Using regression analyis and a simulation model to deveop probability of achieving a market share goal

by

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ABSTRACT

The objective of this thesis is to develop a simulation model to determine the probability of achieving a market share goal. Two different simulation models were developed and compared allowing the author to select the best model.

The first simulation model developed used the current market share as the mean and the standard deviation of historical market share as the standard deviation. So, a market share of 31.00% and a standard deviation of 3.88% were used in the simulation. When these values were simulated the results determined the probability of achieving the market share goal of 33%. The simulation results indicated that only 12 out of 100 observations resulted in market share greater than the goal. Therefore, there is a 12% probability of achieving or exceeding the market share goal based on the current market share and historical market share standard deviation.

To predict future market share, a regression model was used to determine the impact of factors on market share. The regression model was used to forecast an estimate of market share. This forecasted share of 31.13% was used as the mean and 3.45%, the standard error of the model, was used to generate a second simulation model. The simulation results indicated that 26 of 100 observations resulted in market share greater than the goal of 33%. This indicates that there is a 26% probability of achieving or exceeding the market share goal based on results using regression to predict future market share and variability in market share.

The second simulation model generated from the market share forecast and standard error from the regression model produced the better results. When using a

regression model, it resulted in a higher estimate for meeting the goal. The addition of independent variables that impact share explained more of the variability around the projected mean than the historical model did.

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CHAPTER I: INTRODUCTION

The agriculture equipment industry has evolved over the years. Currently there are three companies that have major roles in producing agricultural equipment, John Deere (John Deere n.d.), AGCO (Bruce Bjornson 2000) and CNH Industrial (CNH Industrial n.d.). In the 1930s, seven equipment companies controlled most of the market, John Deere, International Harvester (IH), Case and Allis-Chalmers were in that group with John Deere and IH controlling many product categories.

John Deere was founded in 1837 with the creation of the steel plow. In 1918, John Deere purchased Waterloo Boy Tractors. In 1963, John Deere surpassed International Harvester to become the market share leader in farm equipment. In the 1980s and 1990s AGCO was formed with acquisitions of Allis Chalmers, Hesston, White, Massey Ferguson, Spra-Coupe and Wilmar. CNH Industrial was formed in 2013. Prior to forming CNH Industrial, there were acquisitions and mergers of International Harvester in 1985 and Steiger Tractor in 1986. Ford purchased Speery New Holland in 1986 and formed Ford New Holland Inc. The Fiat group acquired Case and merged it with New Holland in 1999.

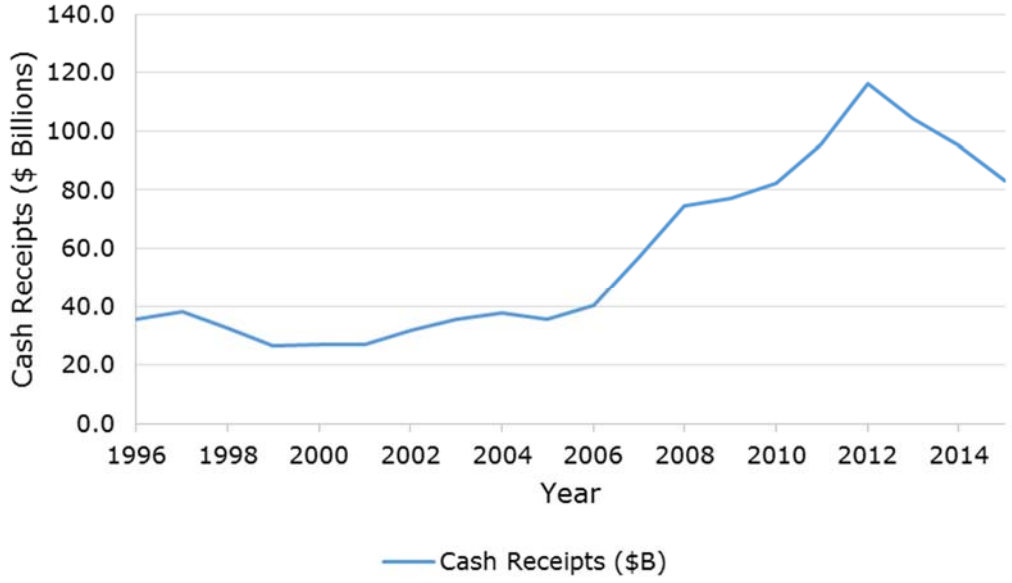
The agriculture equipment market is very competitive with both large and small dealer organizations privately owned, publically owned and others owned by the equipment manufacturers they represent. Not only do these dealers compete with other equipment lines but they can also compete with dealers offering the same line of equipment. This competition is seen when the agricultural economy is growing or declining.

When commodity prices drop, grower's cash receipts decline. In turn, growers have less money to spend on new equipment. This is a major concern to agriculture equipment manufacturers. These manufacturers are structured to produce based upon

demand and when market demand changes dramatically, changes in capacity, workforce and production occur. This translates to even more importance on every sale.

Figure 1.1 reports the cash receipts from the United States farm sector (USDA - United States Department of Agriculture Economic Research Service n.d.). The graph illustrates the cash receipts growers received from the sale of corn and soybeans. Cash receipts increased from 2005 through 2012 and then abruptly declined starting in 2012. This sharp decline signaled to equipment manufacturers that machinery sales may decline significantly.

Figure 1.1: USDA Corn and Soybean Cash Receipts (1996-2015)



When sales decline, organizations focus on retaining current customers and gaining new customers by converting competitive owners. To ensure employees are aligned and moving towards the same common objective, goals are set. Market share is a common sales goal used in equipment industries. Market share is defined as the percentage of total sales volume a company has in a defined market.

