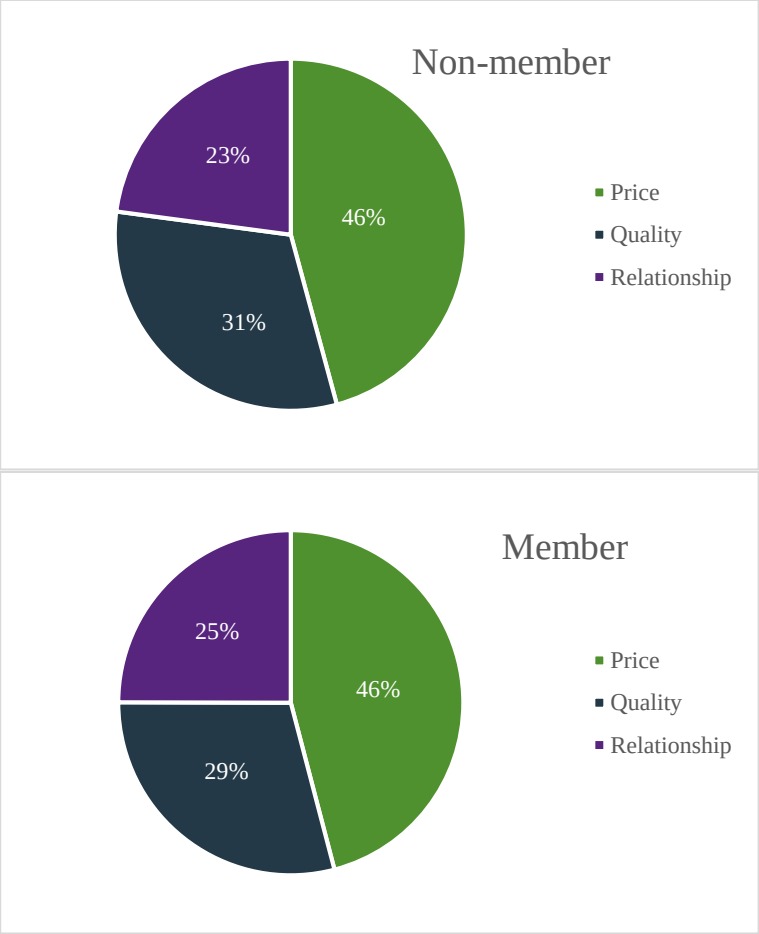


Figure 2.11 Member vs Non-member Benefit Ratings

2.6 Data Analysis

The researchers use the data from the survey to create a Logit model. The entire data set, 628 responses, is used for this analysis. Complete and incomplete responses are included because the questions used in the model are asked at the beginning of the survey. Thus, most of the variables used in the model have data even if the survey is not complete. Cases are excluded list-wise, meaning the entire response is deleted when one variable is not complete, maximizing the number of cases used in the model.

2.6.1 Logit Model Development

The Logit model predicts if an agricultural producer is a member of an agricultural cooperative. The model is developed by the researchers and created in SPSS, a statistical analysis program for social sciences. The researchers only analyze questions that were asked of all agricultural producers, no matter their current and past cooperative membership. *Table*

2.20 shows the variables that were considered for the model. The first column is the question that survey respondents were asked. The second is the name of the corresponding variable. The first row of the table is the dependent variable, and the remining rows are independent variables.

Table 2.20 Variables Names

Question	Variable Name
Are you a member of an agricultural cooperative?	Member or Not (dependent variable)
What is the highest level of education you have completed?	Education
What is your age group?	Age
What is your gender?	Gender
How many years have you been working in agriculture?	Experience
Approximately, what was your gross income from agriculture in 2014?	Ag Income
Did you make more than $50,000 from sources other than agriculture in 2014?	Non-Ag Income Dummy
What is your role in the operation (check all that apply)?	a. Owner b. Operator c. Family Employee d. Employee
Is your agricultural operation family owned?	Family Owned
Are you a member of any of the types of cooperatives listed (check all that apply	a. Ag Input Coop b. Ag Marketing Coop c. Food Coop d. Federal Credit Union e. None Coop
How would you rate your knowledge of agricultural cooperatives?	Knowledge
What is your opinion of agricultural cooperatives?	Opinion
Do you do business with an agricultural cooperative(s)?	Do Business
How important are the following when considering renewing or becoming a member of an agricultural Cooperative?	
Pride and or loyalty	Importance Pride
Access to Market	Importance Access
Community Involvement	Importance Community
Ownership	Importance Ownership
Control	Importance Control
Relationship (i.e. Trust)	Importance Relationship
Price Competitiveness	Importance Price
Quality of Products/Services	Importance Quality
Reputation of Cooperative	Importance Reputation
Patronage of Cooperative	Importance Patronage
Other (optional)	Importance Other
When considering renewing your membership or joining an agricultural cooperative, how much do you value:	a. Ownership b. Control c. Benefit d. Price e. Quality f. Relationship

*First row is the dependent variable of the logit model. Remaining rows are potential independent variables.

The first step in developing the model is eliminating variables that do not belong. Ag Input Coop, Ag Marketing Coop, and None Coop are immediately excluded. Member or Not is highly correlated with the other variables, all having a significant R above 0.4 (*Table 2.21*).

Membership or non-membership of specific types of agricultural cooperatives is essentially measuring the dependent variable with a slightly different version of itself, which does not provide any new information. Therefore, these variables are removed.

Table 2.21 Pearson Correlations of Membership and Cooperative Type

Variable		Ag Input Coop	Ag Marketing Coop	None Coop	Member or Not
Ag Input Coop	*R*	1	.293	-.337	.487
	P		.000	.000	.000
Ag Marketing Coop	*R*	.293	1	-.369	.490
	P	.000		.000	.000
None Coop	*R*	-.337	-.369	1	-.638
	P	.000	.000		.000
Member or Not	*R*	.487	.490	-.638	1
	P	.000	.000	.000	

Food Coop is the next variable that is removed. Only 23 respondents said they were a member of a food cooperative. The researchers conclude that this is too low of a response to provide conclusive data as responses are excluded list-wise in the model, meaning only 23 cases would be considered. The food coop variable is eliminated.

Next, the cooperative principles of ownership, control, and benefit, as well as benefits price, quality, and relationship are evaluated. Survey respondents were asked to split 100 points between the three types of principles, and another 100 points between the three variables of benefits. Because of this, the responses in each group are dependent on one another and cannot all be included in the logit model. The researchers examine how much each variable is related to agricultural cooperative membership using person correlations, (Table 2.22). Control, price, and relationship are eliminated because they are the least significantly correlated with membership of the six variables.

Table 2.22 Principle and Benefit Pearson Correlations

Variable		Member or Not	Ownership	Control	Benefit	Price	Quality	Relationship
Member or Not	*R*	1	-.247	-.087	.244	.007	-.074	.058
	P		.000	.087	.000	.887	.142	.256
Ownership	*R*	-.247	1	.105	-.843	.007	.015	-.021
	P	.000		.038	.000	.896	.772	.679
Control	*R*	-.087	.105	1	-.635	-.097	.113	.015
	P	.087	.038		.000	.055	.025	.763
Benefit	*R*	.244	-.843	-.635	1	.039	-.086	.031
	P	.000	.000	.000		.440	.087	.542
Price	*R*	.007	.007	-.097	.039	1	-.572	-.683
	P	.887	.896	.055	.440		.000	.000
Quality	*R*	-.074	.015	.113	-.086	-.572	1	-.209
	P	.142	.772	.025	.087	.000		.000
Relationship	*R*	.058	-.021	.015	.031	-.683	-.209	1
	P	.256	.679	.763	.542	.000	.000	

Another reason that variables are excluded is strong multicollinearity. Multicollinearity is examined using Pearson two-tailed correlation coefficients with 1 or -1 being perfectly correlated or inversely correlated respectively, and 0 being perfectly uncorrelated. The correlations are tested for significance at the 0.05 level and significant coefficients outside of -0.40 to 0.40 are considered to have high multicollinearity.

The eleven variables asking respondents to rate the importance of value factors offered by agricultural cooperatives, In *Table 2.23*, are highly correlated with each other. This is probably because the questions are very similar, and all of them are measuring the same latent variable, the importance of value factors offered by agricultural cooperatives. Since these variables are highly correlated with each other, they are used in a factor analysis to avoid creating an over-fit model with high multicollinearity.

Table 2.23 Pearson Correlations of Ratings of Importance of Agricultural Cooperative Value Factors

Variable		Pride/ Loyalty	Access to Market	Community	Reputation	Ownership	Patronage	Control	Relationship	Price	Quality	Other
Pride/Loyalty	*R*	1	.687	.656	.657	.710	.533	.652	.640	.606	.647	.306
	P		.000	.000	.000	.000	.000	.000	.000	.000	.000	.001
Access to Market	*R*	.687	1	.727	.787	.797	.591	.752	.807	.783	.798	.168
	P	.000		.000	.000	.000	.000	.000	.000	.000	.000	.085
Community	*R*	.656	.727	1	.698	.716	.561	.668	.654	.648	.692	.217
	P	.000	.000		.000	.000	.000	.000	.000	.000	.000	.026
Reputation	*R*	.657	.787	.698	1	.794	.627	.752	.836	.811	.858	.199
	P	.000	.000	.000		.000	.000	.000	.000	.000	.000	.041
Ownership	*R*	.710	.797	.716	.794	1	.640	.867	.789	.761	.797	.243
	P	.000	.000	.000	.000		.000	.000	.000	.000	.000	.012
Patronage	*R*	.533	.591	.561	.627	.640	1	.599	.642	.635	.650	.144
	P	.000	.000	.000	.000	.000		.000	.000	.000	.000	.177
Control	*R*	.652	.752	.668	.752	.867	.599	1	.760	.719	.754	.262
	P	.000	.000	.000	.000	.000	.000		.000	.000	.000	.007
Relationship	*R*	.640	.807	.654	.836	.789	.642	.760	1	.802	.868	.164
	P	.000	.000	.000	.000	.000	.000	.000		.000	.000	.092
Price	*R*	.606	.783	.648	.811	.761	.635	.719	.802	1	.881	.255
	P	.000	.000	.000	.000	.000	.000	.000	.000		.000	.008
Quality	*R*	.647	.798	.692	.858	.797	.650	.754	.868	.881	1	.231
	P	.000	.000	.000	.000	.000	.000	.000	.000	.000		.017
Other	*R*	.306	.168	.217	.199	.243	.144	.262	.164	.255	.231	1
	P	.001	.085	.026	.041	.012	.177	.007	.092	.008	.017	

2.6.2 Factor Analysis

Factor analysis allows the latent variable of the highly-correlated variables to be included in the model without introducing strong multicollinearity. The eleven value factors included are: Pride/loyalty, access to market, community involvement, reputation of cooperative, ownership, patronage, control, relationship, price competitiveness, quality of goods and services, and other.

2.6.2.1 Factor Analysis Assumptions

Factor analysis assumes 1) the data is interval level, 2) there is no specification error in the model, 3) the sample size is large enough to perform the analysis, and 4) multicollinearity is present (Walker & Maddan 2008). The assumption that the data is interval scaled is violated in this case. However, the variables are Likert type data, meaning they are clearly ordered and are therefore appropriate to use in a Factor Analysis (Walker & Maddan 2008). Specification error occurs when the model's goodness of fit is lacking due to a relevant variable being excluded from the analysis. To avoid specification, error the model is based on logic and real world information about agricultural cooperatives. For example, if the factors are not clearly measuring an underlying structure but are seemingly fitting into the model, they will not be used. This approach, opposed to building a model simply from what the data output is suggesting, helps avoid specification error (Hair et al. 1998).

Hatcher (1994) suggests that for a factor analysis to be reliable, the sample size should be at least five times the number of variables used in the initial analysis. In this case, there are 11 variables, and 628 observations. This is over 57 times the number of variables; therefore, the sample size assumption for factor analysis is met. As seen in *Table 2.23* in *Section 2.6.1* the data has significant multicollinearity; thus, the final assumption for factor analysis is met.

2.6.2.2 Preliminary Analysis

After determining that the assumptions for performing a factor analysis are met, two preliminary tests are performed to confirm that the conclusions regarding the assumptions. The first test is a Bartlett's Test of Sphericity. It tests for multicollinearity between the variables. A significance level of over .05 for Bartlett's Test would indicate the variables are not correlated with each other and therefore not appropriate for factor analysis. *Table 2.24* shows a significance of .000 suggesting that the variables are correlated which each other and factor analysis is an appropriate method for this data.

Table 2.24 KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.932
Bartlett's Test of Sphericity	1468	1740
	55	105
	.000	.000

The second preliminary test the researchers perform on the data assesses if the variables used in the factor analysis are measuring a latent variable or if they are highly correlated by chance (Friel 2007). The test used is the Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO). Low KMO values indicate no latent variable, 0.9 is ideal and anything under 0.5 indicates factor analysis should not be used (Walker & Maddan 2008). *Table 2.24* shows the test resulted in a KMO of .932, an ideal value to conclude that there is in fact a latent variable and a factor analysis can be performed.

2.6.2.3 Unconstrained Factor Analysis

The first factor analysis performed by the researchers is an unconstrained factor analysis. Unconstrained factor analysis does not set the number of factors to be extracted, it lets the statistical program, SPSS in this case, determine how many factors exist based on the eigenvalues of the factors. Groups of variables with eigenvalues greater than one are extracted as factors because they explain a significant amount of variance of the latent variable. The researchers utilize principle component analysis to extract factors and examine how well they explain the variation in the structure they are measuring. Each factor measures an underlying structure that is present in all the variables included in the factor.

The researchers use an oblique rotation for the factor analysis. Oblique rotations allow factors to be correlated to each other. Due to the high degree of correlation that naturally occurs in the data, it is nearly impossible to eliminate it entirely and therefore the researchers decide that forcing the factors to be uncorrelated by using an orthogonal rotation method would produce unnatural results.

Table 2.25 shows the results from the principle component analysis. Based on there being one factor with an eigenvalue above one, SPSS creates one factor. The percent of variance column shows the variance explained by each factor while the cumulative column shows the additional variance explained as each factor is added in. The factor extracted by SPSS explains 77% of the variation in the data.

Table 2.25 Total Variance Explained – Unconstrained Factor Analysis

Initial Eigenvalues				Extraction Sum of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	8.497	77.242	77.242	8.497	77.242	77.242
2	.987	8.977	86.219			
3	.466	4.233	90.451			
4	.358	3.253	93.704			
5	.226	2.050	95.754			
6	.165	1.500	97.254			
7	.109	.989	98.243			
8	.081	.734	98.977			
9	.056	.507	99.484			
10	.037	.333	99.816			
11	.020	.184	100.000			

Table 2.26 shows the loading value for each variable in the Component Matrix. This indicates which variables contribute the most to the factor. Factor loadings can be interpreted as the correlation between the variable and the factor component (Walker & Madden 2008). High factor loading values suggest that the variable is explaining a large amount of the underlying structure that makes up the factor component. *Table 2.26* reveals that all the importance factors are highly correlated with the factor component except for Importance Other.

Table 2.26 Factor Analysis 1 Component Matrix

Factor	Component 1
Importance Pride	.863
Importance Access	.942
Importance Community	.871
Importance Reputation	.974
Importance Ownership	.967
Importance Patronage	.767
Importance Control	.935
Importance Relationship	.947
Importance Price	.949
Importance Quality	.962
Importance Other	.191

2.6.2.4 Final Factor Analysis:

For the final factor analysis, the researchers input only the variables that contributed the most to the factor component in the first constrained factor analysis. These variables are importance pride, importance access, importance community, importance reputation,

importance ownership, importance patronage, importance control, importance relationship, importance price, and importance quality. A new variable is calculated in SPSS using the factor results. This variable will be used in the logit model.

The researchers perform the KMO and Bartlett's Test again on the final analysis to ensure that removing Importance Other did not make the data unfit for factor analysis. *Table 2.27* below shows that Bartlett's Test of Sphericity is still significant at .000 and the KMO value is improved at .95 instead of the .93 in the initial model. These results indicate that the importance factors remaining are a better fit for factor analysis then the entire collection of importance factor variables.

Table 2.27 KMO and Bartlett's Test - Final Analysis

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.953
Bartlett's Test of Sphericity	4024.798	1148.364
	45	10
	.000	.000

Table 2.28 shows that the variables in the factor explain almost 75% of the common variance in the data. This is slightly lower than the 77% in the first analysis but these percentages can be falsely inflated by insignificant variables so the researchers conclude that the final analysis is more accurate and robust. Table 2.29 below shows that all the factor loadings for the final analysis are above 0.7. This indicates that all ten variables are strongly correlated with the factor component.

Table 2.28 Total Variance Explained – Final Analysis

Initial Eigenvalues				Extraction Sum of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	7.485	74.854	74.854	7.485	74.854	74.854
2	.536	5.363	80.217			
3	.491	4.912	85.129			
4	.367	3.668	88.797			
5	.331	3.314	92.111			
6	.224	2.237	94.348			
7	.197	1.966	96.314			
8	.153	1.526	97.840			
9	.126	1.261	99.101			
10	.090	.899	100.000			

Table 2.29 Component Matrix - Final Factor Analysis

Factor	Component 1
Importance Pride	.767
Importance Access	.892
Importance Community	.801
Importance Reputation	.905
Importance Ownership	.916
Importance Patronage	.742
Importance Control	.874
Importance Relationship	.918
Importance Price	.887
Importance Quality	.925

The final step in factor analysis is one for which the process is heavily scrutinized. The researchers decide what underlying structure the factor component is measuring and extract the factor score which represents it. Deciding what the factor score represents is a subjective decision and because of that, many people argue that factor analysis is unreliable. Factor scores can be interpreted in many ways and may not be measuring what the researcher says it is, or could be measuring more than one latent variable. Factor analysis is also criticized with the argument that combining multiple variables loses specificity replaces it with a general measurement.

In this case the researchers are confident in their assessment because all ten of the variables included in the factor component are from the same multi part survey question. The respondents were asked to rate the importance of eleven value factors provided by agriculture cooperatives, these 10 being among them.

The factor score is extracted using the regression method explained by DiStefano, Ahu, Mindrila (2009). In this method, the factor score is the dependent variable in a regression with the factor loadings as independent variables. The independent variable coefficients are calculated by multiplying the inverse of the observed variable correlations by the factor loadings. This method considers the correlation among the variables included in the factor analysis. The factor scores have a mean zero and standard deviation of one.

The factor component in this case is an overall measure of the importance of value factors provided by agricultural cooperatives. The eleven value factors are so highly

correlated with each other, see *Table* 2.23, that they cannot be included in the model as separate variables because they will case falsely inflated measures of fit, making the model unreliable. The factor analysis allows some of the information from the value factors to be included in the model instead of excluding it entirely and the researchers conclude it is a valuable contribution.

2.6.3 Logit Model

After eliminating unfit variables, and creating a new variable from the factor analysis results, the researchers create a logit model using a binary logistic regression function using SPSS. The variables included in the model are: education, age, gender, experience, Ag income, non-Ag income, owner, operator, employee, family employee, credit union, knowledge, opinion, importance factors, Ag coop business, ownership, quality, and relationship.

The logit model includes 290 cases. The null model has a predictive capacity of 67.9% with 197 agricultural cooperative members and 93 non-members. The null predictive capacity shows that if every respondent was predicted to be a member of an agricultural cooperative the model would be almost 68% correct. The actual model's predictive capacity can be seen in Table 2.30. It accurately predicts membership of an agricultural cooperative 91% of the time. 76.3% for non-members and 98% for members.

Table 2.30 Classification Table

			Predicted		
	Observed		Are you a member of an agricultural cooperative?		Percentage Correct
			No	Yes	
Step 1	Are you a member of an agricultural cooperative?	No	71	22	76.3
		Yes	4	193	98.0
	Overall Percentage				91.0

After examining the predictive capacity of the model, the researchers look at the Omnibus Test for model coefficients, another measure of fit. Table 2.31 shows the results of the test. The significance column measures the probability of obtaining the Chi-square value given the null hypothesis that the independent variables in the model have no effect on a respondent's membership to an agricultural cooperative. Since the significance is less than 0.05, the null hypothesis is rejected and the researchers determine that the accuracy of the model is improved with the addition of independent variables.

Table 2.31 Omnibus Test of Model Coefficients

		Chi-square	Degrees of Freedom	Significance
Step 1	Step	203.660	19	.000
	Block	203.660	19	.000
	Model	203.660	19	.000

The Hosmer and Lemeshow test is a measure of fit that tests the predictions of the model against the observed data. An insignificant p-value for a Hosmer and Lemeshow test indicates that the model is a good fit. However even Hosmer and Lemeshow themselves have admitted that their test has some shortfalls. With large sample sizes, it often provides a significant result when the fit is good, and with small sample sizes it provides an insignificant result when the fit is poor (Wuensch 2015). *Table 2.32* shows that the Hosmer and Lemeshow test for the model is significant therefore indicating a poor fit. Given the large sample size used in the model and the other measures of fit indicating differently, the researchers are not concerned with this result.

Table 2.32 Hosmer and Lemeshow Test

Step	Chai-square	df	Sig.
25.149	8	.001	25.149

Another measure of fit that the researchers look at is the Nagelkerke R Square (Table 2.33). The model has a Nagelkerke R Square of .701 which indicates that the model can explain 70.1% of the variation in the outcome. The Nagelkerke R Square is analyzed over the Cox and Snell R Square because the Nagelkerke R Square has a maximum of one and is therefore simpler to interpret. Table 2.34 below presents each variable in the logit model and provides the information needed to create the equation for the model.

Table 2.33 Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	160.226	.505	.706

Table 2.34 Logit Model Variables and Related Statistics

	B	Standard Error	Wald Statistic	Degrees of Freedom	Significance	Exp(B)
Education	-.095	.147	.415	1	.519	.909
Age	.479	.239	4.017	1	.045	1.615
Gender	.409	.533	.589	1	.443	1.506
Experience	-.079	.179	.195	1	.659	.924
Ag Income	.714	.229	9.752	1	.002	2.043
Over $50,000 From Non-Ag	-1.209	.476	6.445	1	.011	.299
Owner	.200	.949	.044	1	.833	1.222
Operator	-.333	.462	.519	1	.471	.717
Employee	1.219	1.069	1.302	1	.254	3.385
Family Employee	.876	.898	.951	1	.329	2.401
Family Owned	.937	.990	.897	1	.344	2.552
Credit Union	.791	.592	1.784	1	.182	2.206
Knowledge	.467	.293	2.541	1	.111	1.594
Opinion	.190	.335	.320	1	.571	1.209
Value Factor Importance	1.008	.288	12.210	1	.000	2.740
Ag Coop Business	5.564	.926	36.094	1	.000	260.895
Ownership	-.004	.021	.041	1	.839	.996
Benefit	.015	.015	.944	1	.331	1.015
Quality	-.019	.012	2.293	1	.130	.982
Constant	-8.540	2.441	12.238	1	.000	.000

2.6.4 Final Logit Model

After examining the results of the first logit model, the researchers eliminate five variables. They remove Owner, Operator, Employee, Family Employee, and Credit Union. These variables are not statistically significant and do not add relevant information to the model. The researchers then perform a second logistic regression with the remaining variables.

The final logit model includes 290 cases. The null model's predictive capacity is 67.9% with 197 members of agricultural cooperatives and 93 non-members. The null model's predictive capacity is identical to the original logit model.

The actual model's predictive capacity is in *Table 2.35*. The final model accurately predicts membership of an agricultural cooperative 89.3% of the time. 73.1% for nonmembers and 97% for members. The final model's predictive capacity is 1.7% less than the original model's. When independent variables are removed from a logistic regression it is expected that the predictive capacity will decrease, in this case the change is very minimal which verifies that the eliminated variables were not contributing relevant information to the model.

Table 2.35 Final Model Classification Table

Observed			Predicted		
			Are you a member of an agricultural cooperative?		Percentage Correct
			No	Yes	
Step 1	Are you a member of an agricultural cooperative?	No	68	25	73.1
		Yes	6	191	97.0
	Overall Percentage				89.3

The Omnibus Test for model coefficients (*Table 2.36*) still has a significance level of less than 0.05, therefore the variables in the equation still significantly increase the model's accuracy.

Table 2.36 Final Model Omnibus Test of Model Coefficients

		Chi-square	Degrees of Freedom	Significance
Step 1	Step	198.007	14	.000
	Block	198.007	14	.000
	Model	198.007	14	.000

The Hosmer and Lemeshow test for the final model has an insignificant p-value indicating that the model is a good fit (*Table 2.37*).

Table 2.37 Hosmer and Lemeshow Test

Step	Chai-square	df	Sig.
1	13.426	8	.098

The Nagelkerke R Square for the final model is in Table 2.38. It is 0.009 less than the Nagelkerke R square in the initial model. This difference is negligent which again shows that the eliminated variables were not significantly contributing to the predictive accuracy of the original model.

Table 2.38 Final Model Summery

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	168.909	.490	.685

A good way to measure the fit of a logit model is to examine the graph of the deviance residuals and predicted probabilities (*Figure 2.12*). The two lines are representative of the error terms for when $Y^i = 1$ (member) and when $Y^i = 0$ (non-member). The error terms are calculated by $e = Y_i - p_i$ where Y^i is a 0 or 1, member or not, and p_i is the predicted probability of Y^i. The error is always positive when $Y^i = 1$ because the predicted probability is less than one. Likewise, the error is always negative when $Y^i = 0$ because the predicted probability is more than zero. Both lines decrease because the error term decreases as the probability of the observed values increase.

In Figure 2.12, most the data point have a deviance value close to zero. This indicates that most agricultural producers who have high (or low) predictive probability of being a member (or nonmember) of an agricultural cooperative are actually members (or nonmembers). This result matches with the classification tables above (Table 2.30) indicating that the model is accurate in predicting if a survey respondent is a member of an agricultural cooperative.

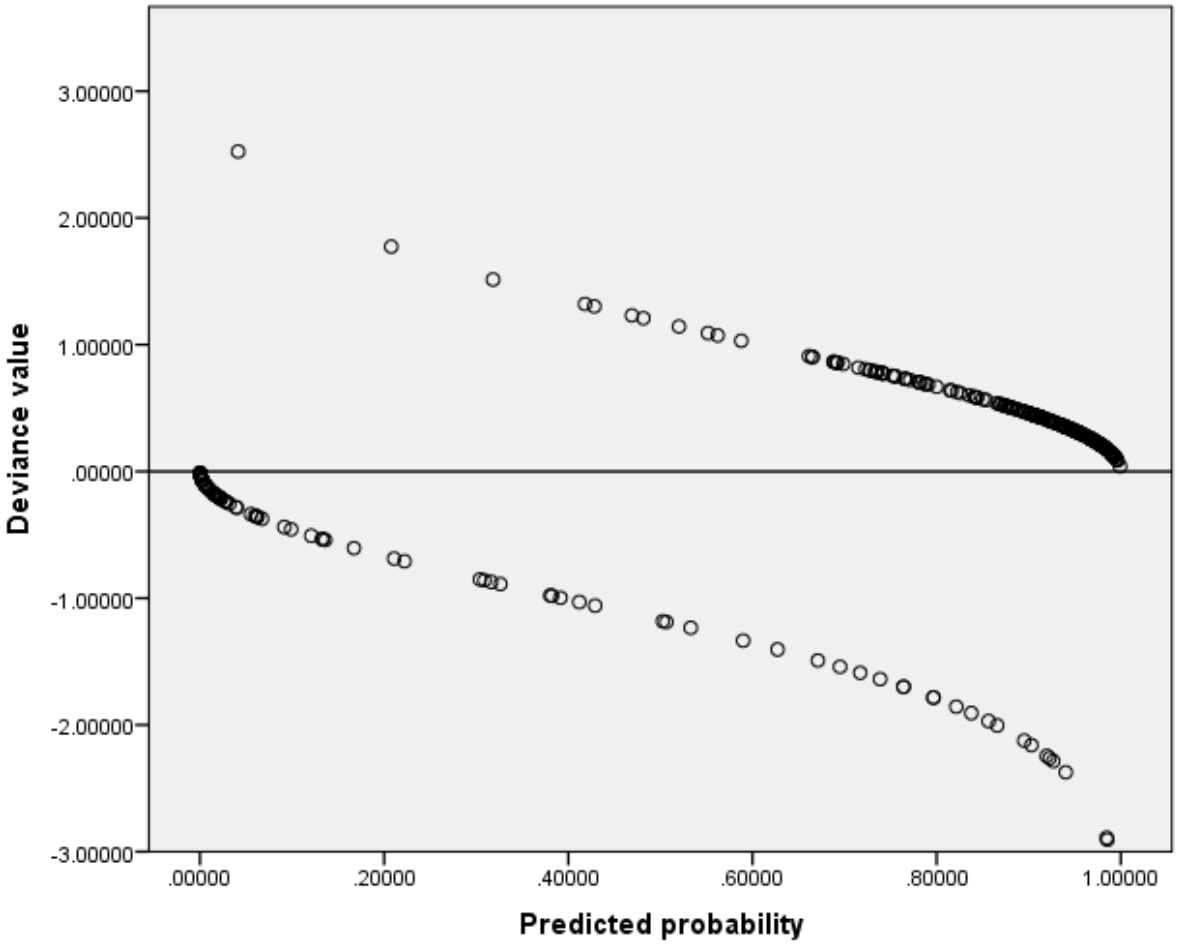


Figure 2.12 Deviance Residuals vs. Predicted Probabilities

The researchers conclude their analysis of the fit of the logit model by looking at two graphs of its characteristics. They first examine the number of cases in each predictive probability group, *Figure 2.13.* The majority of the cases are in the highest group meaning the model predicts that most of the survey respondents are 90-100% likely to be agricultural cooperative members. The second highest number of cases are in the lowest group, maning the model predicts that the second most number of agriculutral producers are 1-10% likely to be an agriculturl cooperative members.

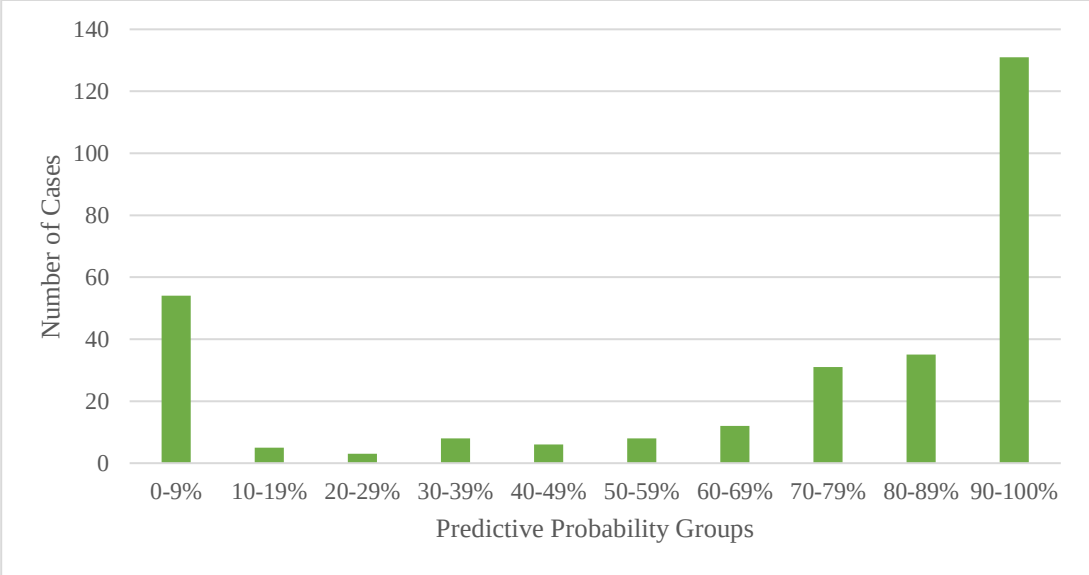


Figure 2.13 Number of Cases per Predictive Probability Group

Figure 2.14 illustrates how accurate the model is, for each predictive probability group. If the predicted probability is less than 50%, the model predicts that the respondent is not a member of an agricultural cooperative. If the predictive probability is equal to or more than 50% the model predicts that they survey respondent is a member of an agricultural cooperative. These predicted values are compared to the actual responses for accuracy. The model's accuracy is over 60% for all groups, and is least accurate in the middle groups which is expected. The closer the model predicts to 50%, the less sure it is if the respondent is a member or not leading to less accurate predictions.

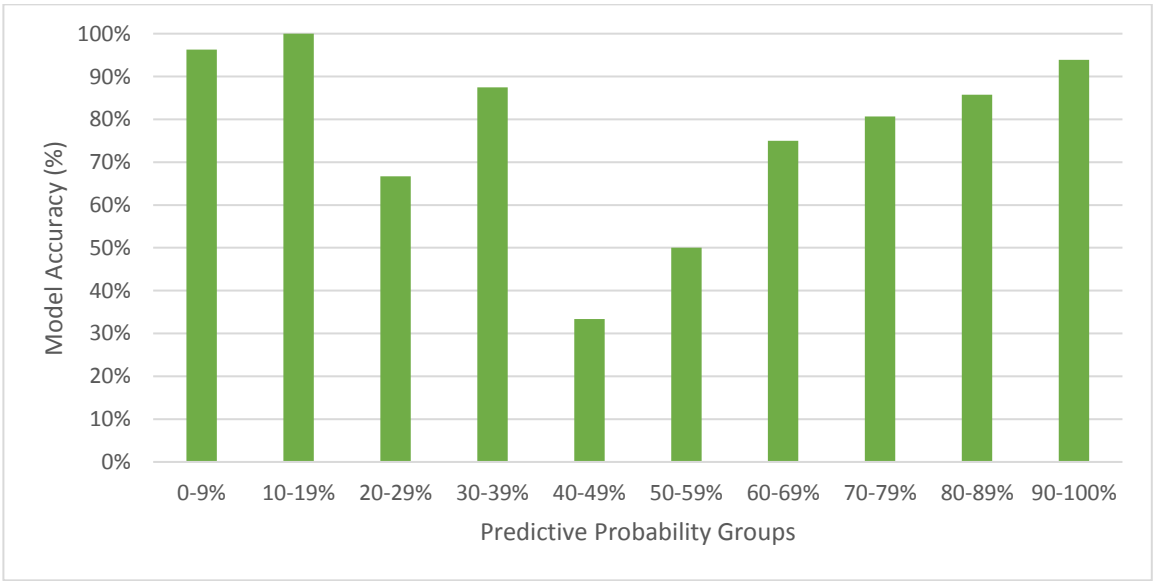


Figure 2.14 Accuracy of Each Predictive Probability Group

Table 2.39 below shows all the variables in the logit model and provides the coefficients for the equation for the model. The equations can be expressed in two forms, linear and non-linear.

Table 2.39 Final Logit Model Variables and Related Statistics

	B	Standard Error	Wald Statistic	Degrees of Freedom	Significance	Exp(B)
Education	-.083	.144	.334	1	.563	.920
Age	.359	.219	2.684	1	.101	1.432
Gender	.400	.511	.612	1	.434	1.491
Experience	-.172	.170	1.022	1	.312	.842
Ag Income	.643	.211	9.261	1	.002	1.902
Over $50,000 From Non Ag	-1.104	.448	6.064	1	.014	.331
Family Owned	1.002	.960	1.090	1	.297	2.723
Knowledge	.469	.288	2.655	1	.103	1.598
Opinion	.247	.319	.604	1	.437	1.281
Value Factor Importance	.972	.278	12.224	1	.000	2.642
Ag Coop Business	5.338	.895	35.551	1	.000	208.186
Ownership	-.007	.020	.123	1	.725	.993
Benefit	.012	.014	.705	1	.401	1.012
Quality	-.018	.012	2.377	1	.123	.982
Constant	-6.858	2.190	9.803	1	.002	.001

Equation 2.7 Linear Form of the Logistic Regression

$$logit[p(x)] = log\left[\frac{p(x)}{1-p(x)}\right]$$
$$= -6.858 - 0.083x_{education} + 0..359x_{age} + .400x_{gender}$$
$$- 0.172x_{expirence} + 0.643x_{ag-income} - 1.104x_{Over\ \$50{,}000\ from\ non-ag}$$
$$+ 1.002x_{famiy\ owned} + 0.469x_{knowledge} + 0.247x_{opinion}$$
$$+ 0.972x_{importance\ value\ factors} + 5.338x_{ag-coop\ business}$$
$$- -.007x_{ownership} + 0.012_{benefit} - 0.018x_{quality}$$

Where p is the probability that the agricultural producer is an agricultural cooperative member.

Equation 2.8 Exponential Form of the Logistic Regression

$$p = \frac{e^z}{1+e^z} = \frac{1}{1+e^{-z}}$$

$$where\ z = -6.858 - 0.083x_{education} + 0..359x_{age} + .400x_{gender} - 0.172x_{expirence} + 0.643x_{ag-income} - 1.104x_{Over\ \$50{,}000\ from\ non-ag} + 1.002x_{famiy\ owned} + 0.469x_{knowledge} + 0.247x_{opinion} + 0.972x_{importance\ value\ factors} + 5.338x_{ag-coop\ business} - .007x_{ownership} + 0.012_{benefit} - 0.018x_{quality}$$

p is the probability that the agricultural producer is an agricultural cooperative member

e is the base of natural logarithms.

The B coefficients (*Table 2.39*) in logit models do not show magnitude of change like they do in traditional regression, however, they do show directionality. The model above shows that advanced education, years in agriculture, making over $50,000 form a non-agricultural source, and valuing the ownership, and quality of a cooperative decrease the likelihood that a respondent is a member of an agricultural cooperative. The remaining variables increase the probability that the respondent is a member of an agricultural cooperative.

The next column in *Table 2.39*, the standard error, is used to calculate the Wald Statistic, which is a chi-squared statistic that is used to determine the significance of the variable. The significance levels indicate that income from agriculture, making over $50,000 from non-agriculture, the factor score of importance levels, and doing business with an agricultural cooperative are statistically significant at the 0.05 level.

The final column in *Table 2.39*, Exp(B), indicates the magnitude of change for each variable. The magnitude is calculated by raising the base of the natural log to the B^{th} power. For example, let's look at the age variable. Its B value is .359. its Exp(B) value is 1.432 and: $e^{.359} = 1.432$. This indicates that for every age group the respondent has surpassed (18-25 years, 26-35 years, 36-45 years, 46-55 years, 56-70 years and 70+ years) the individual is 1.49 times more likely to be a member of an agricultural cooperative.

The information in *Table 2.39* can also be used to calculate the odds ratio for each variable. Let's calculate the odds ratio for the dummy variable of the individual making over $50,000 from a non-agricultural source as an example:

$$log\frac{p_i}{1-p_i} = -6.858 + -1.104x_{Over\ \$50{,}000\ from\ non-ag}$$

Exponentiate both sides:

$$ODDS = \frac{p_i}{1-p_i} = e^{-6.858-1.104x_{Over\ \$50{,}000\ from\ non-ag}}$$

Examine for member ($x_{Over\ \$50{,}000\ from\ non-ag} = 0$):

$ODDS = \frac{p_i}{1-p_i} = e^{-6.858-1.104(0)}0.$

$$ODDS = \frac{p_i}{1-p_i} = 0.00105$$

and not member ($x_{Over\ \$50{,}000\ from\ non-ag} = 1$):

$$ODDS = \frac{p_i}{1-p_i} = e^{-6.858-1.104(1)}$$

$$ODDS = \frac{p_i}{1-p_i} = 0.00035$$

Covert odds to probabilities:

$$\hat{Y} = \frac{ODDS}{ODDS+1} = \frac{0.00105}{1.00105} = 0.00149$$

$$\hat{Y} = \frac{ODDS}{ODDS+1} = \frac{0.00035}{1.00035} = 0.0035$$

This shows that the model predicts that 0.14% of agricultural producers that do not make over $50,000 from a non-agricultural source are members of agricultural cooperatives, and 0.35% of agricultural producers that make over $50,000 from a non-agricultural source are members of agricultural cooperatives.