Sales plans are established for most companies each year. A goal should be established when these plans are created. Market share is often used as the goal. Using this goal provides a target for the company to focus on. Due to the variability in market share from year to year, goals are not always met.

1.1 Thesis Objective

Some of the change in market share from year to year may be explained by changes in economic variables. Finding the relationship between these variables helps establish appropriate market share goals. Even when other variables are accounted for, there is still some variability in the market that is not explained. This variability can be used to simulate the probability of achieving a goal.

The objective of this thesis is to develop a simulation model to determine the probability of achieving a market share goal. Historically, sales goals are often set by reviewing current share and adding stretch goals. Sometimes these goals are unachievable. Unrealistic sales goals can disengage the sales force, resulting in underperformance. A model with an understanding of factors that influence market share can be used to understand the probability of achieving a market share goal.

When it comes to understanding factors that impact market share, analysts examine the company of study in depth. Analysts understand variables inside the company as well as industry variables that could impact market share. New product introduction, quality, pricing and incentives are just a few variables that can impact a company's market share. For the purpose of this thesis, the impact of industry variables such as cash receipts and debt to equity ratio are examined to determine their impact on market share.

1.2 Thesis Organization

Within the content of this thesis, the reader will find an introduction, a literature review, theory and methods used, a recommendation as well as a conclusion of the work. The introduction provides an overview of the agriculture equipment manufacturers' changes through the years detailing mergers and acquisitions. The literature review will highlight the importance of setting challenging yet achievable market share goals. Details regarding the regression and simulation methods are provided. Results comparing the two simulation models approaches at calculating the probability of achieving a goal are discussed. The conclusion highlights the results and recommendations.

CHAPTER II: LITERATURE REVIEW

For a business to move forward, goals need to be determined. The process in which goals are established should be defined. For this research project goal setting methods and determining the probability of achieving a market share goal are reviewed. (Kalb 2014) states that when setting goals to achieve marketing plans, the goals should be focused, coordinated, and measurable. Measurable goals ensure everyone working towards the goal has the same target. It also ensures that the methods tracking progress to the goal are similar. Challenging goals motivate teams to help the company meet its potential. However, if the goal is too lofty, employees can become frustrated and disengage. (Kalb 2014) defines 3 types of goal setting methods: market potential, historic and full time equivalent. For the market potential method, the market must be defined, size understood, limiting factors evaluated and penetration goals established. The historic method, although not optimal is a popular method because most businesses understand and have access to past performance. Similar to the market potential method, the market must also be defined and the potential should be determined with this method. Past sales need to be evaluated and a growth rate applied to calculate the new goal.

What is the best predictor of future performance? (Hoag 2009) comments that past performance may not always be the best predictor of the future. Instead of simply using historical performance alone, researchers should consider using statistical tools. Combining statistical tools, historical performance and relevant current data is a better predictor of future performance than history alone (Hoag 2009).

Market share is defined as a company's portion of the market. It is calculated by dividing the company sales by industry sales. Market share may be influenced by a wide

variety of factors. Relationships between market share and several independent variables will be examined in this thesis using regression analysis. Market share is defined as the dependent variable, the goal. Two independent industry variables, farmer cash receipts and the sector debt to equity ratio are used. Time is also used as an independent variable to capture the trend in market share over time. Other independent variables could impact share and each researcher must understand internal and external variables and evaluate their importance. Internal variables such as new product development, quality, pricing and incentives are just a few internal variables that may impact a company's market share. External variables and their impact to market share must also be understood. Cash receipts, farm income, commodity prices, interest rates and competitor's performance are external variables that could impact market share.

Materials and resources from Agribusiness Risk Management (Schurle 2015), were used as resources in choosing the research methods. Microsoft Excel and the book, *Microsoft Excel – Data Analysis and Business Modeling* (Winston 2004) were the resources used to understand the functionality and interpretation of the results of Excel's data analysis features. A regression model is used to estimate the market share mean and determine the standard error of a model with a dependent variable and three independent variables.

(Ragsdale 1998) defines independent variables as having functional relationships on the dependent variable. When the certainty of value of independent variables in the future is not known, simulation can be used to produce a random set of generated results. Risk analysis has several different techniques such as best-case / worst-case analysis, simulation and what-if analysis. Various independent variables are explored to understand their

impact on the dependent variable. Results from regression analysis are used to generate sample values based on the mean and standard deviation of the market share for the next year.

Monte Carlo methods are a mathematical simulation approach to account for risk, and is used by a variety of professionals (Palisade Corporation 2016). Monte Carlo simulation is often used to help the researcher understand risk and make decisions by viewing possible outcomes and the probabilities associated with the outcomes. The number of possible outcomes generated by Monte Carlo can be in the thousands.

CHAPTER III: THEORY & METHODS

3.1 Simulation

Simulation modeling can be used to determine the probability of achieving a desired outcome based on random conditions. To setup a simulation model, statistical measures are necessary. The data used for this thesis is market share from 2005 through 2015. Mean, variance and standard deviation are important descriptive statistics used to summarize information about uncertain outcomes (Michael R. Baye 2014).

The mean of the data set must be calculated. The mean is the measure of the central tendency of a data distribution within the population (Schurle 2015). The mean formula is:

$(X_1 + X_2 + X_N) / N$

where X is the market share of each year and N is the number of years (observations)

Outliers in the data set can affect the mean estimates. Therefore the data must be examined for outliers. The data were examined and there were years when the market share variances were observed. These variations were not omitted.