The odds ratio is found by dividing the two odds:

$$\frac{0.0035}{0.00149} = 0.331$$

Which is the same value as the Exp(B) value in *Table 2.39*. The odds ratio can be calculated for all the binary variables in this manner. For non-binary variables with x_i being equal to something other than 0 or 1, the odds ratio is calculated by the exponential of the coefficient B Model Assumptions

Logistic regression assumptions are slightly different than those of Ordinal Least Squares (OLS) regression. Logit models don't assume a linear relationship between the

dependent and independent variables like OLS does. Logit models do not assume that variables or error terms are normally distributed and they don't require heteroskedastic variances (Pohlman & Leitner 2003). Logistic regression can use ordinal and nominal data as independent variables, unlike OLS that requires metric independent variables (Statistic Solutions 2014). The following list is the assumptions that must be met by logit models.

1. The dependent variable must be binary. The dependent variable in this case is yes, no question, so this assumption is met.
2. The probability of the event occurring (the respondent being a member of an agricultural cooperative) is $P(Y = 1)$ and the dependent variable needs to be coded to agree with this. In the data for this model 0 = not a member of an agricultural cooperative and 1 = agricultural cooperative member so this assumption is met.
3. The model needs to be properly fitted. The model should only contain relevant variables and no variables should be left out. Although the researchers determined that that model has strong goodness of fit in *Section 0,* they examine it again, graphically to ensure this assumption is met. *Figure 2.15* illustrates the predicted probability and the observed data. The data is in two straight lines because of its binary nature. Most of the data points for members are clustered around predated probability of 1, while most of the data points for nonmembers are clustered around predicted probability of 0. This suggests that the model puts members and nonmembers in their correct categories most of the time. In a perfect world the Loess curve on the graph would be a straight line, however, since the data in this model had more members than nonmembers it is distorted. The predictive capacity of the model shows that it correctly predicts for this distortion allowing the researchers to conclude that the assumption is met and the model is properly fitted.

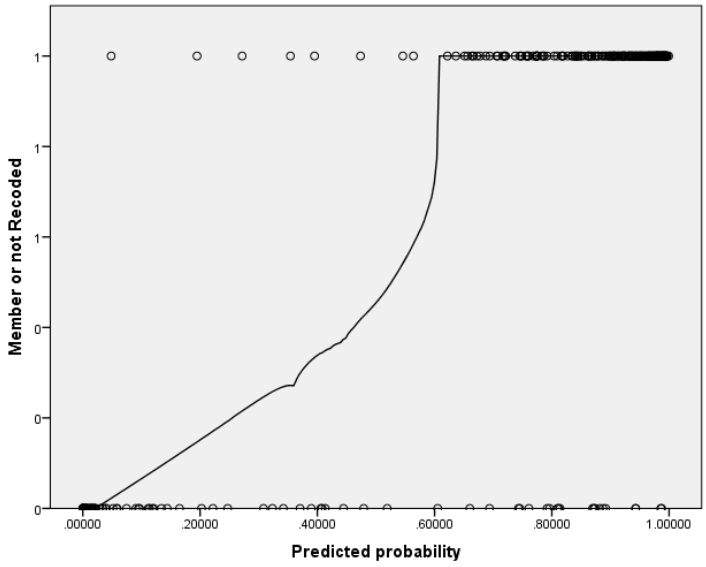


Figure 2.15 Logit Model Observed Values and Predicted Probability

4. Error terms are independent of each other (Statistics Solutions, 2014). To test if the error terms are independent of each other the researchers examine a graph of the

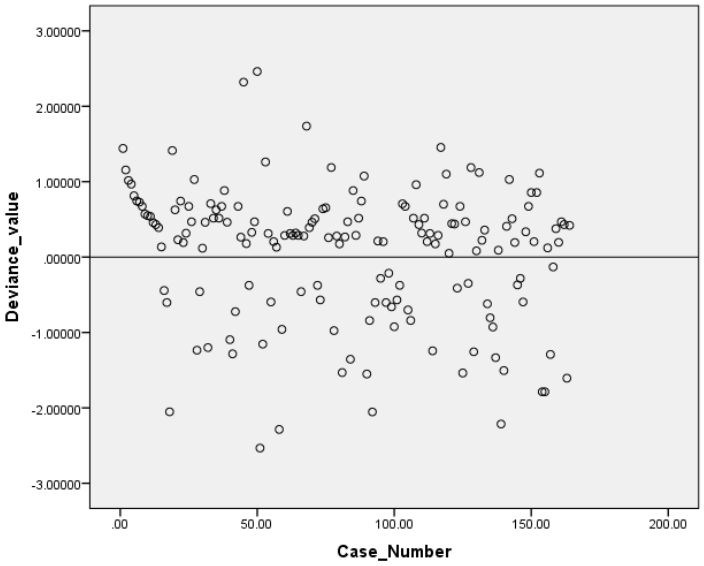
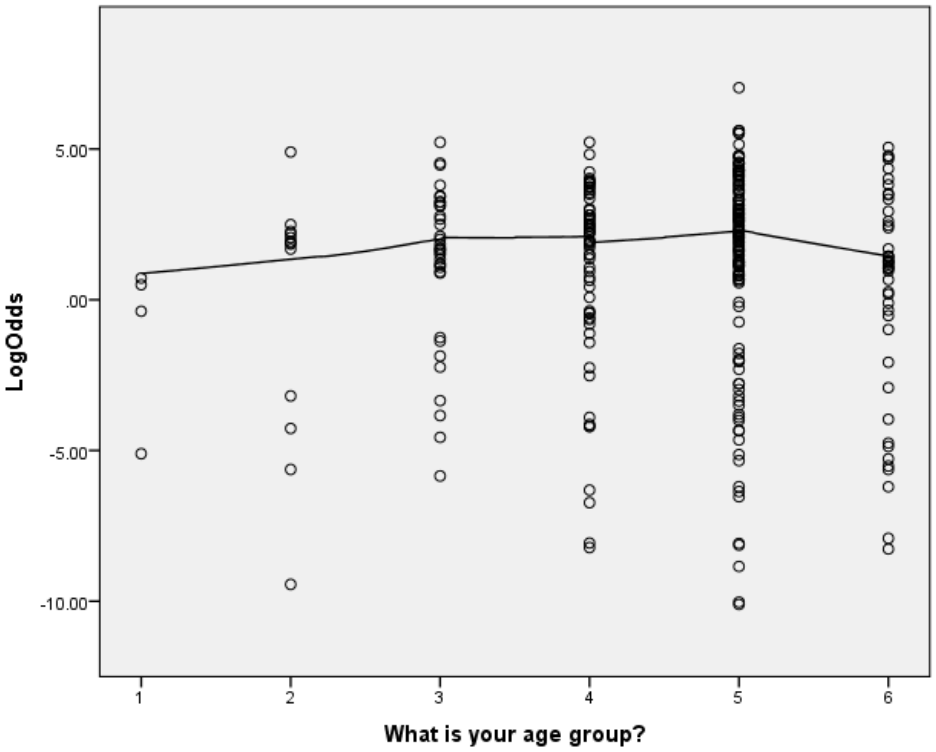
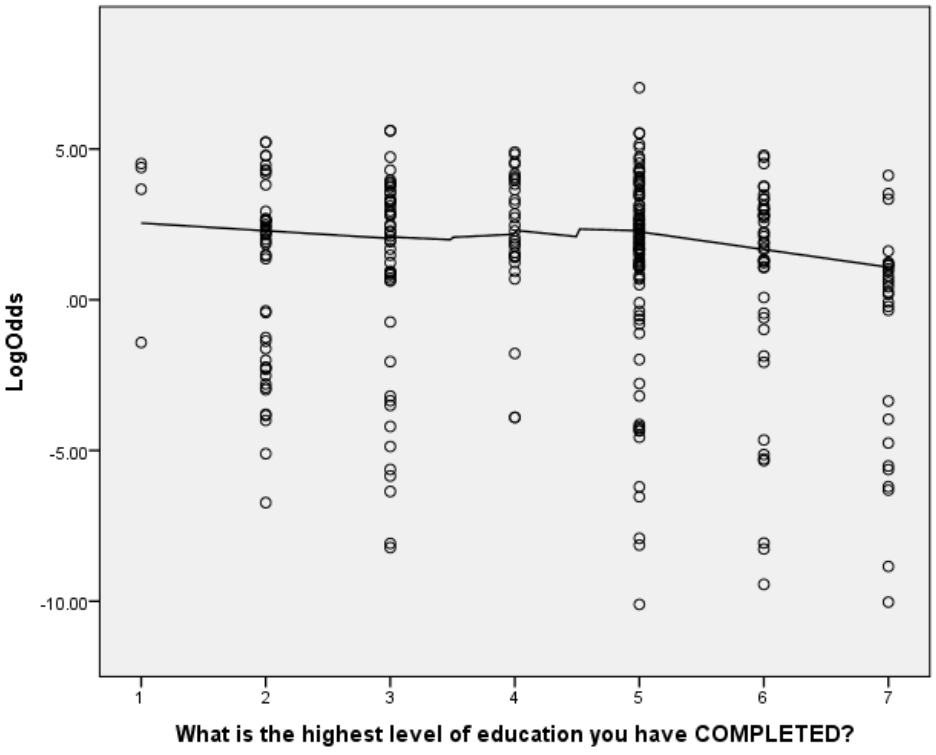


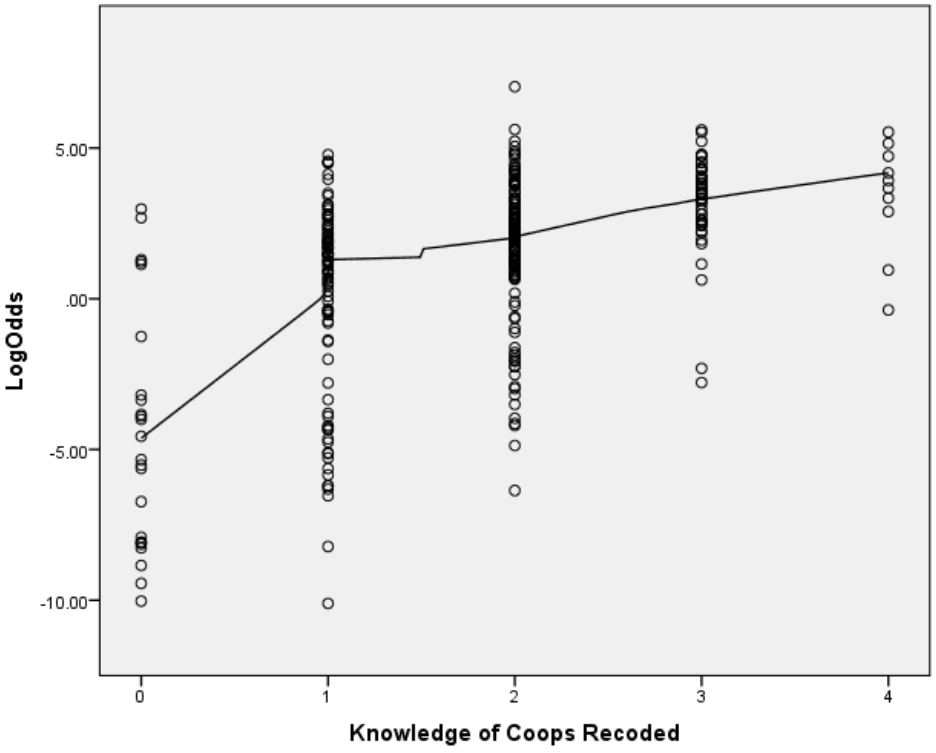
Figure 2.16 Index Plot of Deviance Residuals

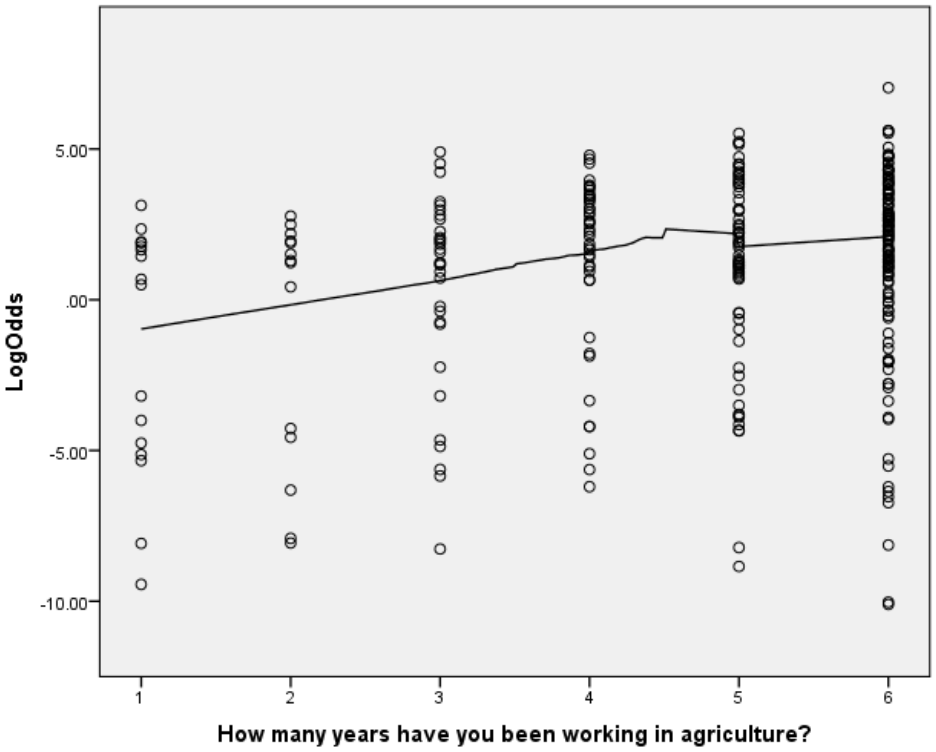
deviance individuals. Each response was assigned a number based on the survey start time to create an index plot. *Figure 2.16* below shows the plot of deviance residuals. There is no evidence of a pattern in graph of the residuals. Therefore, the error terms are independent and this assumption is met.

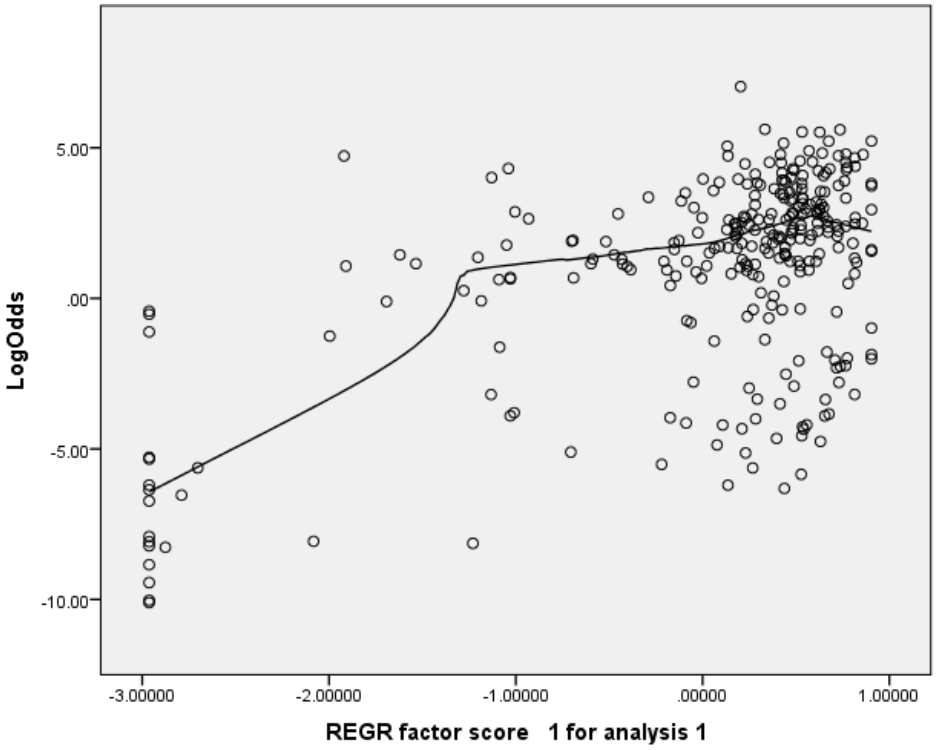
5. There is a linear relationship between independent variables and log odds (Statistics Solutions, 2014). The log odds are calculated by taking a common logarithm of the odds: $\log(\frac{p_i}{1-p_i})$. Binary variables are always assumed to have a linear relationship with log odds so they are excluded from this analysis. The graphs below show the log odds graphed with each non-binary variable. The fitted loess curves (Fit to 66% of the data points) for each variable are mostly straight lines with little curvature. This indicates that there is a linear relationship between the log odds and the independent variables and this assumption is met.

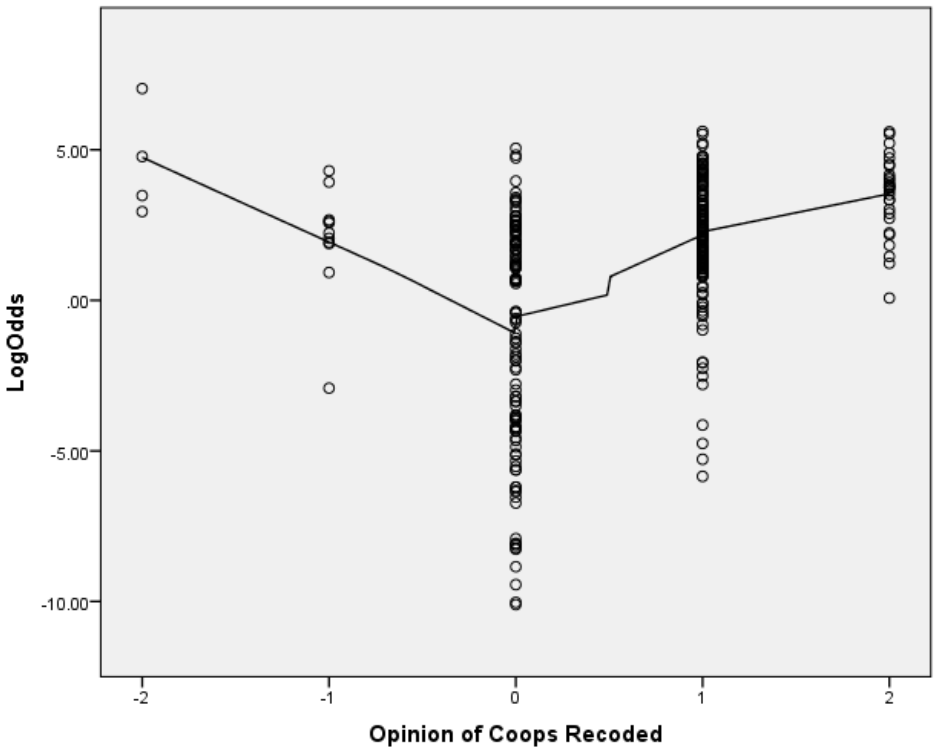

LogOdds
5.00
.00
-5.00
-10.00
1
2
3
4
5
6
What is your age group?

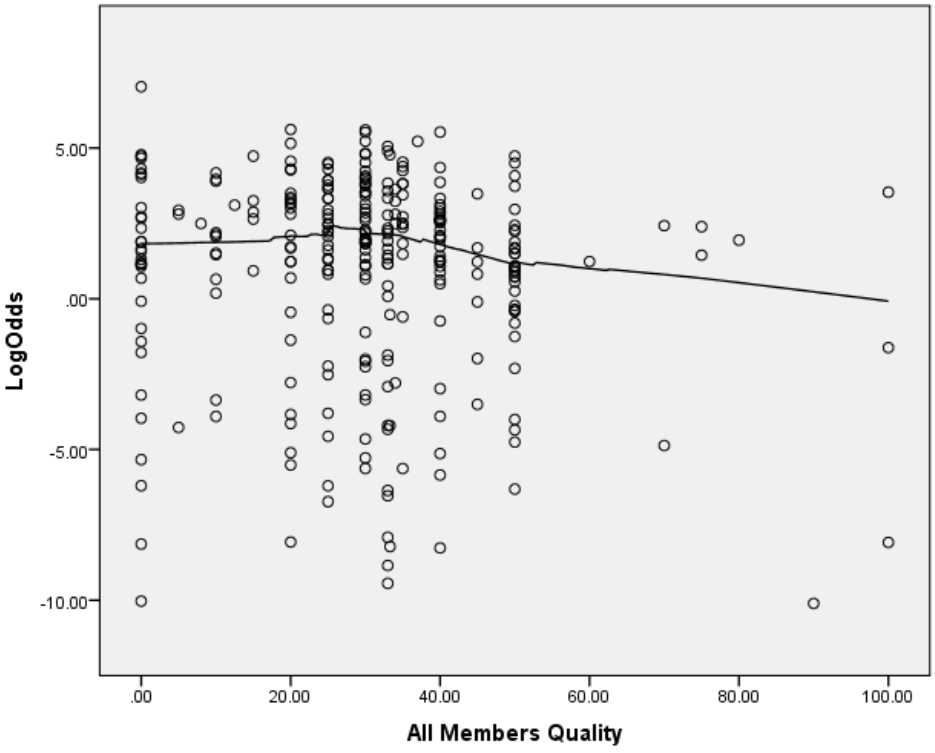

LogOdds
5.00
.00
-5.00
-10.00
1
2
3
4
5
6
7
What is the highest level of education you have COMPLETED?

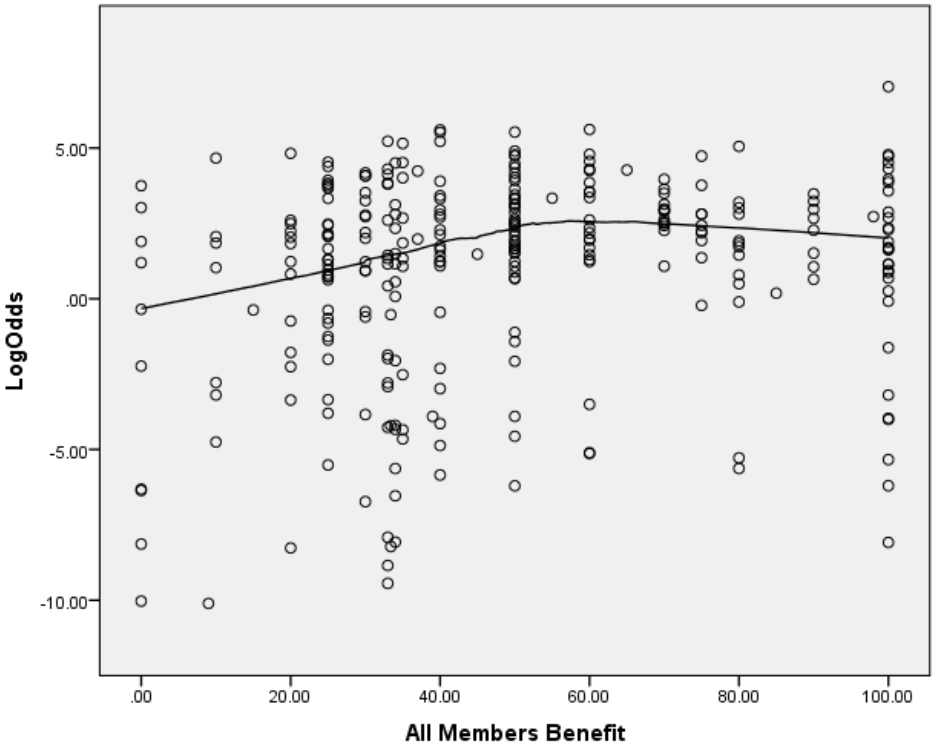

LogOdds
5.00
.00
-5.00
-10.00
0
1
2
3
4
Knowledge of Coops Recoded

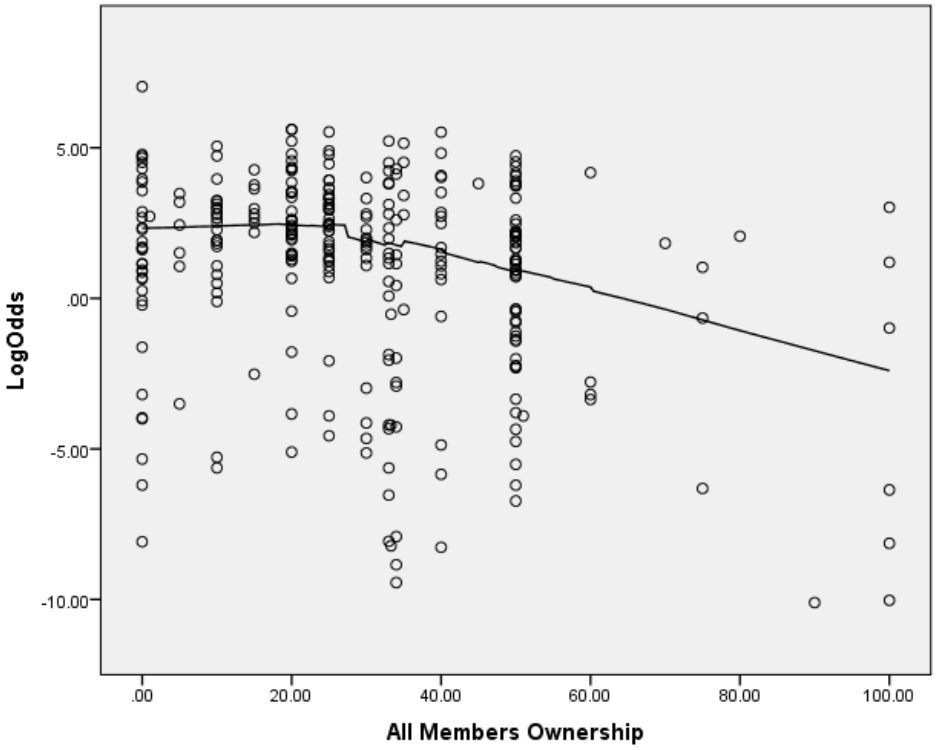

LogOdds
5.00
.00
-5.00
-10.00
1
2
3
4
5
6
How many years have you been working in agriculture?

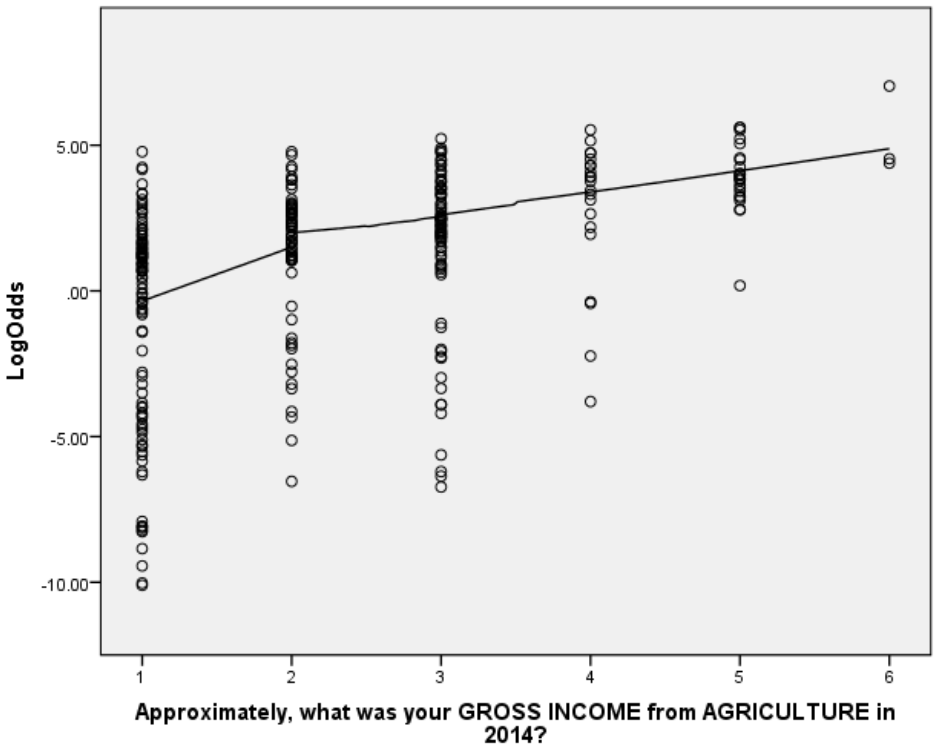

LogOdds
5.00
.00
-5.00
-10.00
-3.00000
-2.00000
-1.00000
.00000
1.00000
REGR factor score 1 for analysis 1


LogOdds
5.00
.00
-5.00
-10.00
-2
-1
0
1
2
Opinion of Coops Recoded


LogOdds
5.00
.00
-5.00
-10.00
.00
20.00
40.00
60.00
80.00
100.00
All Members Quality


LogOdds
5.00
.00
-5.00
-10.00
.00
20.00
40.00
60.00
80.00
100.00
All Members Benefit


LogOdds
5.00
.00
-5.00
-10.00
.00
20.00
40.00
60.00
80.00
100.00
All Members Ownership


LogOdds
5.00
.00
-5.00
-10.00
1
2
3
4
5
6
Approximately, what was your GROSS INCOME from AGRICULTURE in 2014?

6. No problems with multicollinearity exist (Statistics Solutions, 2014). To test for multicollinearity the variance inflation factors (VIFs) are examined. VIFs are found using a linear regression with independent variables replacing the dependent variable. Each independent variable is used as the dependent variable in a series of tests. If VIFs are over three than multicollinearity may be present in the data. In this data all of the VIFs were under two, most being very close to one so the researchers conclude that multicollinearity is not a problem in this data.
7. The sample size is large enough for the number of variables used. The logit model uses 291 cases and 19 variables. This is a 15.31 case to variable ratio which exceeds the ideal 10/1 ratio so this assumption is met (Kellogg School of Management at Northwestern University, 2016).

All the assumptions for the logit model are met. The researchers can now safely draw conclusions from the model.

2.7 Conclusions and Implications

Retaining and gaining membership is becoming increasingly difficult for agricultural cooperatives. This research developed a logit model that helps identify characteristics of individuals that are most likely to become a cooperative member, which helps cooperatives identify producers who are ideal prospects.

2.7.1 Summary of Survey Data

The data for the research came from a survey of agricultural producers in the Northwest United States. The goal of the survey is to discover how agricultural cooperative members and non-members perceive the value of agricultural cooperatives. Examining the differences between the views of members and non-members helps identify some misconceptions that non-members may have which helps cooperatives better communicate their value package to non-members.

Very few survey respondents viewed agricultural cooperatives as very unfavorable or unfavorable. This indicates that agricultural cooperatives don't need to put effort into combating a negative public image. Fifteen percent of survey respondents reported doing business with agricultural cooperatives but not being members. Researchers recommend targeting these individuals since they already understand the value offered by cooperatives

through doing business with them. Now they need to be shown the value of becoming a member.

Agricultural cooperative members value the benefits offered by cooperatives twice as much as they value ownership and the control. Non-members differ slightly here. They value benefits and ownership equally and control about half as much as the other two. This suggests that cooperatives can target non-members by showcasing the ownership that being a member of a cooperative provides.

Both members and non-members value the price benefits cooperatives provide far above those of quality and relationship. Non-members of cooperatives reported inconvenience and price to be the biggest reasons why they are not members. Agricultural cooperatives should focus on communicating to non-members how the benefits of becoming a member outweigh the costs.

2.7.2 Summary of Model

Using the data from the survey, the researchers create a logit model that predicts if an agricultural producer is a member of an agricultural cooperative. The model uses the following 14 variables to make the prediction: education, age, gender, experience, income from agriculture, if the producer makes over $50,000 from non-agriculture, if the operation is family owned, the respondents rating of their knowledge of cooperatives, the respondents rating of their opinion of cooperatives, a factor score of the respondents rating of 11 value factors provided by agricultural cooperatives, if the respondent does business with an agricultural cooperative, and the amount of importance the respondent places on quality, relationship and ownership of agricultural cooperatives. Some of the variables included in the model are insignificant at the .05 level, indicating they don't statistically contribute to the model. However, they provide important information in that they identify traits of agricultural producers that do not affect their cooperative membership. A robustness check, in the form of a logit model with only significant variables is in *Appendix B.* It confirms that the inclusion of the insignificant variables is not having a large effect on the results.

The model identifies important traits that determine if an agricultural producer is likely to be a member of an agricultural cooperative. The remainder of this section will discuss each variable in the model and that variable's impact on the probability of an agricultural producer being a member of an agricultural cooperative.

The higher an individual's income from agriculture, the more likely they are to be a member. Agricultural cooperatives should target producers with successful agricultural operations. Cooperatives should show these producers how being a member makes them successful so that their perception of their operation's profitability is tied to cooperative membership.

Individuals who make over $50,000 annually from nonagricultural sources are less likely to be agricultural cooperative members than those who make under $50,000 annually from nonagricultural sources. Agricultural cooperatives should not spend their efforts trying to recruit membership from hobby farmers and those who have other occupations that supply their main source of income.

The higher an individual's importance rating of the value factors offered by agricultural cooperatives is, the more likely they are to be a member. Agricultural cooperative should target individuals who value what cooperatives offer when recruiting members. These value factors are: pride, community, access, reputation, ownership, patronage, control, relationship, price, and quality. These values are intangible, and therefore hard to identify in potential members, however, if agricultural cooperatives market their value package, they can reach potential members that value what they offer through communication.

Most producers who do business with agricultural cooperatives are also members. However, doing business with cooperatives and being a member are not mutually exclusive. The researchers recommend that coops target non-members that already do business with agricultural cooperatives as these individuals already understand the cooperative value package.

The following variables' p-values are over .05 indicating they do not have a statistically significant impact on cooperative membership. Therefore, they should not be considered when identifying potential members of agricultural cooperatives.

1. Age
2. Education
3. Gender
4. Ag Experience

5. Family Owned
6. Knowledge
7. Opinion
8. Ownership
9. Benefit
10. Quality

2.7.3 Implications

The results of the logit model and survey analysis allow researchers to outline steps for cooperatives to follow when recruiting new members. The following list, created from the results of the logit model, is ordered from most to least impact that the variable has on the probability of an individual being an agricultural cooperative member. Following these steps will help agricultural cooperatives maximize their efficiency when converting non-members to members.

1. Target individuals who already do business with agricultural cooperatives but are not members. These non-members are knowledgeable about the cooperative culture and are willing to work with cooperatives, they simply need to be convinced of the value of becoming a member.
2. Target individuals who give high importance to the following cooperative value factors: pride, community, access, reputation, ownership, patronage, control, relationship, price, and quality. These non-members see the importance of the value package that cooperatives offer and need to be shown that they will receive these values by becoming members. This can be done using marketing materials that clearly convey how the cooperative offers these benefits.
3. Target individuals who earn a high income from agriculture and communicate to non-members that current members earn high income from their operations. Marketing to individuals that make a large income from agriculture increases the chances that they will become members. Showing non-members that current members make a high income from agriculture suggests that agriculture cooperative patronage increases the profitably of producer's operations.

4. Target individuals who generate most their income from agriculture. These producers are more likely to become members than hobby farmers. They are also more likely to be involved in the cooperative as they have more at stake in its success.

2.7.4 Limitations

The main limitation in this study is its geographic coverage. Most of the survey respondents are pacific northwest agricultural producers. The results of this research may not be generalizable to areas outside of the Pacific Northwest United States.

A secondary limitation of this research is that there are many different types of agricultural cooperatives and the model was generalized across them. The results may not be generalizable across all types of agricultural cooperatives. If the results were controlled for specific cooperatives types more detailed conclusions could be reached.

2.7.5 Further Research

This research can be expanded in two directions. First, the study could be conducted again with a survey that reaches a larger geographic area. This would provide a robustness check for the current project as well as provide results that could be presented to a wider audience. Second, the model could be refined to control for different types of cooperatives which would add a dimension of detail to the current research. In addition, the importance value factor rating could be considered in detail in future research. Further researchers could look at each value factor individually and develop ways to help agricultural cooperatives convey their value package to members.

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Chapter 3. An Analysis of Local Tomato Demand in Rural and Urban Areas

3.1 Introduction

A large local food movement has emerged in the United States over the last decade (Brian 2012). The movement is driven by demand for healthy, fresh, food that supports local economies (Guptill & Wilkins 2002). At the beginning of the movement, local foods were sold almost entirely through direct marketing channels, meaning consumers bought goods straight from producers (Jewett, Neslon, & Braaten 2011). Whereas these direct markets offer a substantial number of customers, the mass of food consumed is accessed through indirect channels like grocery stores and restaurants. Fortunately, today the local movement has grown so that indirect sales channels such as grocery stores and restaurants are a viable way for producers to distribute local products. Many individuals are focusing on building local food hubs, but is there enough of a market for this endeavor to be worth wile? The exact market size in a region is often unknown. This research effort looks at the amount of acreage needed to supply local markets with produce to better understand the potential impact of such efforts.

Getty (2014) explains a popular method of estimating a firm's market size for a retail good, Total Available Market (TAM), Serviceable Available Market (SAM), and Serviceable Obtainable Market (SOM). This method of market estimation starts with a very wide market; TAM is the total consumption of the retail good within the market area. SAM narrows the estimate of TAM to the niche that the retail good is targeted towards. SOM further specifies the estimate to the number of consumers within the niche that the good can realistically reach given its availability (Getty 2014). In this chapter, the concepts of TAM, SAM, and SOM are modified to estimate the market size for an entire region instead of an individual firm. The SOM is then used to calculate the production required to supply the market.

Calculating TAM, SAM, and SOM provides an educated estimate of the market size for a good, but it does not guarantee it will be profitable. A breakeven analysis helps determine if a good will be profitable. Breakeven analyses can be used to calculate how many customers are needed to support a good. The number of customers needed to support a good is referred to as the threshold population (Garrison 1958). Breakeven analyses are different in urban and rural areas. Urban areas have larger populations and can more easily offer specialized products while rural areas have less competition among goods and firms. The

threshold population is the customer base for one firm, but comparing it to the total population helps determine how many firms the total market area will support.

Threshold population is also used to calculate the demand threshold. Demand threshold is the minimum geographic market size needed to support a good (Rodrigue, Comtois & Slack 2013). The threshold population is located within the area of the demand threshold.

The exact numerical data needed to calculate the market size and breakeven thresholds for a good is often unavailable, forcing market analysts to make assumptions when completing estimates. If assumptions are not made carefully, they can lead to large errors in market estimates that can cause goods to fail (Barnett 1988). It is important to understand how assumptions are affecting the outcome of the market estimate. This way, analysts understand which assumptions the estimate relies on most, and how the estimate changes if the assumptions are incorrect.