Variance is defined as the sum of probabilities that different outcomes will occur times the squared deviation from the mean of the resulting payoffs (Michael R. Baye 2014). Standard deviation is defined as the square root of variance (Michael R. Baye 2014). If a distribution is normally distributed, approximately two thirds of the time a random variable's outcome will fall within 1 standard deviation from its mean. The larger the standard deviation the larger the range of possible outcomes of the random variable.

To simulate for the data, the NORMINV(RAND) function was used in conjunction with the data table feature of EXCEL. A simulation with 100 random generations was examined. Each of the 100 market share assumptions were estimated using the EXCEL formula:

=(NORMINV(RAND(), Mean, Standard Deviation)).

When management sets a market share goal, the actions and decisions made throughout the year results in more than one possible outcome. Each potential outcome has a probability of occurring, some more than others. Understanding the probability of the outcome is critical when setting the goal. Probability is defined as a numeric measure of the likelihood that an event will occur (Schurle 2015). Probabilities are between 0% and 100%. All the probabilities must add up to 100%.

Probabilities can be objective or subjective. Objective probabilities are more like a game of chance and rise as relative frequencies over the long run under constant conditions. The probability of hitting red on the roulette wheel is constant if the spin is repeated enough times. Objective probabilities are less prevalent when considering the probability of meeting a market share goal because many different variables change throughout the course of a year. Subjective probability occurs when conditions are not held constant. Probability assessments range from highly objective to highly subjective (Schurle 2015). For the purpose of this study, probabilities are subjective.

Probabilities are either discrete or continuous. Discrete probabilities have a fixed number of possible results. Continuous probabilities have an infinite number of results. The purchase of a piece of equipment a farmer makes is either from the brand of the company or another brand, the competitor. This is a discrete probability.

3.2 Regression Analysis

Regression was used to examine the impact of variables on market share. Regression is a statistical method to explain correlations in a dependent variable as a result of the movements in other variables known as independent variables. Market share was the dependent variable and three independent variables were examined to estimate their impact on market share. Finding published information on factors relating to farm equipment machinery market share proved difficult. An article published by the USDA (USDA - United States Department of Agriculture Economic Research Service n.d.) found that debt-equity ratio was highly significant in determining machinery demand. For the purpose of this research, the impact of cash receipts and debt / equity ratio on market share was studied. Cash receipts, the debt / equity ratio, and the year are the independent variables.

$$Market\ Share = f(\beta_{1\ CASH\ RECEIPTS}, \beta_{2DEBT\ /\ EQUITY\ RATIO}, \beta_{3\ YEAR})$$

Table 3.1 further outlines this theoretical model.

Table 3.1: Theoretical market share model coefficients

Coefficient	Description	Expected Sign
β_1	Corn + Soybean Cash Receipts from Farm Marketings (USDA)	Positive
β_2	Debt / Equity Ratio from Farming Sector Balance Sheets (USDA)	Negative
β_3	Year	Positive

Market Share: Market share is a company's portion of the market. It is calculated by dividing the company sales by the industry sales. Historical market share values were collected from the Association of Equipment Manufacturers (AEM).

Cash Receipts:

USDA defines crop cash receipts as the cash income the United States farm sector receives from the sale of agricultural commodities (USDA - United States Department of

Agriculture Economic Research Service n.d.). As indicated in Figure 1.1, an increase of cash receipts occurred until 2012 when the commodity prices dropped resulting in lower cash receipts.

Table 3.2 displays the historical debt / equity data from USDA for the time period 1996 to 2015. An article published by Farm Equipment in 2015 indicated that an increase in non-real estate borrowing occurred in 2015 due to lower cash income resulting in farmers being unable to cover operating expenses (Equipment 2015).

Agricultural equipment is expensive and the majority is used on a seasonal basis depending on the crop type. These expenses have been estimated to account from 35 to 50 percent of the total operating expense on a farm (Adrian 1986). As cash receipts increase, farmers have more income to update and upgrade machinery. Used equipment buyers may enter the new equipment space with increased cash. Higher income farmers may invest in higher capacity machines with better quality. (Robert D. Buzzell 1975) indicates that when purchasing durable higher unit-cost items such as equipment, buyers have a bigger risk of making the wrong choice. Therefore, the purchaser is often willing to pay a premium for assured quality. Depending on the company of study this could impact market share positively or negatively.

Based on the company of study, it is known that the equipment receives high quality ratings, is viewed as more advanced in technology and therefore typically receives a higher price. When farmers are unable to cover operating expenses, it is expected to result in a lower market share. As a result, based on the company of study, it is suggested that as corn and soybean cash receipts increase, the market share will increase.

Table 3.2: USDA Historical Cash Receipts (1996 – 2015)

Year	Corn and Soybean Cash Receipts ($ Billions)
1996	35.53
1997	38.11
1998	32.76
1999	26.43
2000	27.21
2001	27.10
2002	31.71
2003	35.54
2004	37.62
2005	35.40
2006	40.16
2007	57.12
2008	74.77
2009	77.17
2010	82.20
2011	95.86
2012	116.12
2013	104.43
2014	95.31
2015	83.36
2016F	80.40

Debt / Equity Ratio from Farming Sector Balance Sheets:

USDA defines debt to equity ratio as the proportion of total farm capital in the form of debt compared to the owner provided capital, equity (USDA - United States Department of Agriculture Economic Research Service n.d.). When commodity prices increase and farmers earn more money they often purchase new technology and equipment, invest in the farm and add more equity to their operations.

Table 3.3 displays the historical debt / equity data for the United States farming sector from USDA for the time period 1996 through 2015. From 2003 to 2006 as farmer

debt / equity was decreasing market share was increasing. An article in Farm Equipment reported that the Federal Reserve of Kansas City saw an increase in production loans but less demand for equipment loans (Equipment 2015). This occurred as the asset and equity rates declined in 2015.

(Maynard 2007) found that in relation to car buyers, cash-paying customers are typically wealthier. They have the ability to pull cash from investments. A general sales manager for Lexus said 25 percent of customers paid cash (Maynard 2007). If car buyers can be compared to farmers, this would suggest that when farmers have the cash and debt is decreasing they purchase more equipment.

Therefore, based on the company of study, it is suggested that as the debt / equity ratio decreases, market share increases.

Table 3.3: USDA Debt / Equity Ratio

Year	Debt / Equity Ratio
1996	0.17
1997	0.18
1998	0.18
1999	0.17
2000	0.16
2001	0.16
2002	0.18
2003	0.16
2004	0.15
2005	0.14
2006	0.13
2007	0.14
2008	0.15
2009	0.16
2010	0.15
2011	0.15
2012	0.13
2013	0.13
2014	0.13
2015	0.14
2016 F	0.14

Year:

Year is the four digit year in the analysis. Year represents a time trend and captures the effects of other non-quantifiable variables. Farmers expect more from agricultural equipment. As technology advances, the equipment must advance to meet the demands of the customer. Based on the company being studied, advances in technology have occurred. As farmers understand and embrace new technology, it is likely that companies that produce more efficient, productive and innovative equipment will lead the market. An analysis on the market share for 1996 through 2015 was completed. A positive trend was

reflected in the market share over time. Therefore, based on the company of study it would suggest that as time increases market share increases.

CHAPTER IV: RESULTS

4.1 Simulation Model Using Historical Mean and Standard Deviation

After obtaining historical market share data from AEM, a simulation model using EXCEL data table was created to determine the likelihood of achieving a market share goal.

4.1.1 Simulation using Data Table:

The NORMINV(RAND) function was used with the data table feature of EXCEL to develop the simulation model with 100 random generations. Each of the 100 market share assumptions were determined using the formula:

=(NORMINV(RAND(), Mean, Standard Deviation)).

The historical market share had a mean of 27.53 and a standard deviation of 3.88%. The prevous year share was 31.00%. It was determined that the previous year share of 31.00% was a better representation of the expected market share next year than the historical mean. Table 4.1 shows a summary of the data set used.

Table 4.1: Data Set Summary

	Mean	Standard Deviation	Goal
Market Share	31.00%	3.88%	33.00%

4.1.2 Goal:

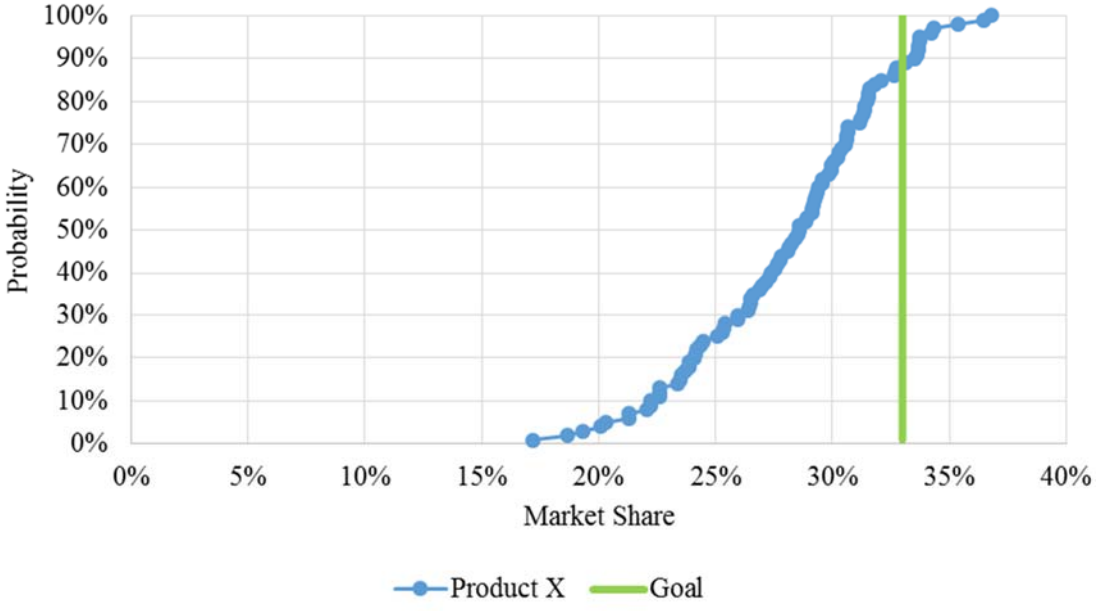
A market share goal of 33.00% was set for next year. This goal was set by examining the market share from the previous year and then applying a 2.00% degree of stretch.

4.1.3 Simulation Results:

The simulation results determined the probability of achieving the 33.00% market share goal. As illustrated in Figure 4.1, with the mean and standard deviation of historical data only 12 of 100 random generations resulted in market share greater than the 33.00% goal. This indicates that there is a 12.00% probability of meeting or exceeding the market share goal. There is a 88.00% probability of the market share for 2016 being below the goal of 33.00%. The complete data set is found in Appendix (A.1).