This chapter outlines a method for calculating the regional market for local produce within a defined geographical area. It explains how the traditional definitions of TAM, SAM, SOM, threshold population and demand threshold are utilized to develop a method of calculating local produce demand for an entire region. Regional demand size allows the researchers to calculate how many firms selling local produce the area can support, and the amount of acreage required to supply the market.

The calculations in this chapter make many assumptions about the market environment but they are presented in a way that allows users to constrain and relax them and see how the market size is affected. There are distinct differences between urban and rural markets caused by contrasting demographics, culture, and access to goods (Strain 2016). The assumptions made in the calculations are slightly different for urban and rural areas to account for this.

In the existing literature, there are works that define TAM, SAM, and SOM, but there are no specific explanations of how to calculate these concepts. This chapter contributes to the literature by outlining a method of using TAM SAM SOM, threshold population, and demand threshold to calculate regional demand for local produce. The method used to create a calculator that can be used by any business or individual interested in calculating how much of a local produce item is consumed in their geographical area.

The remainder of this paper consists of five sections. The second section is a review of the current literature on local foods, TAM, SAM, SOM, demand threshold, and population threshold. An overview of the methods used in this study as well as a discussion of the assumptions made in the calculations is in section three. Section four discusses two examples of calculating TAM SAM SOM, one in a rural setting and one in an urban one. The final section explains the implications of the results of section four and provides details about the excel calculator that can be used to calculate the market size for any locally grown produce item.

3.2 Review of Literature

The following review of current literature provides background information on the importance of local foods and the market estimation methods that are used in this chapter. It begins by defining local foods and examining their current trends. Next it provides a detailed explanation of TAM, SAM, and SOM. Finally, this section provides an overview of central place theory and its underlying concepts and limitations.

3.2.1 Local Foods

Local foods service a niche market of consumers who are willing to pay a premium price for goods that they feel positively impacts their personal health, community economy, and environment (Guptill & Wilkins 2002). This niche market has seen significant growth in the last decade, providing an opportunity for producers to sell their goods at a higher price to individuals their region (Martinez et al., 2010).

There is no universal definition, or qualification standards for local food. What qualifies as local, varies across published literature. Local foods are generally defined as any food that is "locally produced, marketed, and consumed" (Hand & Martinez 2010). Some works consider a good to be local if it is produced within a defined distance of being sold while others classify it as being local if it is produced within the same state or region that it is sold (Pirog & Rassmussen 2008; Pirog, 2003; Norton 2008; Smith and Mackinnon, 2007; Barham et al., 2005).

In this chapter, Pirog and Rassmussen's (2008) definition of local is used. They conducted a consumer market survey of consumers of local food in the United States. When asked, what constitutes a local good, most the survey respondents agreed that a local good is a

good that is created within 100 miles of where it is sold. Specifically, for this project, produce is considered local if it was grown within 100 miles of where it is purchased by consumers.

Before the era of modern transportation in the twentieth century, there was no concept of local, or nonlocal foods (Giovannucci, Barham & Pirog 2009). Everything was local because it was too costly and took too long to transport foods long distances. Once transporting goods by trains and trucks became affordable, and feasible with refrigeration, goods were produced on a large scale and distributed far and wide to stores where they were sold. Today, most non-local food products travel thousands of miles and are handled upwards of 33 times by the time they arrive on store shelves (Guptill & Wilkins 2002; Kahn and McAlister 1997).

In the 1970s grocery stores and supermarkets made most of their sales from packaged foods. (Guptill & Wilkins 2002). Since that time, a health-conscious trend has emerged. Consumers are becoming increasingly concerned with how their purchase decisions impact their health, as well as the health of the environment and local economies (Giovannucci, Barham & Pirog 2009). Per capita consumption of fresh meats and produce has increased with this trend, and consumers are becoming increasingly interested in locally produced, fresh foods (Guptill & Wilkins 2002; Giovannucci, Barham & Pirog 2009). Annual sales of local foods through direct channels increased by 57% from 1997 to 2007 (Martinez et al., 2010).

Demand for local foods is driven by consumer values. Locally grown and produced foods offer an opportunity for consumers to develop a connection with their food source while supporting local businesses (Guptill & Wilkins 2002). Supporting local producers and the local economy is a large factor in consumer's decisions to purchase local food (Gao et al. 2012). Onozaka, Nurse & McFadden (2010) found that consumers who shop directly with suppliers of local foods have slightly different values than those who purchase local foods through indirect channels. According the authors, those who buy directly from producers are primarily concerned with fostering a healthy local community while those who purchase from indirect channels are more concerned with avoiding pesticides and saving the environment.

It is beneficial for firms to sell local food because consumers are willing to pay a premium price for it. Consumers are willing to pay 18% above the standard retail price for an entrée at a restraint that features local food (Ortiz 2010). They are also willing to pay nearly 12% above standard retail price for local produce from the grocery store (Willies et al 2013).

Giovannucci, Barham & Pirog (2009) explain three more ways firms can benefit from selling local products. They claim that offering locally sourced goods helps firms achieve a positive reputation with environmentally conscious consumers and, in some cases, reduces the transportation costs that come with purchasing food from large distributors. Another benefit of using small local suppliers is that food safety problems can be contained and do not spread chain wide like they do when they originate form a centralized source (Giovannucci, Barham & Pirog 2009).

Despite the benefits they provide local businesses, producers of local goods sometimes have troubles providing for large chain companies. They also often struggle with meeting the policy and product requirements that large companies require of their suppliers (Giovannucci, Barham & Pirog 2009). Because of these difficulties, some large firms are not able to take advantage of the benefits that selling local goods provide.

In 2008, local foods only accounted for 1.9% of total annual food sales in the U.S. Of this 1.9%, 59% of it was sold through indirect markets (Low & Vogel, 2011). The indirect market for local foods is slightly concentrated with a small number or large farms (Pinchot 2014). Encouraging smaller farms to start selling their goods through the indirect market would increase the competition in the indirect local food market. However, before farmers can be convinced to enter the market, they need to be sure that one exists. The remainder of the literature review provides a dissection of the methods used to develop calculations of local produce demand and the acreage needed to supply it, for specific geographical regions.

3.2.2 TAM SAM SOM

Total addressable market (TAM), Serviceable available market (SAM), and serviceable obtainable market (SOM) are market estimation tools primarily used for measuring a good's potential market. This chapter utilizes TAM, SAM, and SOM to calculate regional annual consumption of a specified local produce item in a specified area. For example, the TAM, SAM, and SOM equations developed by researchers can be used to calculate the pounds of locally grown spinach consumed annually in Moscow, Idaho. TAM, SAM and SOM help determine how many individuals are needed to support an indirect market for local produce and how many acres of farmland it would take to supply the threshold population.

Traditionally, TAM, SAM, and SOM are defined at the firm level. TAM is the total market demand for the good or service, SAM is the portion of TAM that is targeted by the

good or service, and SOM is the portion of SAM that can realistically be captured by the firm or region (Getty 2014 &The Business Plan Shop 2013). To continue the spinach example, let's define TAM, SAM, and SOM from the perspective of the Moscow Food Coop selling locally grown spinach. TAM is the total pounds of spinach consumed annually in Moscow Idaho. SAM is the total pounds of locally grown spinach consumed annually in Moscow Idaho. The SOM is the total pounds of locally grown spinach purchased from the Moscow Food Coop annually. TAM SAM SOM can be measured using any metric that works for the good or service being analyzed, for example units, dollars, or number of consumers (Blank and Dorf 2012).

Aulet (2013) explains how to accurately calculate TAM, using number of consumers as the units, to ensure the market is not overestimated. His process is outlined here. The first step is to determine a beachhead market. The beachhead market is the total number of consumers of the good or service. For example, when calculating TAM for locally grown produce, the beachhead market is all produce consumers. His second step is to use the beachhead market to perform a bottom up analysis that estimates the total number of consumers in the beachhead market that are in the good or service's market area. A bottom up analysis uses customer lists, trade associations, and any other internal sources of data to count all potential customers for the good or service. Once the bottom up analysis is completed, Autlet (2013) recommends a top-down analysis to confirm the findings. An overestimated target market size leads to an overestimation of TAM. This can cause the good or service to fail when there are not as many available customers as were planned for. A conservative estimate of TAM is much safer and the top down analysis is performed as an extra measure to ensure the target market size is estimated correctly. A top down analysis uses secondary market data to estimate how many end users exist. Secondary market data can be market analysis reports, US census data, or any data that is available but was not collected for the purpose of calculating the population of end users.

After the number of end users is determined, TAM can finally be calculated. The size of the target market multiplied by the consumption or price of the product (depending on the units chosen) is the TAM for that product or service. SAM is calculated by extracting the portion of TAM that is specific to the good or service (Berry 2014; The Business Plan Shop 2013). For example, when calculating SAM for locally grown produce the TAM is multiplied

by the portion of all produce consumed that is local to get the total amount of locally grown produce consumed in the area. SOM is calculated by extracting the portion of SAM that is obtainable by the firm (Berry 2014). For example, when calculating SOM for locally grown produce from the perspective of a grocery store, the SAM is multiplied by the portion of all produce consumed that comes from that grocery store. This results in the total amount of locally grown produce consumed that comes from the grocery store's market area.

3.2.3 Definitions of Market Thresholds and Range

Overlaying the TAM, SAM and SOM calculations with Demand Threshold, Threshold Population, and Range allows one to know the market potential for a product, and also the minimum market size necessary to sell it profitably. Demand Threshold, Threshold Population, and Range are elements of Central Place Theory (CPT), a theory that explains the number of firms or goods and their arrangement within a geographical area (Shaffer, Deller, & Marcouiller 2004).

Range is the distance that consumers are willing to travel to purchase a good or service (Berry & Garrison 1958). A product's range is determined by demand for the product and its geographic limits (Deller & Ryan 1996). Geographic limits affect the range of a good by determining how easy it is for consumers to access it. A good's geographic limits are measured using physical distance, travel costs, travel time, access to substitutes, transportation availability and technology (Shaffer, Deller, & Marcouiller 2004). Readily accessible competitive markets decrease a good's range while things like public transportation and technology, which make it easier for people to access the market, increase it (Shaffer, Deller, & Marcouiller 2004).

The upper limit of a good's range is the largest possible "radius of sales" (Berry & Garrison 1958). The area outside of the range's upper limit is the area where people will not travel to in order to purchase the good at its current price (Berry & Garrison 1958). The lower limit of a good's range is the radius around the smallest number of consumers needed to profitably support the good. The lower range is called the demand threshold (Berry & Garrison 1958).

Demand threshold is **"**The minimum market size, or population required to support a particular good or service and still yield an acceptable rate of return to the business" (Deller 1996 p 1) Rodrigue (1998) explains what happens to a good when demand rises above, and

falls below, the demand threshold. If demand falls below the demand threshold the good or service will eventually fail because there are not enough consumers within the area for it to be profitable. If the demand rises above the market threshold, the profitability of the good or service will increase as will the good's outer range.

Demand threshold is typically measured using regression analysis (Wensley 1998). Single variable linear models estimate the relationship between community population and the number of establishments providing a need for the community. This method assumes a constant urban-multiplier relationship between the population of the community and the demand threshold population (Wensley 1998).

Another way of measuring minimum demand for a good is threshold population. Threshold population is the minimum number of consumers required for a good to be profitable. Berry & Garrison (1958) provide the background information needed to understand this method of measurement. Threshold population and demand threshold both measure required demand, but they are not always equal. When they are equal, the following two assumptions hold. First there are constant multiplier effects within the market threshold and the basic employment of the urban center satisfying the demand. This means that as the market size increases, the availability of goods increases at the same rate. Second there are constant employment ratios within the urban centers (Berry & Garrison 1958). Demand threshold relies on the assumption that demand increases as the size of the urban center increases (Berry & Garrison 1958). If per capita demand decreases as the radius of the range expands this assumption is violated and the threshold population and demand threshold will not be equal.

Berry and Garrison (1958) measure threshold population using least squares averaging. For each urban function, they calculate a best fit relationship using *Equation 3.1* where P is the population of the centers, N is the number of stores located in the centers and A and B are parameters to be estimated. The threshold population is P in *Equation 3.1 Threshold Population* when $N = 1$.

$$P = A(B^N)$$

Equation 3.1 Threshold Population

The threshold population is equal to the inner range of a good if the following two assumptions hold. There are constant multiplier effects between total demand within the inner

range and the basic employment of the urban center. Also, there are constant basic, non-basic employment ratios within the urban centers (Shaffer, Deller, & Marcouiller 2004).

Demand threshold, threshold population, and range make three assumptions, explained by Shaffer, Deller, & Marcouiller (2004). The first assumption is that there is an even distribution of homogenous people across an economic plane. This assumption is unlikely to be true in a real word application, but violating this assumption does not completely invalidate the method. Lifting the assumption allows for a more realistic view of central places by allowing for concepts like multipurpose shopping trips and business clustering which cannot occur when people are evenly distributed. When the assumption is lifted, threshold population is used in the place of demand threshold. This is an adequate substitution because the concepts both measure the same thing but thresholds population does not require the market to be evenly distributed.

The second assumption is that each firm will serve the largest area that they can. This ensures that the concepts of range and demand threshold are used correctly. The final assumption is that consumers will go to the firm that is closest to them. If this assumption is violated, then range and demand threshold cannot be used. This study assumes that consumers will purchase the local foods nearest to them in its use of range and demand threshold.

One limitation of demand threshold and range is that they assume physical space is the dominant element of an economic plane when in reality it is travel cost and travel time (Shaffer, Deller, & Marcouiller 2004). It is possible to travel a very long distance in a short time if adequate transportation exists. However, in a place without adequate transportation, traveling a short distance, especially with larger goods, can be very difficult and expensive.

A second limitation of demand threshold, population threshold, and range is that they do not consider "qualitative variety across central places" (Shaffer, Deller, & Marcouiller 2004). These variations include product selection, availability of parking, store hours, store atmosphere, and community atmosphere. If a consumer is willing to travel farther to get a similar good from a firm where it is more enjoyable, safer, or more convenient to shop at, demand threshold, population threshold, and range should not be used. The final limitation of these methods is that they do not account for tourists and other visitors that purchase goods and services from a central place. This creates a problem for areas whose economies are highly dependent on tourism.

3.3 Methods

This section outlines the methods used to calculate the macro market size for locally grown produce using TAM, SAM, SOM, threshold population, demand threshold, and range. The methods used in this project are adapted from a combination of industry recommendations and assumptions based on the definitions of the concepts that are being measured. To calculate the regional market for local produce, the researchers split the market in two, one market for in home consumption, and one for away from home consumption. The split allows the market potential for local produce to be analyzed separately for restaurants and grocery stores.

3.3.1 Calculating Regional Market Size

In this chapter, TAM, SAM, and SOM are calculated as pounds of local produce consumed annually within a region. In this context, TAM is the total pounds of produce consumed annually in the market area. SAM is the portion of the TAM that local produce sellers can consider attainable sales. SOM is the portion of the SAM that the produce sellers can be confident they can capture. For example, TAM for local tomatoes in Boise, Idaho would be the total pounds of tomatoes consumed annually in Boise. SAM is the total pounds of locally grown tomatoes consumed annually in Boise, and SOM is the total pounds of locally grown tomatoes consumed annually in Boise that were purchased from restaurants or grocery stores.

Traditionally, calculating TAM, SAM, and SOM begins with a bottom up analysis from data that exists within a firm and verifies it with a top down analysis using secondary data (Aulet 2013). In this case, the researchers modify the calculations to capture a macro view of a regional market, and therefore do not have access to firm specific data, so only a top down analysis is used.

Threshold population is the number of consumers of local produce required to support 1 firm selling local produce. The demand threshold is the geographic area that the individuals in the threshold population exists within. The threshold population is also used to calculate the number of firms supported by the market and the SOM helps determine acreage needed to supply the demand. The following subsections outline the methods of market calculations for the away from home and in home markets for a locally grown produce item.

3.3.1.1 Away from Home Market Calculations

The TAM for a local produce item in the away from home market is the total pounds of the item consumed annually away from home within the market area. *Equation 3.2* shows the calculation for away from home TAM.

Equation 3.2 Away from Home Total Available Market

$$TAM_a = p * c_a * g$$

Where:
$p =$ the market area population (people)
$c_a =$ the portion of total U.S. food expenditures on food away from home (%)
$g =$ the annual per capita consumption of the local produce item (lbs. per person)

The market area population is from the US census bureau. The portion of total U.S. food expenditures on food away from home is from a 2015 USDA report on American food expenditures, and the annual per capita consumption of the local produce item is from USDA per capita consumption reports.

This calculation of TAM assumes three things. First, it assumes the annual per capita consumption of the local produce item within the market area is the same as the national average annual per capita consumption of the item. Second, it assumes that the portion of food purchased away from home within the market area is the same as that of all Americans' in home food expenditures. Third, it assumes that the percentage of expenditures on food away from home is proportional to the percentage of the per capita consumption of the local good consumed away from home.

SAM is the portion of TAM that is locally grown. The SAM for a locally grown produce item in the away from home market is the annual consumption of the produce item that is locally produced and consumed away from the home within the market area. The equation used to calculate SAM for the away from home market is in *Equation 3.3.*

It should be noted that the portion of consumer's diets that is local produce is not a portion of their entire produce consumption. There are certain goods that will never be produced locally in certain areas. For example, mangos will not be grown and sold as local in Alaska. To avoid underestimating the SAM, the researchers create a local basket of goods for the market area. This basket is completed by adding the annual per capita consumption for each local produce item that is grown within 100 miles of the market area, using data from the USDA National Agricultural Statistics Service Census of Agriculture. The summation of the

annual per capita consumption data provides a local basket that makes up an individual's local diet within the market area. The researchers use the portion of the local basket that is the local produce item multiplied by the annual per capita consumption of local produce to calculate the annual per capita consumption of the local good. This is illustrated as $\frac{g}{b} * t * l$ in *Equation 3.3*

Equation 3.3 Away from Home Serviceable Available Market

$$SAM_a = p * \frac{g}{b} * c_a * t * l$$

Where:
$p =$ the market area population (people)
$g =$ the annual per capita consumption of the local produce item (lbs. per person)
$b =$ the annual per capita consumption of the local basket (lbs. per person)
$t =$ the annual per capita consumption of all produce (lbs. per person)
$l =$ the portion of all produce consumed that is local (%)
$c_a =$ the portion of total U. S. food expenditures on food away from home (%)

The sources for the new variables introduced in this equation are as follows: The annual per capita consumption of all produce is reported in the United States Department of Agriculture's Office of Communication Agricultural Factbook, and the portion of all produce consumed that is local is reported by Low & Vogel (2011).

This calculation of SAM assumes three things. First, that the none of the individuals within the market consume locally grown items from outside of their basket while traveling. The researchers are confident that violations of this assumption are negligible in the overall calculations. Second, the calculation assumes that the proportion of the per capita consumption of the local produce item, relative to the rest of the local produce diet, is equal to the proportion of the per capita consumption of the non-local produce item, relative to the rest of the non-local produce diet. Third, the calculation assumes that the portion of all food produced that is sold locally is equal to the portion of American's produce diet that is local.

The SOM for a locally grown produce item in the away from home market is the portion of the SAM that is sold in restaurants. The method for calculating SOM is in *Equation 3.4*. The portion of local food that is sold through indirect markets comes from a USDA report by Low & Vogel, (2011).

Equation 3.4 Away from Home Serviceable Available Market

$$SOM_a = SAM_a * i * (c_a * c_r)$$

Where:

$SAM_a =$ the servicable available market for the away from home market (lbs.)

$c_a =$ the portion of total U.S. food expenditures on food away from home (%)

$i =$ the portion of local food that is sold through indirect markets (%)

$c_r =$ the portion of all food consumed away from home that is purchased from restaraunts (%)

There are two new variables introduced in this equation. The portion of all food consumed away from home that is purchased from restaurants is from a 2015 USDA report on American food expenditures. The portion of local food that is sold through indirect markets is from a USDA report by Low & Vogel, (2011).