The first simulation model used historical data to estimate a mean and a standard deviation without considering any economic variables that could influence market share. This approach, while simple, may not accurately estimate a mean or the standard deviation around that mean. Therefore, a more refined model was developed to take into account variables that influence market share by using a regression model.

Figure 4.1: Market Share Probability of Achieving Goal of Product X using Simulation Modeling



4.2 Regression Model

To predict future market share, a regression model was used to determine the impact of factors on market share. Three independent variables were used in the regression model. (USDA - United States Department of Agriculture Economic Research Service n.d.) historical data was used to gather the cash receipts and debt / equity ratio for the years 1996 - 2015. A year variable representing time trend was used to capture the effects of other non-quantifiable variables that change over time. After all the data was obtained the regression model was estimated using the data analysis add-in from EXCEL.

4.2.1 Regression Model Results Summary:

Table 4.3 provides a summary of the regression model output. The signs of the coefficients were as expected. None of the coefficients were statistically significant (t Stat greater than 2.00 and a P-value less than 0.05). The t stat, also known as the t-statistic is a measure of the statistical significance of the variable. A t stat in its absolute form greater than 2.00 indicates that the variable is statistically significant. None of the variables in this model generated a t-statistic greater than 2.00. The P-value measures the probability of the statistical significance of a variable and is considered statistically significant if less than 0.05. None of the variables generated a P-value less than 0.05.

The model forecasted market share at 31.13 % and a standard error of 3.45%. The market share forecast was used as the mean and the standard error of 3.45% was used in a second simulation model. The mean and standard error of the regression model can be compared to the mean and standard deviation of the historical data. The complete data set can be found in Appendix (A.4).

4.2.1.1 Cash Receipts – Variable Results:

The sign returned for cash receipts was positive as expected. For every 1 billion dollar increase in cash receipts, market share will increase by 0.007% holding all other variables constant. The p-value is 0.89 and is not statistically significant.

4.2.1.2 Debt / Equity Ratio – Variable Results:

The sign returned for debt / equity ratio was negative as expected. For every 1 unit increase in debt / equity ratio, market share will decrease by 0.075% holding all other variables constant. The p-value is 0.92 and is not statistically significant.

4.2.1.2 Time – Variable Results:

The sign returned for time was positive as expected. For every year increase in time, market share will increase by 0.33% holding all other variables constant. The p-value is 0.39 and is not statistically significant.

Table 4.3: Regression Model Output

Variable	Model	Coefficients	Standard Error	t Stat	P-value
Intercept		-6.01375	7.64393	-0.78674	0.44293
Cash Receipts		0.00007	0.00057	0.12995	0.89822
Debt/Equity Ratio		-0.07461	0.82865	-0.09003	0.92938
Time		0.00329	0.00378	0.86941	0.39748
Standard Error	3.45%				
Mean	31.13%				

4.3 Simulation Model Using Regression Model Results

After obtaining historical market share data from AEM, a simulation model using EXCEL data table was completed to determine the probability of achieving a market share goal. The forecasted market share from the regression model was used as the mean and standard error were used in the development of a simulation model.

4.3.1 Simulation using Data Table:

The NORMINV(RAND) function was used in conjunction with the data table feature of EXCEL to develop the simulation model with 100 random generations. Each of the 100 market share assumptions were determined using the formula: =(NORMINV(RAND(), Mean, Standard Error)).

The forecasted market share of 31.13% from the regression model was used as the mean in the simulation. The regression model generated a standard error of 3.45%. Table 4.4 shows a summary of the data set used in the simulation.

Table 4.4: Data Set Summary

	Mean	Standard Deviation	Goal
Market Share	31.13%	3.45%	33.00%

4.3.2 Goal:

As indicated previously, a market share goal of 33.00% for next year was set. This goal was set by examining the market share from the last year in the data set and then applying a 2.00% degree of stretch.

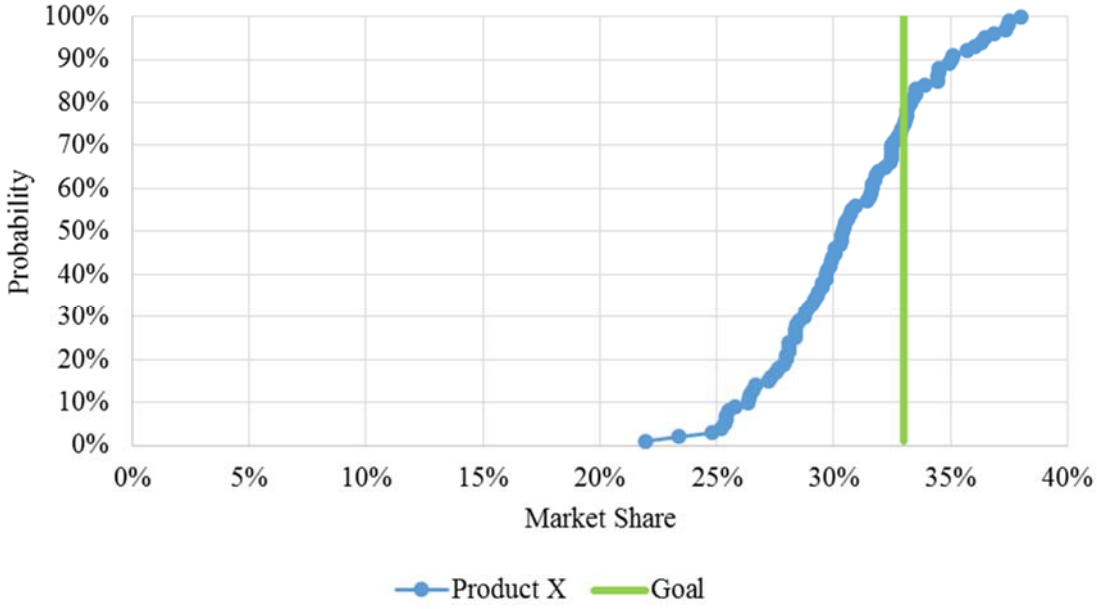
4.3.2 Simulation Results using Regression Model:

The simulation results determined the probability of achieving the 33.00% market share goal. As illustrated in Figure 4.2, with the forecasted mean of the regression model and standard error, 26 random generations resulted in market share greater than the 33.00% goal. This indicates that there is a 26.00% likelihood of meeting or exceeding the market share goal. There is a 74.00% probability of the market share for 2016 being below the goal of 33.00%. The complete data set can be found in Appendix (A.3).

This model generated a probability indicating that 26.00% of the time, the goal would be met. This probability should be considered when looking at adjusting the sales

goals to a more achievable level. If other independent variables are known, they should be modeled using regression models to determine the best estimate for the mean and determine if more of the variability can be explained.

Figure 4.2: Market Share Probability of Achieving Goal of Product X using Simulation Modeling generated from Regression Model



4.4 Comparison of the Historical Simulation Model and the Simulation Model using Regression Analysis

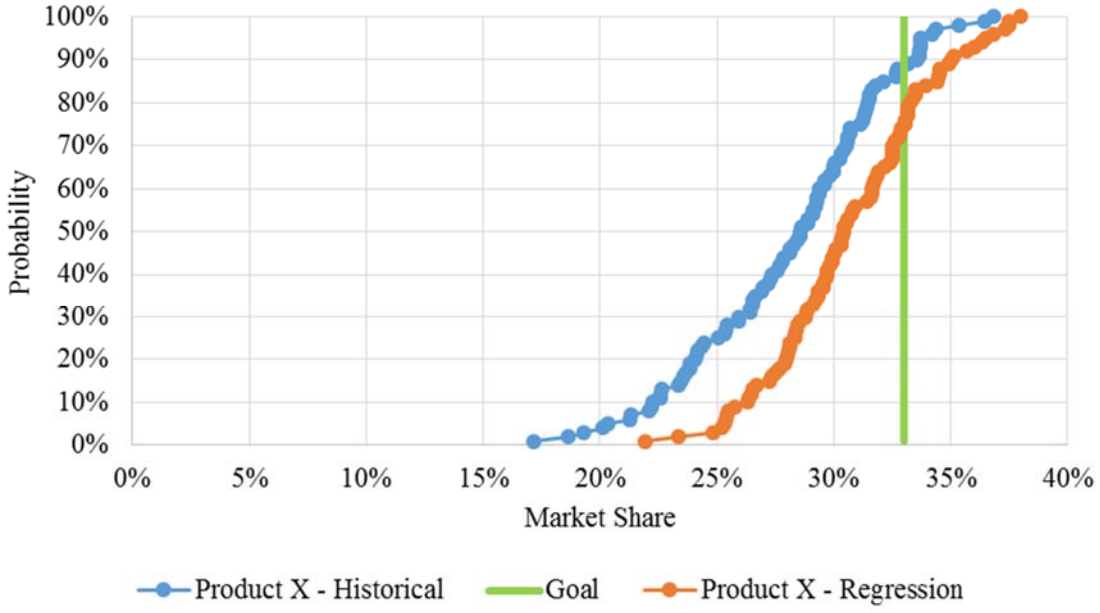
The mean and standard error generated by the regression model were compared against the mean and standard deviation calculated from the historical data. This was performed to allow a comparison between the two simulation models. The data in Table 4.5 shows a summary of the two outputs. The mean for the historical model was 31.00%. The regression model forecasted a market share of 31.13%, using cash receipts, debt / equity ratio and year as independent variables. The range between the two means was less than 4.00%, with the forecasted mean being higher. The standard deviation for the historical model was 3.88% and the standard error generated from the regression model

was 3.45%. Regression removed only a small amount of the expected variability in market share. The standard deviation and standard error between the two models had a difference less than 0.43%. Figure 4.3 shows the output of the historical and regression model. The figure illustrates that the historical model predicts share to surpass the goal 12.00% of the time. The simulation using regression modeling predicts that share will exceed the goal 26.00% of the time.

Table 4.5: Comparison of Simulation Data and Results – Historical vs. Regression Model

	Mean	Standard Deviation	Goal	Liklihood of Achieving Goal	Liklihood of Not Achieving Goal
Market Share (Historical)	31.00%	3.88%	33.00%	12.00%	88.00%
Market Share (Regression Model)	31.13%	3.45%	33.00%	26.00%	74.00%

Figure 4.3: Comparison of Market Share Probability of Achieving Goal of Product X using Simulation Modeling generated from Historical Data versus Regression Model



CHAPTER V: CONCLUSION

The overall purpose of this thesis was to develop a model that determines the probability of achieving a market share goal. The mean and standard deviation of the historical data was first used to develop a simulation model. In an effort to obtain a better estimate the of the mean and standard deviation, a regression model with independent variables assumed to impact share was used to forecast market share. The forecasted share was used as the mean and the standard error of the model was used to create a second simulation model.

The market share forecast and standard error from the regression model produced the best simulation model in terms of meeting the goal. Although none of the independent variables were statistically significant, the regression model generated better results. It has a higher mean and a slightly lower estimate of the expected variability of the market share. Some of the variability in the historical market share was explained when using a regression model with independent factors that influence market share. Internal and external variables can change from year to year and the regression model allows the user to change variables to determine which best explains the variability in share. The more variability that can be explained, the better the tool will be in predicting the probability of achieving a market share goal.