The away from home SOM calculation makes two key assumptions. First, it should be noted that the portion of all local food that is sold through indirect markets is the percent of locally produced food that farmers sell through indirect channels. It is assumed that the proportions of local food sold by farmers through indirect and direct markets are equal to the proportions of local food consumed by individuals through indirect and direct markets. Second, it is assumed that the portion of all American's food expenditures on restaurant food is equal to the portion of individuals within the market's expenditures on restaurant food.

Equation 3.5 calculates the threshold population for a restaurant within the market that serves the local produce item. The first step in calculating away from home threshold population is to determine how much revenue a restaurant needs to generate from an entrée featuring the local produce item to make it worthwhile to offer it. The researchers determine that this amount should be at least equal to the revenue from selling the entrée featuring non-local produce. If the restaurant can make more money by selling non-local produce than there is no incentive to sell local produce. The minimum revenue required is calculated in the numerator of *Equation 3.5*. The denominator in *Equation 3.5* is the revenue that a restaurant will receive from one customer.

Equation 3.5 Away from Home Threshold Population

$$TP_a = \frac{m * \frac{g}{b} * s * x * e * h}{e + (e * w_t)}$$

Where:
$m =$ the portion of the restaraunt menu that is local (%)
$g =$ the annual per capita consumption of the local produce item (lbs. per person)
$b =$ the annual per capita consumption of the local basket (lbs. per person)
$s =$ the average restaurant seating capacity (people)
$x =$ restaurant nightly turnover rate (per day)
$e =$ average non local entrée price
$h =$ restaraunt days open during local item′s harvet season
$w_t =$ willingness to pay over average for locally sourced restaurant entrée

The portion of the restaurant menu that is local, as well as the average restaurant seating capacity is from a survey of restaurant owners in the Northwest United States by Hildebrandt (2015). The survey data is divided into rural and urban locations which allows different numbers to be used for rural and urban restaurants. The data shows that the portion of local food on the menu and the seating capacity of urban restaurants is higher than that of rural ones. The restaurant nightly turnover rate is an average of all US restaurants from the National Restaurant Association. The average non-local entrée price is reported by a 2010 Intelaprice study, and is adjusted for inflation. The willingness to pay for a locally sourced entrée above the average entrée price comes from a study by Ortiz (2010).

The threshold population calculation assumes that the portion of local produce items offered on the restaurant menu is equal to the portion of produce in the market area's local basket. It also assumes that the portion of the restaurant's menu that is local is equal to the portion of local food that is ordered. The number of days open is based on the assumption that the restaurant is open six days a week throughout the local good's harvest season. The restaurant seating capacity and percent of the menu that is local is assumes that the averages in the market area are the same as the averages of the restaurant owners in the Northwest United States.

The area that the individuals of the threshold population exist within is the Demand Threshold. It is calculated in *Equation 3.6* by dividing the threshold population by the population density of the market area.

Equation 3.6 Away from Home Demand Threshold

$$DT_a = \frac{TP_a}{(\frac{p}{a})}$$

Where:
TP_a
$=$ the threshold population for one restaraunt serving the local good (people per firm)
$p =$ the number of people within the market area (people)
$a =$ the size of the market area (square miles)

The threshold population is calculated above, and the square miles of the market area is inputted into the calculations by the user. For the examples in this research it is from the United States Census Bureau.

The threshold population helps determine how many restaurants the market area can support as seen in *Equation 3.7*. The population of the market area divided by the number of people required to support one restaurant results in the number of restaurants supported by the market area.

Equation 3.7 Number of Restaurants Supported

$$R = \frac{p}{TP_a}$$

Where:
$p =$ the market area population (people)
$TP_a =$ the threshold population for one restaraunt serving the local good (people per firm)

The number of restaurants supported assumes that all the firms have similar seating capacities, portions of local food on their menu, and are selling their entrees at similar prices.

The final calculation for the away from home market is the number of acres required to supply the demand for the market area, .

Equation 3.8.

Equation 3.8 Away from Home Acres Supported

$$A_a = \frac{SOM_a}{y * z}$$

Where:
$SOM_a =$ the pounds of the local good consumed annually from restaraunts within the marekt area (lbs.)
$y =$ the average yield per acre of the local proudce item (cwt per acre)
$z =$ pound per hundred weight (lbs. per cwt)

The average yield per acre of the local produce item is inputted by the user of the calculations. In this research, it is the average yield per acre that is reported by the USDA.

3.3.1.2 In-Home Market Calculations

The TAM for a local produce item in the in-home market is the total pounds of the item consumed annually in home within the market area. The method for calculating TAM for the in-home market is in *Equation 3.9*.

Equation 3.9 In Home Total Available Market

$$TAM_i = p * c_i * g$$

Where:
$p =$ the market area population (people)
$g =$ the annual per capita consumption of the local produce item (lbs. per person)
$c_i =$ the portion of total U.S. food expenditures on food in the home (%)

The portion of total U.S. food expenditures on food in the home is from a 2015 USDA report on American food expenditures. This calculation introduces two new assumptions. First, it assumes that the portion of food purchased in-home within the market area is the same as that of all Americans' in home food expenditures. Second, it assumes that the percentage of expenditures on food in-home is proportional to the percentage of the per capita consumption of the local good consumed in-home.

The SAM for a locally grown produce item in the in- home market is the annual consumption of the produce item that is locally produced and consumed in the home within the market area. The equation for calculating in home SAM is presented in *Equation 3.10*.

Equation 3.10 In-Home Serviceable Available Market

$$SAM_i = p * \frac{g}{b} * c_i * t * l$$

Where:
$p =$ the market area population (people)
$g =$ the annual per capita consumption of the local produce item (lbs. per person)
$b =$ the annual per capita consumption of the local basket (lbs. per person)
$c_i =$ the portion of total U.S. food expenditures on food away from home (%)
$t =$ the annual per capita consumption of all produce (lbs. per person)
$l =$ the portion of all produce consumed that is local (%)

No new variables or assumptions are introduced in this calculation. The SOM for a locally grown produce item in the in-home market is the portion of the SAM that is sold in grocery stores. The method for calculating SOM is in *Equation 3.11*.

Equation 3.11 In- Home Serviceable Available Market

$$SOM_i = SAM_i * i * (c_i * c_g)$$

Where:

SAM_i = the servicable available market for the away from home market (lbs.)
c_i = the portion of total U.S. food expenditures on food in home (%)
i = the portion of local food that is sold through indirect markets (%)
c_g = the portion of all food consumed away from home that is purchased from grocery stores (%)

The portion of local food that is sold through indirect markets comes from a USDA report by Low & Vogel, (2011). The portion of all food consumed in-home that is purchased from grocery stores found in a 2015 USDA report on American food expenditures. This calculation introduces one new assumption, that the portion of all American's food expenditures on food from the grocery store is equal to the portion of individuals within the market's expenditures on food from the grocery store.

Equation 3.12 calculates the population threshold for one grocery store within the market selling the local produce item. The first step in calculating away from home threshold population is to determine how much revenue a grocery store needs to generate from selling the local produce item to make it worthwhile. The researchers determine that this amount needs to be at least equal to the revenue from selling the same produce as non-local. If the grocery store can make more money by selling normal produce than there is no incentive to sell locally grown produce. The minimum revenue required is calculated in the numerator of Equation 3.12. The denominator in Equation 3.12 is the revenue that the grocery store will receive from one customer.

Equation 3.12 In- Home Threshold Population

$$TP_i = \frac{\frac{n}{m_y} * k * d}{\frac{g}{b} * (t * l * c_i) * (c_g * c_i) * (r * (r + w_g))}$$

Where:
$n =$ annual grocery store sales per square foot (\$ per square foot)
$m_y =$ months in a year (12 months)
$k =$ good′s harvest season (Months)
$d =$ size of the local good display (square feet)
$g =$ the annual per capita consumption of the local produce item (lbs. per person)
$b =$ the annual per capita consumption of the local basket (lbs. per person)
$t =$ the annual per capita consumption of all produce (lbs. per person)
$l =$ the portion of all produce consumed that is local (%)
$c_i =$ the portion of total U. S. food expenditures on food away from home (%)
$r =$ average retail price of the produce item (\$)
$w_g =$ willingness to pay over average retail price for locally grown produce (%)

The annual grocery store sales per square foot is reported by the Food Marketing Institute. The good's harvest season is inputted by the user of the calculations. The size of the local good display is assumed to be four square feet but can be changed to any size. The average retail price of the local produce item is an average of monthly retail prices throughout the good's harvest season reported by the USDA. The willingness to pay over average retail price for locally grown produce in the grocery store is reported in a study by Willis et al. (2013).

The in-home threshold population equation makes two assumptions. First it assumes that the annual grocery stores sales per square foot are equal to the grocery store sales per square foot in the produce department. Second, it assumes that the national average retail price of the produce item is the same as the price for grocery stores within the market area.

The area that the individuals within the threshold population exist in is the Demand Threshold. It is calculated in

Equation 3.13 by dividing the threshold population by the population density of the market area. The threshold population is calculated above and the square miles of the market area is inputted into the calculations by the user. For the examples in this research it is from the United States Census Bureau

Equation 3.13 In- Home Demand Threshold

$$DT_i = \frac{TP_i}{(\frac{p}{a})}$$

Where:
$TP_i =$ the threshold population for one grocery store selling the local good (people per firm)
$p =$ the number of people within the market area (people)
$a =$ the square miles of the market area (square miles)

The threshold population also helps determine how many grocery stores selling the local produce item the market area can support as seen in *Equation 3.14.* The population of the market area divided by the number of people required to support one grocery store results in the number of grocery stores supported by the market area.

Equation 3.14 Number of Grocery Stores Supported

$$G_i = \frac{p}{TP_i}$$

Where:
$p =$ the number of people within the market area (people)
$TP_i =$ the threashold population for one grocery store selling the local good (people per firm)

The number of grocery stores supported assumes that all the firms have similar sized produce stands, and are selling the local good at similar prices. The final calculation for the in-home market is the number of acres required to supply the demand for the market area, *Equation 3.15*.

Equation 3.15 In-Home Acres Supported

$$A_i = \frac{SOMi}{y * z}$$

Where:
$SOM_i =$ the pounds of the local good consumed annually at from grocry stores within the marekt area (lbs).
$y =$ the average yield per acre of the local produce item (cwt per acre)
$z =$ pound per hundred weight (lbs. per cwt)

3.3.2 Excel Calculator

The calculations discussed thus far provide a comprehensive overview of the market for a locally grown produce item in a specific area. The researchers develop a calculator in Microsoft Office Excel that performs these calculations for the user after they input the data that is specific to the good and market area. The user must make many educated assumptions when utilizing this calculator.

Due to the many assumptions made in the calculations, the calculator is designed to allow the user to make changes to any of the metrics that are used. If any changes are inputted, the calculator fills in new market calculations, and shows the user the difference in the results from the original assumptions and the new input. This allows the user to customize the calculator to their specific market as much or as little as they wish.

When using the calculator, the user has a choice to input their information into one of two tabs, Rural Inputs and Results, or Urban Inputs and Results. The user should choose the tab that fits their area based on its Rural Urban Continuum Codes (RUCC). These codes are published by the USDA's Economic Research Services by county locations. Counties are classified as rural or urban on a scale of 1-9, 1 being the most urban. Counties that had a RUCC less than or equal to four are classified as urban and counties that had a RUCC greater than 4 are classified as rural.

3.4 Results

This section provides an example for using the excel calculator to estimate the market for locally grown tomatoes in Boise, Idaho, an urban location, and then Twin Falls Idaho, a rural location. It also showcases a sensitivity analysis that determines which variables in the calculations have the largest effects on the model and what happens to the results when they are changed.

3.4.1 Local Tomatoes in Boise

The researchers use the Boise Metropolitan area to estimate the market for local tomatoes in an urban location. Table 3.1 shows the results of the calculations. The Boise Metropolitan area can potentially consume over 103,000 pounds of locally grown tomatoes in restaurants, and over 91,000 pounds from the grocery store annually. Two-hundred and seventy patrons are needed to order local tomatoes from a restaurant for the restaurant to make the same amount of money as they would selling normal tomatoes. Two-thousand one-hundred, and six customers are needed to purchase local tomatoes from the grocery store for the store to maintain the national average of $500 per square foot in sales. The Boise Metropolitan area can support over 2500 restaurants serving local tomatoes and 321 grocery stores with local tomato stands. Just over six acres supply the locally grown tomato market for Boise Idaho.

Table 3.1 Boise Metropolitan Area Market for Locally Grown Tomatoes

Away from Home	
TAM (annual lbs.)	6,988,895.9
SAM (annual lbs.)	466,885.9
SOM (annual lbs.)	103,739.7
Threshold Population (number of people)	270
Demand Threshold (miles)	4.71
Restaurants Supported	2503
Acres Supported	3.61
In-Home	
TAM (annual lbs.)	6,955,429.5
SAM (annual lbs.)	464,650.2
SOM (annual lbs.)	91,658.7
Threshold Population (number of people)	2106
Demand Threshold (miles)	36.66
Grocery Store Stands Supported	321
Acres Supported	3.19
Total Market for Indirect Sales	
TAM (annual lbs.)	13,944,325.4
SAM (annual lbs.)	931,536.1
SOM (annual lbs.)	195,398.4
Restaurants and Grocery Stores Supported	2824
Acres Supported	6.81

3.4.2 Local Tomatoes in Twin Falls, Idaho

The researchers use Twin Falls, Idaho to estimate the market for local tomatoes in a rural location. *Table 3.2* shows the results of the calculations. Twin Falls can potentially consume over 11,000 pounds of locally grown tomatoes in restaurants, and over 10,000 pounds from grocery stores annually. One hundred and sixty-two patrons are needed to order local tomatoes from a restaurant for the restaurant to make the same amount of money as they

would selling normal tomatoes. Two-thousand, nine-hundred, and twenty-two customers are needed to purchase local tomatoes from the grocery store for the store to maintain the national average of $500 per square foot in sales. The Twin Falls Market can support 492 restaurants serving local tomatoes and 27 grocery stores with local tomato stands. Under one acre supplies the locally grown tomatoes market for Twin Falls, Idaho.

Table 3.2 Twin Falls, Idaho Area Market for Locally Grown Tomatoes

Away from Home	
TAM (annual lbs.)	825,533.6
SAM (annual lbs.)	52,992.7
SOM (annual lbs.)	11,774.7
Threshold Population (number of people)	162
Demand Threshold (miles)	3.92
Restaurants Supported	492
Acres Supported	0.41
In-Home	
TAM (annual lbs.)	821,580.6
SAM (annual lbs.)	52,738.9
SOM (annual lbs.)	10,403.5
Threshold Population (number of people)	2922
Demand Threshold (miles)	70.46
Grocery Store Stands Supported	27
Acres Supported	0.36
Total Market for Indirect Sales	
TAM (annual lbs.)	1,647,114.2
SAM (annual lbs.)	105,731.6
SOM (annual lbs.)	22,178.2
Restaurants and Grocery Stores Supported	520
Acres Supported	0.77

3.4.3 Range

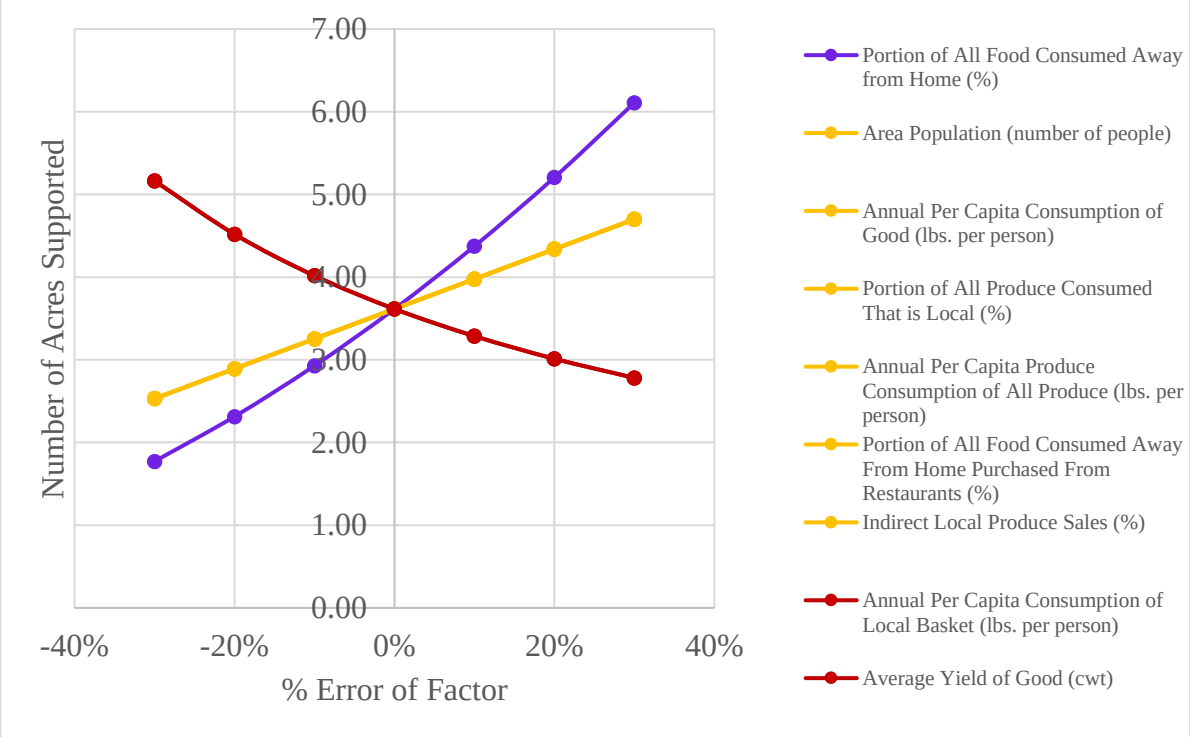
According to the USDA economic research service, the average consumer travels 3.5 miles to get to the grocery store. Recall that the demand threshold is equal to the inner limit of the range, meaning the demand threshold must be smaller than the range for the good to be successful, otherwise the individuals within the demand threshold will not be willing to travel to purchase the good. For Boise Idaho, this lower limit of the range is 36 miles, and for twin falls it is 70.46 miles suggesting that there is not enough demand for local tomatoes in either area to support grocery store selling them at the same level of profitability per square foot as conventional tomatoes. This leads us to believe that groceries offer local produce as a loss leader to draw customers, who will purchase other items while in the store.

According to a national survey by Bright Local, consumers are willing to travel 17 minutes to restaurants. Assuming they are going an average speed of 30 miles per hour it can be assumed that the range for restaurants is 8.5 miles. The demand threshold for Boise restaurants is 4.71 miles. The demand threshold for Twin Falls restaurants is 3.92 miles. The Twin Falls demand threshold is smaller than that of Boise because the average number of seats in restaurants is smaller in Twin Falls, meaning the their restaurants require less patrons to maintain their normal revenue levels. Both markets are large enough to support restaurants selling entrees with local tomatoes.

3.4.4 Sensitivity Analysis

After calculating the tomato market size, the researchers perform a sensitivity analysis to examine what happens to the number of acres needed to supply the market when the assumptions within the calculations are changed. The first step in the sensitivity analysis is to identify which variables the equation is most sensitive to. The researchers create spider plots to identify these variables. Spider plots are graphs that present the effects of each independent variable on the dependent variable as the independent variables increase and decrease by factors of error in increments of 10%. The independent variables with the steepest slopes have the most impact on the dependent variable. Although the market is calculated separately for urban and rural areas, the structure of the equations is the same and therefore this sensitivity analysis will only focus on the equations for the urban market. The results for the rural sensitivity analysis are in *Appendix C*.