This tool can be leveraged in discussions prior to setting market share goals. Neither of these models produced a high probability of achieving the market share goal. This feedback can be shared with management to determine if goals should be adjusted to ensure the sales and marketing teams stay actively engaged in achieving the goal.

WORKS CITED

Adrian, Ebenezer F. Kolajo and John L. 1986. "Structural Analysis of Farm Machinery Demand in the United States." *Oxford Journals* 8 (2): 12. Accessed October 09, 2016.

Bruce Bjornson, Jason Klipfel. 2000. "Farm equipment industry performance: past and future." Columbia, Missouri: International Food and Agribusiness Managment Review, August 22. 14.

n.d. *CNH Industrial.* Accessed October 29, 2016. http://www.cnhindustrial.com/en-us/know_us/our_history/Pages/default.aspx.

Equipment, Farm. 2015. *Farm Equipment.* April 10. Accessed November 21, 2015. https://www.farm-equipment.com/articles/11543-declining-growth-rate-of-us-farm-assets-will-impact-lending-in-2015.

Hoag, Dana L. 2009. "Relying on History to Define Performance." In *Applied Risk Managment in Agriculture*, by Dana L. Hoag, 419. Boca Raton, London, New York: CRC Press - Taylor & Francis Groug.

n.d. *John Deere.* Accessed October 29, 2016. https://www.deere.com/en_US/corporate/our_company/about_us/history/timeline/timeline.page?

Kalb, Ira. 2014. *Business Insider.* January 21. Accessed October 04, 2015. https://www.entrepreneur.com/article/234204.

Maynard, Micheline. 2007. *The New York Times.* July 28. Accessed November 21, 2016. http://www.nytimes.com/2007/07/28/business/yourmoney/28money.html.

Michael R. Baye, Jeffrey T. Prince. 2014. *Managerial Economics and Business Strategy.* Vol. 8. McGraw-Hill Irwin. Accessed October 2016.

Palisade Corporation. 2016. *Monte Carlo SImulation.* Accessed October 2016, 04. http://www.palisade.com/risk/monte_carlo_simulation.asp.

Ragsdale, Cliff T. 1998. *Spreadsheet Modeling and Decision Analysis: A Practical Introduction to Managment Science.* Second. Cincinnati, OH: International Thomson Publishing.

Robert D. Buzzell, Bradley T. Gale, Ralph G.M. Sultan. 1975. *Harvard Business Review.* January. Accessed November 22, 2016. https://hbr.org/1975/01/market-share-a-key-to-profitability.

Schurle, Dr. Bryan. 2015. "Agribusiness Risk Managment - AGEC 730."

n.d. *USDA - United States Department of Agriculture Economic Research Service.* Accessed October 04, 2016. http://www.ers.usda.gov/data-products/farm-income-and-wealth-statistics/general-documentation.aspx.

Winston, Wayne L. 2004. *Microsoft Excel Data Analysis and Business Modeling.* Redmond, Washington: Microsoft Press.