The spider plot for the sensitivity analysis for restaurants is in *Figure 3.1*. The portion of all food consumed away from home has the steepest slope, indicating that is has the most impact on the acres needed to supply the away from home local tomato market. However, this variable does not actually change the market size. It only redistributes the away from home market to the in-home market. When the factor of error is decreased the annual per capita consumption of the local basket and the average yield of the good have the most impact on the acres required to supply the local tomato market. When the annual per capita consumption of the local basket is decreased, the portion of tomatoes in the local basket increases, meaning more tomatoes are consumed relative to other locally grown produce items which increases the acres required to support the local market. When the average yield of the tomatoes are decreased, farmers become less efficient, the market size does not change. When the error of factor is increased, the population, annual per capita consumtpion of tomatoes, portion of all produce consumed that is local, annual per capita produce consumption, portion of all food consumed away from home that is purchased from restraunts, and indirect local produce sales have equally the most impact on the acres needed to supply the market.

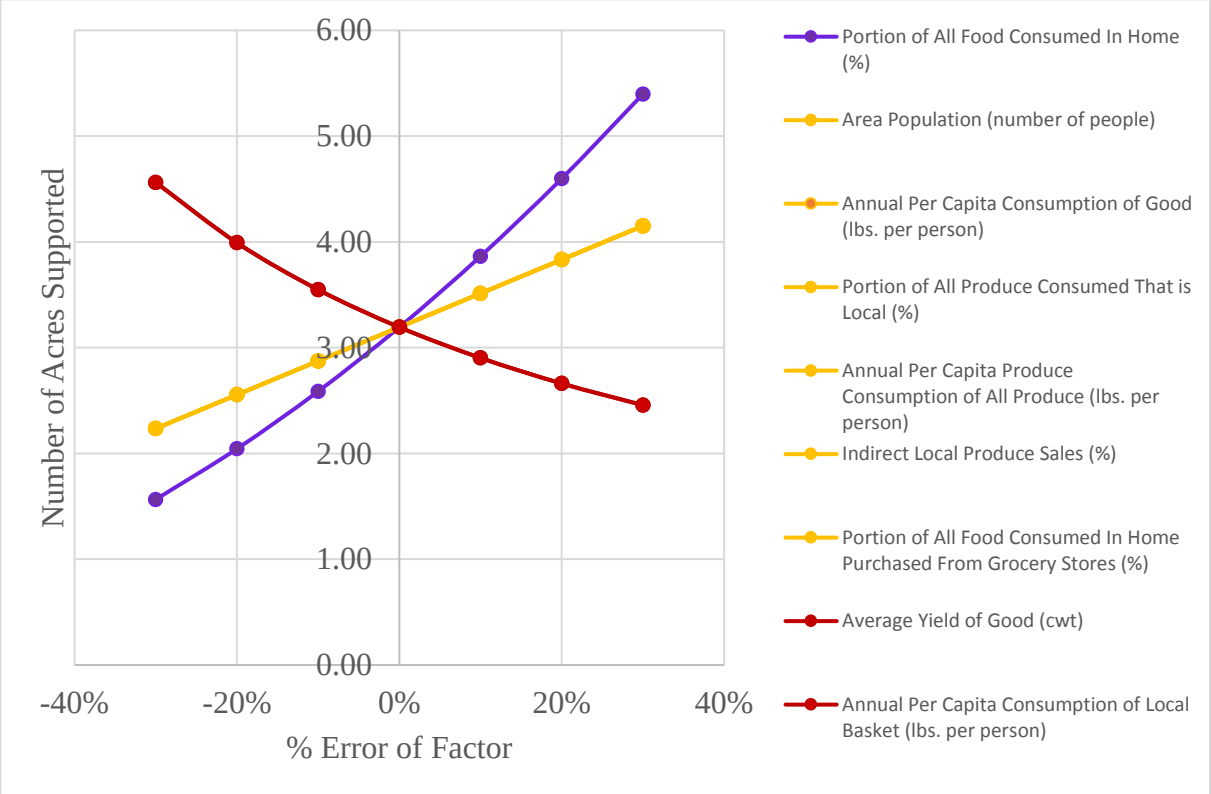


*All yellow entries have identical effects on number of acres supported so are represented under the same line.

Figure 3.1 Urban Restaurant Acres Supported Spider Plot

The spider plot for the sensitivity analysis for grocery stores is in **All* yellow entries have identical effects on number of acres supported so are represented under the same line.

Figure 3.2. The portion of all food consumed in- home has the steepest slope, indicating that is has the most impact on the acres needed to supply the in-home local tomato market. However, this variable does not actually change the market size. It only redistributes the in-home market to the away from home market. When the factor of error is decreased the annual per capita consumption of the local basket and the average yield of the good have the most impact on the acres required to supply the local tomato market. When the annual per capita consumption of the local basket is decreased, the portion of tomatoes in the local basket increases, meaning more tomatoes are consumed relative to other locally grown produce items which increases the acres required to support the local market. When the average yield of the tomatoes are decreased, farmers become less efficient, the market size does not change. When the error of factor is increased, the population, annual per capita consumtpion of tomatoes, portion of all produce consumed that is local, annual per capita produce consumption, portion of all food consumed in-home that is purchased from grocery stores, and indirect local produce sales have equally the most impact on the acres needed to supply the market.



*All yellow entries have identical effects on number of acres supported so are represented under the same line.

Figure 3.2 Urban Grocery Store Acres Supported

The next step of the sensitivity analysis is to measure how much impact each variable has on the acres needed to supply the local market. The variables used for this part of the analysis are the annual per capita consumption of the local basket and the portion of all produce consumed that is local. The remaining variables, population, annual per capita consumption of tomatoes, annual per capita produce consumption, indirect local produce sales, and portion of all food consumed in grocery stores and restaurants have the same impact on the acres needed as the portion of all produce consumed that is local. Therefore, they do not need to be individually examined.

The effects of decreasing the consumption of the local basket by 20% is in Table 3.3. The number of acres needed to supply the market for local tomatoes increases by 25%. Recall that decreasing the consumption of the local basket increases the relative consumption of tomatoes. The effects of increasing the portion of the produce diet that is local is in *Table 3.4.* The number of acres needed to supply the market size increase by 20% when the portion of the diet that is local increases by 20%.

Table 3.3 Results of 20% Increase in Consumption of the Local Basket

Results				
Away from Home - Restaurant				
Restaurant	Original	Results of User Changes	Difference	
TAM (annual lbs.)	6,988,895.9			
SAM (annual lbs.)	466,885.9	583,607.4	116,721.5	25.00%
SOM (annual lbs.)	103,739.7	129,674.6	25,934.9	25.00%
Threshold Population (number of people)	270	338	68	25.00%
Demand Threshold (miles)	4.71	5.88	1.18	25.00%
Restaurants Supported	2503	2002	(501)	-20.00%
Acres Supported	3.61	4.52	0.90	25.00%
In Home - Grocery				
Grocery	Original	Results of User Changes	Difference	
TAM (annual lbs.)	6,955,429.5			
SAM (annual lbs.)	464,650.2	580,812.7	116,162.5	25.00%
SOM (annual lbs.)	91,658.7	114,573.4	22,914.7	25.00%
Threshold Population (number of people)	2106	1685	(421)	-20.00%
Demand Threshold (miles)	36.66	29.33	(7.33)	-20.00%
Grocery Store Stands Supported	321	402	80	25.00%
Acres Supported	3.19	3.99	0.80	25.00%
Total Market for Indirect Sales				
Restaurant + Grocery	Original	Results of User Changes	Difference	
TAM (annual lbs.)	13,944,325.4			
SAM (annual lbs.)	931,536.1	1164420.103	232,884.0	25.00%
SOM (annual lbs.)	195,398.4	244248.0349	48,849.6	25.00%
Firms Supported	2824	2404	(420)	-14.88%
Acres Supported	6.81	8.51	1.70	25.00%

Table 3.4 Results of 20% Increase in Portion of Produce Diet that is Local

Results				
Away from Home - Restaurant				
Restaurant	Original	Results of User Changes	Difference	
TAM (annual lbs.)	6,988,895.9			
SAM (annual lbs.)	466,885.9	560,263.1	93,377.2	20.00%
SOM (annual lbs.)	103,739.7	124,487.6	20,747.9	20.00%
Threshold Population (number of people)	270			
Demand Threshold (miles)	4.71			
Restaurants Supported	2503			
Acres Supported	3.61	4.34	0.72	20.00%
In Home - Grocery				
Grocery	Original	Results of User Changes	Difference	
TAM (annual lbs.)	6,955,429.5			
SAM (annual lbs.)	464,650.2	557,580.2	92,930.0	20.00%
SOM (annual lbs.)	91,658.7	109,990.5	18,331.7	20.00%
Threshold Population (number of people)	2106	1755	(351)	-16.67%
Demand Threshold (miles)	36.66	30.55	(6.11)	-16.67%
Grocery Store Stands Supported	321	386	64	20.00%
Acres Supported	3.19	3.83	0.64	20.00%
Total Market for Indirect Sales				
Restaurant + Grocery	Original	Results of User Changes	Difference	
TAM (annual lbs.)	13,944,325.4			
SAM (annual lbs.)	931,536.1	1117843.299	186,307.2	20.00%
SOM (annual lbs.)	195,398.4	234478.1135	39,079.7	20.00%
Firms Supported	2824			
Acres Supported	6.81	8.17	1.36	20.00%

3.4.5 Rural vs Urban

The results of the rural and urban tomato market analysis allow the researchers to highlight some differences between rural and urban communities which confirm that the calculator is resulting in logical outcomes. The TAM SAM SOM for the urban market is much larger than the rural market. This makes sense because with more people living in urban areas, there should be more consumers of tomatoes. Another reasonable result is that the urban area supports many more businesses than the rural area which should be the case given the area's populations.

The threshold population for rural restaurants is smaller than that of urban ones. This is because the average seating capacity is smaller for rural restaurants than urban ones and rural restaurants on average, have a lower percentage of local food on their menu. This means that rural restaurants need to sell less entrees than urban ones to make it worthwhile to serve a locally sourced meal. The demand threshold for urban grocery stores is larger than that of rural ones. This is because the population density in urban areas is much larger than in rural areas.

Naturally, the urban market requires many more acres of tomatoes to supply it than the rural one does. The acres required to supply both the urban and rural markets are very small. Just over six acres can supply the entire market for Boise, and it takes less than an acre to

supply the local market for tomatoes in Twin Falls. The current market in both locations is not large enough to make it worthwhile for produces to peruse selling local tomatoes.

3.5 Conclusions and Implications

Local food is food that has been produced within 100 miles of where it is sold to the consumer. Local food is a fresh product that consumers are willing to pay a premium for. In agricultural areas like Boise, Idaho there is an abundant supply of local produce but most of it is exported elsewhere due to lack of demand.

The current portion of the average American's produce consumption that is locally sourced is 1.9% (Low & Vogel, 2011). At that portion, the Boise, Idaho local tomato market can be served by just over six acres. Few farmers are needed to supply the current demand for local tomatoes.

Table 3.5 shows if the portion of local produce consumption is increased to 10%, 38 acres of tomatoes would be needed to supply the local demand. This is almost all the tomatoes that are currently grown locally in the Boise, Idaho area. Increasing local food consumption by over 8% is not going to happen overnight. The current market for local produce is not large enough to support very many producers and it is unlikely that local food consumption will increase drastically on its own in the near future.

Table 3.5 Results of Increasing Portion of All Produce Consumed That is Local to 10%

Results				
Away from Home - Restaurant				
Restaurant	Original	Results of User Changes	Difference	
TAM (annual lbs.)	6,988,895.9	8,386,675.1	1,397,779.2	20.00%
SAM (annual lbs.)	466,885.9	2,948,753.0	2,481,867.1	531.58%
SOM (annual lbs.)	103,739.7	786,237.8	682,498.1	657.89%
Threshold Population (number of people)	270			
Demand Threshold (miles)	4.71			
Restaurants Supported	2503			
Acres Supported	3.61	27.40	23.78	657.89%
In Home - Grocery				
Grocery	Original	Results of User Changes	Difference	
TAM (annual lbs.)	6,955,429.5	5,564,343.6	(1,391,085.9)	-20.00%
SAM (annual lbs.)	464,650.2	1,956,421.9	1,491,771.7	321.05%
SOM (annual lbs.)	91,658.7	308,745.2	217,086.4	236.84%
Threshold Population (number of people)	2106	625	(1481)	-70.31%
Demand Threshold (miles)	36.66	10.88	(25.78)	-70.31%
Grocery Store Stands Supported	321	1083	761	236.84%
Acres Supported	3.19	10.76	7.56	236.84%
Total Market for Indirect Sales				
Restaurant + Grocery	Original	Results of User Changes	Difference	
TAM (annual lbs.)	13,944,325.4	13951018.68	6,693.3	0.05%
SAM (annual lbs.)	931,536.1	4905174.84	3,973,638.8	426.57%
SOM (annual lbs.)	195,398.4	1094982.936	899,584.5	460.38%
Firms Supported	2824			
Acres Supported	6.81	38.15	31.34	460.38%

3.5.1 Policy Implication

The calculations performed for the Boise and Twin Falls tomato markets show that at the current market demand, there is little incentive for grocery stores and restaurants to sell local produce. This suggests that policies are needed to increase the consumption of local produce. Although there are no policies currently in place to promote consumption of local foods in Idaho, there is one government organization, and several private organizations that are working to meet this goal.

Idaho Preferred is a program of the Idaho State Department of Agriculture. Its mission is to "identity and promote Idaho food and agriculture produces increasing market share and opportunity for profitability for Idaho farmers, ranchers, and growers" (Idaho Preferred 2016). Idaho Preferred works with farm to school programs, farmer's markets, restaurants, retailers, and distributors to provide as much opportunity to Idaho agricultural producers as possible.

Idaho's Bounty is a small local cooperative in Boise that distributes local food to restaurants and stores. They guarantee that their food is sustainably and locally produced (Idaho's Bounty Co-op 2016). They are working to increase the consumption of locally grown food in Idaho at the corporate level, meaning trying to get large companies to feed their patrons and employees with locally sourced foods. Building a corporate commitment to buying local creates a large-scale market for local foods. Another example of a company that

encourages consuming local foods at the cooperate level is Bon Appétit Management Company. They are a catering and food management company that services corporations and universities throughout the west coast. They provide food that is locally sourced and responsibly produced by vetting all suppliers with a list of standards regarding their production practices (Bon Appétit Management Company 2016). Bon Appétit's headquarter are in California but they currently serve the College of Idaho in Caldwell with local Idaho foods.

The calculations presented in this research show that the supply for locally produced goods exists, and could easily support a much higher demand. There are currently 40 acres of tomatoes being grown locally in the Boise area and the indirect market can be served by just over six. The market size for local tomatoes is very small, and there is little direct financial incentive for grocery store and restaurant owners to peruse selling them at this time. However, that does not rule out other reasons for including the product in their venues. For example, local goods might be loss leaders for grocery stores.

The methods in this research are highly dependent on local variables and assumptions regarding local food consumption. The excel calculator be used as a tool to estimate if there is a local market for a producer's produce and if one exists, how many acres are needed to supply the local demand. The calculator has a section that allows users to customize the assumptions to those that are specific to their area.

3.5.2 Limitations and Further Research

The largest limitation of this study is the number of assumptions that are made in the calculations. There is very little data available that is specific to local foods so the assumptions had to be made. However, the customization options on the calculator will allow any user to change the assumptions to best fit their environment. In the future, this research could be extended and verified with further research on local produce consumption and demand that would lessen the number of assumptions made in the calculator.

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Appendices

Appendix A

Survey of Agricultural Producers

Q43 My name is Laura Griffing and I am a graduate student in applied economics at the University of Idaho. I need your help to complete my thesis. I am working with Dr. Aaron Johnson, agribusiness professor at the University of Idaho. We are looking at the value that input and service providers offer agricultural producers. This study will help increase the value proposition service providers offer, meaning better options for you.

The survey will only take 5-10 minutes, and your responses are completely confidential. YOU CAN CHOOSE TO NOT ANSWER ANY OR ALL QUESTIONS WITHOUT RISK OF PENALTY. You may also stop the survey at any point (although we would encourage you to fully complete the survey as partial surveys will provide limited usefulness).

If you have any questions about the survey, please email Laura Griffing (ag-producers@uidaho.edu) or Dr. Aaron Johnson (aaronj@uidaho.edu). If you have concerns about the project, please contact Dr. Johnson (208-885-5489) or the University of Idaho's Institutional Review Board (208-885-6162).

Thank you in advance for your participation!

Sincerely,

Laura Griffing

Q1 What is the highest level of education you have COMPLETED?
- ❍ Attended High School
- ❍ High School Graduate
- ❍ Graduate of Two- year College/Technical/Trade Program
- ❍ Some Four- year College
- ❍ Four- year College Graduate
- ❍ Master's Degree
- ❍ Advanced Graduate Work

Q2 What is your age group?
- ❍ 18-25 Years
- ❍ 26-35 Years
- ❍ 36-45 Years
- ❍ 46-55 Years
- ❍ 56-70 Years
- ❍ 70+ Years

Q3 What is your gender?
- ❍ Male
- ❍ Female

Q4 How many years have you been working in agriculture?
- ❍ Less than 5 Years
- ❍ 5-9 Years
- ❍ 10-19 Years
- ❍ 20-29 Years
- ❍ 30-39 Years
- ❍ 40+ Years

Q5 Approximately, what was your GROSS INCOME from AGRICULTURE in 2014?

- ❍ Less than $50,000
- ❍ $50,000-$99,999
- ❍ $100,000-$499,999
- ❍ $500,000-$999,999
- ❍ $1 Million-$4.9 Million
- ❍ +$5 Million

Q6 How much additional GROSS INCOME came from NON-AGRICULTURAL sources in 2014?

- ❍ None
- ❍ $0.01-$9,999
- ❍ $10,000-$49,999
- ❍ +$50,000

Q7 What is your role in the operation (check all that apply)?
- ❑ Owner
- ❑ Operator
- ❑ Family Employee
- ❑ Employee

Q8 Is your agricultural operation family owned (i.e. regardless of business structure, the owners are related)?
- ❍ Yes
- ❍ No

Answer If Is your agricultural operation family owned (i.e. regardless of business structure, the owners ar... Yes, Is Selected

Q10 How many generations have been involved with the family farm?
- ❍ 1
- ❍ 2
- ❍ 3
- ❍ 4
- ❍ 5
- ❍ 6+
- ❍ Don't Know

Answer If Is your agricultural operation family owned (i.e. regardless of business structure, the owners ar... Yes Is Selected

Q11 What generation are you in the operation?
- ❍ N/A
- ❍ 1
- ❍ 2
- ❍ 3
- ❍ 4
- ❍ 5
- ❍ 6+
- ❍ Don't Know

Answer If Is your agricultural operation family owned (i.e. regardless of business structure, the owners ar... Yes Is Selected

Q12 Were previous generations involved with agricultural cooperatives?
- ❍ Yes
- ❍ No

Answer If Is your agricultural operation family owned (i.e. regardless of business structure, the owners ar... Yes Is Selected

Q13 How many active partners do you have in your operation?
- ❍ 0
- ❍ 1
- ❍ 2
- ❍ 3
- ❍ 4
- ❍ 5+
- ❍ Don't Know

Answer If Is your agricultural operation family owned (i.e. regardless of business structure, the owners ar... Yes Is Selected

Q14 Do you share equipment with other farmers/ranchers (excluding custom harvesting, etc.)?

- ❍ Yes
- ❍ No
- ❍ Don't Know

Q15 Are you a member of any of the types of cooperatives listed (check all that apply)?

- ❑ Agricultural Input Cooperative
- ❑ Agricultural Marketing Cooperative
- ❑ Consumer Food Cooperative
- ❑ (Federal) Credit Union
- ❑ None
- ❑ Other (please specify) _____

Q16 How would you rate your knowledge of agricultural cooperatives?

- ❍ Not at all Knowledgeable
- ❍ Slightly Knowledgeable
- ❍ Moderately Knowledgeable
- ❍ Very Knowledgeable
- ❍ Extremely Knowledgeable

Q17 What is your opinion of agricultural cooperatives?

- ❍ Very Unfavorable
- ❍ Unfavorable
- ❍ Neutral
- ❍ Favorable
- ❍ Very Favorable

Q18 How important are the following when considering renewing or becoming a member of an agricultural cooperative?

	Not Very Important (1)	Somewhat Important (2)	Moderately Important (3)	Important (4)	Extremely Important (5)	N/A (6)
Pride/loyalty (1)	❍	❍	❍	❍	❍	❍
Access to Market (2)	❍	❍	❍	❍	❍	❍
Community Involvement (3)	❍	❍	❍	❍	❍	❍
Ownership (4)	❍	❍	❍	❍	❍	❍
Control (5)	❍	❍	❍	❍	❍	❍
Relationship (i.e. Trust) (6)	❍	❍	❍	❍	❍	❍
Price Competitiveness (7)	❍	❍	❍	❍	❍	❍
Quality (products/services) (8)	❍	❍	❍	❍	❍	❍
Reputation of Cooperative (9)	❍	❍	❍	❍	❍	❍
Patronage (11)	❍	❍	❍	❍	❍	❍
Other (optional) (10)	❍	❍	❍	❍	❍	❍

Q19 Do you do business with an agricultural cooperative(s)?

❍ Yes
❍ No

Answer If Do you do business with an agricultural cooperative(s)? Yes Is Selected

Q21 For each of the following, what percentage did you use agricultural cooperatives in 2014 (for example, 100% would be buying or selling all that product listed in a single row through agricultural cooperatives)?

	None (1)	1-25% (2)	26-50% (3)	51-75% (4)	76-100% (5)	N/A (6)
Purchase Animal Feed (1)	❍	❍	❍	❍	❍	❍
Purchase Animal Health Products (2)	❍	❍	❍	❍	❍	❍
Purchase Reproduction Services (3)	❍	❍	❍	❍	❍	❍
Purchase Fertilizer/Manure Application Services (4)	❍	❍	❍	❍	❍	❍
Purchase Other Inputs/Services (5)	❍	❍	❍	❍	❍	❍
Sell Market Animal/Meat (6)	❍	❍	❍	❍	❍	❍
Sell Dairy (7)	❍	❍	❍	❍	❍	❍
Sell Other Animal Products (8)	❍	❍	❍	❍	❍	❍

Answer If Do you do business with an agricultural cooperative(s)? Yes Is Selected

Q22 For each of the following, what percentage did you use agricultural cooperatives in 2014? (for example, 100% would be buying or selling all that product listed in a single row through agricultural cooperatives)?

	None (1)	1-25% (2)	26-50% (3)	51-75% (4)	76-100% (5)	N/A (6)
Purchase Fertilizer Application (1)	❍	❍	❍	❍	❍	❍
Purchase Crop Protection Chemical Application (2)	❍	❍	❍	❍	❍	❍
Purchase Seeding (3)	❍	❍	❍	❍	❍	❍
Purchase/Rent Farming Equipment (4)	❍	❍	❍	❍	❍	❍
Sell/Market Crops (5)	❍	❍	❍	❍	❍	❍
Use Agronomist Services (6)	❍	❍	❍	❍	❍	❍

Q45 Are you a member of an agricultural cooperative?
❍ Yes
❍ No
If No Is Selected, Then Skip to End of Block

Q24 Please list the agricultural cooperative(s) you are a member of:
Agricultural Cooperative 1
Agricultural Cooperative 2
Agricultural Cooperative 3
Agricultural Cooperative 4
If More, Please List (separated by a comma)

Q25 How long have you been a member of each cooperative you listed above?
Agricultural Cooperative 1 (Years)
Agricultural Cooperative 2 (Years)
Agricultural Cooperative 3 (Years)
Agricultural Cooperative 4 (Years)
If More, Please List (separated by a comma, respectively)

Q26 What do you consider the number one reason for being a member of any of the cooperatives you listed above?

Q27 In general, how loyal are you to the cooperative(s) you are a member of?
- ❍ Not at all Loyal
- ❍ Somewhat Loyal
- ❍ Moderately Loyal
- ❍ Very Loyal
- ❍ Extremely Loyal

Q28 How loyal are you to cooperatives as a whole?
- ❍ Not at all Loyal
- ❍ Somewhat Loyal
- ❍ Moderately Loyal
- ❍ Very Loyal
- ❍ Extremely Loyal

Q29 How would you rate your participation/involvement in your cooperative(s)?
- ❍ Not at all Involved
- ❍ Slightly Involved
- ❍ Moderately Involved
- ❍ Very Involved
- ❍ Extremely Involved

Q30 Have you ever or do you currently serve on a board of directors for at least one of the cooperative you are a member of?
- ❍ Yes
- ❍ No

Q31 Did you vote for the board of directors in the last election for at least one of the cooperatives you are a member of?
- ❍ Yes
- ❍ No

Q32 Did you attend the last annual meeting for at least one of the cooperatives you are a member of?
- ❍ Yes
- ❍ No

Q33 Have you and/or a family member ever been employed by an agricultural cooperative?
- ❑ Yes, Me
- ❑ Yes, Family Member
- ❑ No

Q34 When considering renewing your membership or joining an agricultural cooperative, how much do you value the following items? Please distribute 100 points, according to importance, across the cooperative principles of ownership (pride included), control (i.e. electing the board of directors), and benefit (price, products/services, and relationship). The sum between the three must equal 100.

_____ Ownership
_____ Control
_____ Benefit

Q35 When considering renewing your membership or joining an agricultural cooperative, how much do you value the following items? Please distribute 100 points, according to importance, across the cooperative benefits of price (economic benefits including patronage and discounts), quality (quality of products/services), and relationship (relationship with cooperative employees and trust) The sum between the three must equal 100.

_____ Price
_____ Quality
_____ Relationship

Q36 How important are the following sources for receiving information from your cooperative(s)?

	Not Very Important (1)	Somewhat Important (2)	Moderately Important (3)	Important (4)	Extremely Important (5)	N/A (6)
Face-to-Face (1)	❍	❍	❍	❍	❍	❍
Newsletter (2)	❍	❍	❍	❍	❍	❍
Website (3)	❍	❍	❍	❍	❍	❍
Phone (4)	❍	❍	❍	❍	❍	❍
Email (5)	❍	❍	❍	❍	❍	❍
Social Media (6)	❍	❍	❍	❍	❍	❍
Texts (7)	❍	❍	❍	❍	❍	❍
Annual Meeting (8)	❍	❍	❍	❍	❍	❍
Non-annual Meetings (9)	❍	❍	❍	❍	❍	❍
Other (optional) (10)	❍	❍	❍	❍	❍	❍

Answer If Are you a member of an agricultural cooperative? No Is Selected

Q37 Have you ever been a member of an agricultural cooperative?

❍ Yes, please explain why you left. _____

❍ No

Answer If Are you a member of an agricultural cooperative? No Is Selected

Q38 Why are you not a member of an agricultural cooperative?

	Not Very Important (1)	Somewhat Important (2)	Moderately Important (3)	Important (4)	Extremely Important (5)	N/A (6)
Lose Independence (1)	❍	❍	❍	❍	❍	❍
Dislike Coop Idea (2)	❍	❍	❍	❍	❍	❍
Prices (3)	❍	❍	❍	❍	❍	❍
Switching Costs (4)	❍	❍	❍	❍	❍	❍
Other Business Relationships (5)	❍	❍	❍	❍	❍	❍
Inconvenience (i.e. Location) (6)	❍	❍	❍	❍	❍	❍
Unawareness (7)	❍	❍	❍	❍	❍	❍
Feel Undervalued (8)						
Other (optional) (9)						

Answer If Are you a member of an agricultural cooperative? No Is Selected

Q39 When considering joining an agricultural cooperative, how much do you value the following items? Please distribute 100 points, according to importance, across the cooperative principles of ownership (pride included), control (i.e. electing the board of directors), and benefit (price, products/services, and relationship). The sum between the three must equal 100.

_____ Ownership

_____ Control

_____ Benefit

Answer If Are you a member of an agricultural cooperative? No Is Selected

Q40 When considering joining an agricultural cooperative, how much do you value the following items? Please distribute 100 points, according to importance, across the cooperative benefits of price (economic benefits including patronage and discounts), quality (quality of products/services), and relationship (relationship with cooperative employees and trust) The sum between the three must equal 100.

_____ Price

_____ Quality

_____ Relationship

Appendix B

Logistic Regression Robustness Check

The final logit model chosen by the researchers includes variables that are insignificant. The researchers realize that this can, at times, create an unreliable model so they perform a two-part analysis to ensure the insignificant variables are not falsely influencing the model.

The first thing that the researchers examine is the variable to case ratio. Ideally this ratio will be at least 1/10 when many variables are insignificant (Northwestern University, 2016). In this case, there are 14 variables and 290 cases making the case to variable ratio over 1/20. This indicates that insignificant variables are unlikely to be creating an over fit model.

In their second part of analyzing the model's insignificant variables the researchers create a logit model with only the variables in the final model with significance levels under .15 and compare its results to the original model. The logit model includes 299 cases. The null model has a predictive capacity of 68.2%, 0.3% more than the final model. This null model has 204 agricultural cooperative members and 95 non-members and the final model has 197 members and 93 non-members.

The model's predictive capacity can be seen in *Appendix Table 1* Classification Table. Its predictive capacity is only 0.4% less than the final model. 2.6% less for non-members and 0.5% more for members of agricultural cooperatives. These differences are very slight which shows that including the insignificant variables in the model is not causing problems with its predictive accuracy.

Appendix Table 1 Classification Table

			Predicted		
	Observed		Are you a member of an agricultural cooperative?		Percentage Correct
			No	Yes	
Step 1	Are you a member of an agricultural cooperative?	No	66	28	69.5%
		Yes	5	199	97.5%
	Overall Percentage				88.9%

After examining the predictive capacity of the model, the researchers look at the Omnibus Test for model coefficients, another measure of fit. *Appendix Table 2* Omnibus Test of Model Coefficients shows the results of the test. The Chi-square value only changes by 6.109 and the significance level is the same. This indicates that the added insignificant variables do not have a big impact on the accuracy of the model.

Appendix Table 2 Omnibus Test of Model Coefficients

		Chi-square	Degrees of Freedom	Significance
Step 1	Step	191.898	7	.000
	Block	191.898	7	.000
	Model	191.898	7	.000

Next the researchers look at the change in the Nagelkerke R Square (*Appendix Table 3*). The model with only the significant variables has a Nagelkerke R Square of .021 less than the original model which indicates that the original model can explain 2.1% more of the variation in the outcome. This shows that the insignificant variables are not largely inflating the goodness of fit of the model.

Appendix Table 3 Model Summery

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	181.938	.474	.664

Appendix Table 4 below shows the variables in the model with only significant variables. The sign for all the variables is the same as in the model with insignificant variables. The significance levels are very similar to those in *Table 2.39* and the order of variables in terms of magnitude of change, Exp(B), is the same. This means that none of the insignificant variables are causing alarming changes in the significant ones and are therefore the insignificant variables are not changing the meaning of the model.

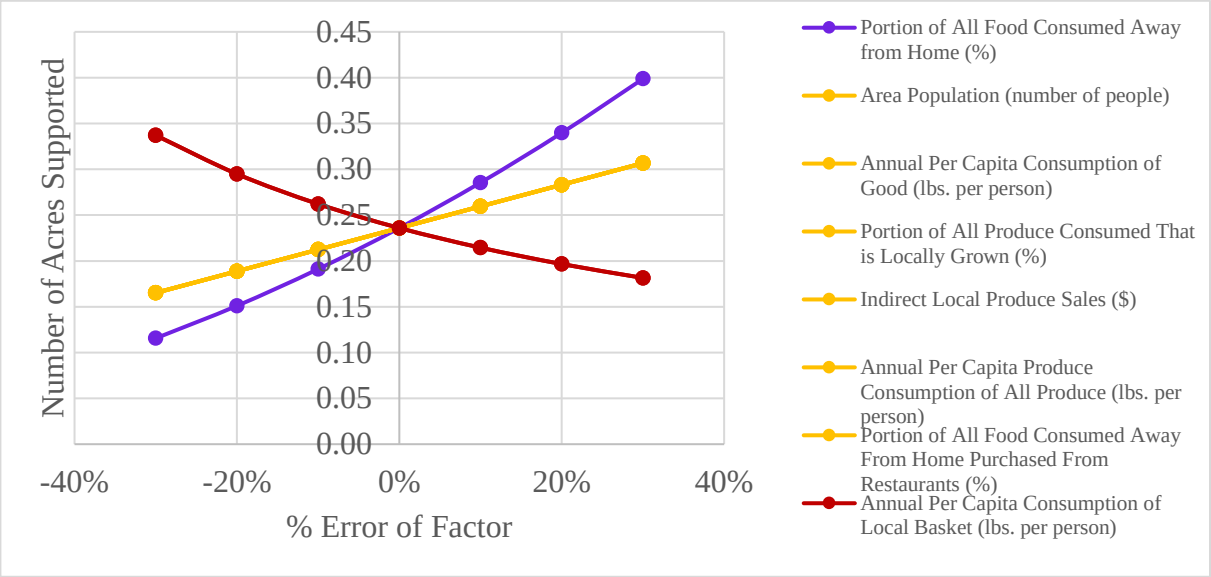
Appendix Table 4 Variables and Related Statistics

	B	Standard Error	Wald Statistic	Degrees of Freedom	Significance	Exp(B)
Age	.278	.170	2.665	1	.103	1.320
Ag Income	.599	.192	9.752	1	.002	1.820
Over $50,000 From Non-Ag	-1.137	.417	7.413	1	.006	.321
Knowledge	.362	.248	2.140	1	.143	1.436
Value Factor Importance	.889	.257	11.930	1	.001	2.432
Ag Coop Business	5.163	.748	47.601	1	.000	174.638
Quality	-.024	.011	4.685	1	.030	.976
Constant	-5.433	1.233	19.421	1	.000	.004

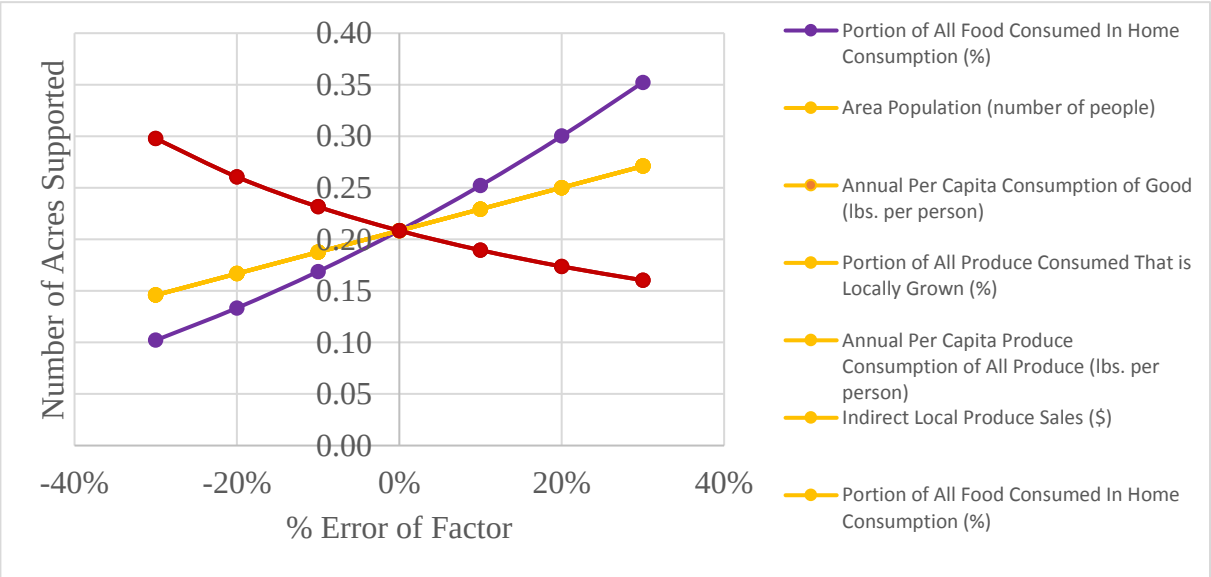
Appendix C

Sensitivity Analysis of Twin Falls Idaho Tomato Market

Rural Restaurant Acres Supported Spider Plot



Rural Grocery Store Acres Supported Spider Plot



Results of 20% Decrease in Consumption of the Local Basket

Results				
Away from Home - Restaurant				
Restaurant	Original	Results of User Changes	Difference	
TAM (annual lbs.)	474,741.0			
SAM (annual lbs.)	30,474.6	38,093.2	7,618.6	25.00%
SOM (annual lbs.)	6,771.3	8,464.1	1,692.8	25.00%
Population Threshold (number of people	162	203	41	25.00%
Demand Threshold (miles)	0.06	0.08	0.02	25.00%
Restaurants Supported	283	227	(57)	-20.00%
Acres Supported	0.24	0.29	0.06	25.00%
In Home - Grocery				
Grocery	Original	Results of User Changes	Difference	
TAM (annual lbs.)	472,467.6			
SAM (annual lbs.)	30,328.6	37,910.8	7,582.2	25.00%
SOM (annual lbs.)	5,982.7	7,478.4	1,495.7	25.00%
Population Threshold (number of people	2922	2338	(584)	-20.00%
Demand Threshold (miles)	1.15	0.92	(0.23)	-20.00%
Grocery Store Stands Supported	16	20	4	25.00%
Acres Supported	0.21	0.26	0.05	25.00%
Total Market for Indirect Sales				
Restaurant + Grocery	Original	Results of User Changes	Difference	
TAM	947,208.6			
SAM	60,803.2	76004.02801	15,200.8	25.00%
SOM	12,754.0	15942.55754	3,188.5	25.00%
Firms Supported	299	246	(53)	-17.63%
Acres Supported	0.44	0.56	0.11	25.00%

Results of 20% Increase in Portion of Produce Diet that is Local

Results				
Away from Home - Restaurant				
Restaurant	Original	Results of User Changes	Difference	
TAM (annual lbs.)	474,741.0			
SAM (annual lbs.)	30,474.6	36,569.5	6,094.9	20.00%
SOM (annual lbs.)	6,771.3	8,125.6	1,354.3	20.00%
Population Threshold (number of people	162			
Demand Threshold (miles)	0.06			
Restaurants Supported	283			
Acres Supported	0.24	0.28	0.05	20.00%
In Home - Grocery				
Grocery	Original	Results of User Changes	Difference	
TAM (annual lbs.)	472,467.6			
SAM (annual lbs.)	30,328.6	36,394.4	6,065.7	20.00%
SOM (annual lbs.)	5,982.7	7,179.3	1,196.5	20.00%
Population Threshold (number of people	2922	2435	(487)	-16.67%
Demand Threshold (miles)	1.15	0.96	(0.19)	-16.67%
Grocery Store Stands Supported	16	19	3	20.00%
Acres Supported	0.21	0.25	0.04	20.00%
Total Market for Indirect Sales				
Restaurant + Grocery	Original	Results of User Changes	Difference	
TAM	947,208.6			
SAM	60,803.2	72963.86689	12,160.6	20.00%
SOM	12,754.0	15304.85524	2,550.8	20.00%
Firms Supported	299			
Acres Supported	0.44	0.53	0.09	20.00%