APPENDIX A

A.1 Simulation Model Using Historical Mean and Standard Deviation Results

Random #	Market Share	Probability	Cumulative Probability	Goal
1	17.17%	1.00%	1.00%	33.00%
2	18.65%	1.00%	2.00%	33.00%
3	19.31%	1.00%	3.00%	33.00%
4	20.10%	1.00%	4.00%	33.00%
5	20.31%	1.00%	5.00%	33.00%
6	21.28%	1.00%	6.00%	33.00%
7	21.31%	1.00%	7.00%	33.00%
8	22.07%	1.00%	8.00%	33.00%
9	22.21%	1.00%	9.00%	33.00%
10	22.25%	1.00%	10.00%	33.00%
11	22.59%	1.00%	11.00%	33.00%
12	22.60%	1.00%	12.00%	33.00%
13	22.64%	1.00%	13.00%	33.00%
14	23.36%	1.00%	14.00%	33.00%
15	23.48%	1.00%	15.00%	33.00%
16	23.57%	1.00%	16.00%	33.00%
17	23.69%	1.00%	17.00%	33.00%
18	23.86%	1.00%	18.00%	33.00%
19	23.86%	1.00%	19.00%	33.00%
20	24.08%	1.00%	20.00%	33.00%
21	24.14%	1.00%	21.00%	33.00%
22	24.18%	1.00%	22.00%	33.00%
23	24.36%	1.00%	23.00%	33.00%
24	24.46%	1.00%	24.00%	33.00%
25	25.06%	1.00%	25.00%	33.00%
26	25.30%	1.00%	26.00%	33.00%
27	25.35%	1.00%	27.00%	33.00%
28	25.41%	1.00%	28.00%	33.00%
29	25.93%	1.00%	29.00%	33.00%
30	25.95%	1.00%	30.00%	33.00%
31	26.39%	1.00%	31.00%	33.00%
32	26.44%	1.00%	32.00%	33.00%
33	26.51%	1.00%	33.00%	33.00%
34	26.52%	1.00%	34.00%	33.00%
35	26.62%	1.00%	35.00%	33.00%
36	26.90%	1.00%	36.00%	33.00%
37	26.97%	1.00%	37.00%	33.00%
38	27.18%	1.00%	38.00%	33.00%
39	27.31%	1.00%	39.00%	33.00%
40	27.37%	1.00%	40.00%	33.00%
41	27.57%	1.00%	41.00%	33.00%
42	27.68%	1.00%	42.00%	33.00%
43	27.77%	1.00%	43.00%	33.00%
44	27.82%	1.00%	44.00%	33.00%
45	28.10%	1.00%	45.00%	33.00%
46	28.13%	1.00%	46.00%	33.00%
47	28.27%	1.00%	47.00%	33.00%
48	28.42%	1.00%	48.00%	33.00%
49	28.55%	1.00%	49.00%	33.00%
50	28.58%	1.00%	50.00%	33.00%
51	28.59%	1.00%	51.00%	33.00%
52	28.87%	1.00%	52.00%	33.00%
53	28.89%	1.00%	53.00%	33.00%
54	29.11%	1.00%	54.00%	33.00%
55	29.12%	1.00%	55.00%	33.00%
56	29.19%	1.00%	56.00%	33.00%
57	29.25%	1.00%	57.00%	33.00%
58	29.29%	1.00%	58.00%	33.00%
59	29.36%	1.00%	59.00%	33.00%
60	29.39%	1.00%	60.00%	33.00%
61	29.58%	1.00%	61.00%	33.00%
62	29.59%	1.00%	62.00%	33.00%
63	29.82%	1.00%	63.00%	33.00%
64	29.98%	1.00%	64.00%	33.00%
65	29.98%	1.00%	65.00%	33.00%
66	30.05%	1.00%	66.00%	33.00%
67	30.24%	1.00%	67.00%	33.00%
68	30.30%	1.00%	68.00%	33.00%
68	30.41%	1.00%	69.00%	33.00%
69	30.55%	1.00%	70.00%	33.00%
70	30.59%	1.00%	71.00%	33.00%
71	30.60%	1.00%	72.00%	33.00%
72	30.68%	1.00%	73.00%	33.00%
73	30.69%	1.00%	74.00%	33.00%
74	31.14%	1.00%	75.00%	33.00%
75	31.22%	1.00%	76.00%	33.00%
76	31.31%	1.00%	77.00%	33.00%
77	31.37%	1.00%	78.00%	33.00%
78	31.38%	1.00%	79.00%	33.00%
79	31.48%	1.00%	80.00%	33.00%
80	31.52%	1.00%	81.00%	33.00%
81	31.54%	1.00%	82.00%	33.00%
82	31.62%	1.00%	83.00%	33.00%
83	31.79%	1.00%	84.00%	33.00%
84	32.10%	1.00%	85.00%	33.00%
85	32.66%	1.00%	86.00%	33.00%
86	32.68%	1.00%	87.00%	33.00%
87	32.75%	1.00%	88.00%	33.00%
88	33.16%	1.00%	89.00%	33.00%
89	33.52%	1.00%	90.00%	33.00%
90	33.63%	1.00%	91.00%	33.00%
91	33.66%	1.00%	92.00%	33.00%
92	33.69%	1.00%	93.00%	33.00%
93	33.72%	1.00%	94.00%	33.00%
94	33.73%	1.00%	95.00%	33.00%
96	34.21%	1.00%	96.00%	33.00%
97	34.34%	1.00%	97.00%	33.00%
98	35.36%	1.00%	98.00%	33.00%
99	36.46%	1.00%	99.00%	33.00%
100	36.82%	1.00%	100.00%	33.00%

A.2 Regression Model Results

Regression Statistics	
Standard Error	0.0345
Observations	20

ANOVA

	df	SS	MS	F	Significance F
Regression	3	0.01	0.00	2.70	0.08
Residual	16	0.02	0.00		
Total	19	0.03			

Variable	Model	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept		-6.01	7.64	-0.79	0.44	-22.22	10.19	-22.22	10.19
Cash Receipts		0.00	0.00	0.13	0.90	0.00	0.00	0.00	0.00
Debt/Equity Ratio		-0.07	0.83	-0.09	0.93	-1.83	1.68	-1.83	1.68
Time		0.00	0.00	0.87	0.40	0.00	0.01	0.00	0.01
Standard Error	3.45%								
Mean	31.13%								

A.3 Simulation Model Using Regression Model Mean and Standard Deviation Results

Random #	Market Share	Probability	Cumulative Probability	Goal
1	21.94%	1.00%	1.00%	33.00%
2	23.38%	1.00%	2.00%	33.00%
3	24.81%	1.00%	3.00%	33.00%
4	25.21%	1.00%	4.00%	33.00%
5	25.33%	1.00%	5.00%	33.00%
6	25.40%	1.00%	6.00%	33.00%
7	25.42%	1.00%	7.00%	33.00%
8	25.49%	1.00%	8.00%	33.00%
9	25.78%	1.00%	9.00%	33.00%
10	26.32%	1.00%	10.00%	33.00%
11	26.38%	1.00%	11.00%	33.00%
12	26.45%	1.00%	12.00%	33.00%
13	26.54%	1.00%	13.00%	33.00%
14	26.68%	1.00%	14.00%	33.00%
15	27.23%	1.00%	15.00%	33.00%
16	27.34%	1.00%	16.00%	33.00%
17	27.54%	1.00%	17.00%	33.00%
18	27.68%	1.00%	18.00%	33.00%
19	27.88%	1.00%	19.00%	33.00%
20	27.97%	1.00%	20.00%	33.00%
21	28.01%	1.00%	21.00%	33.00%
22	28.08%	1.00%	22.00%	33.00%
23	28.11%	1.00%	23.00%	33.00%
24	28.12%	1.00%	24.00%	33.00%
25	28.35%	1.00%	25.00%	33.00%
26	28.36%	1.00%	26.00%	33.00%
27	28.37%	1.00%	27.00%	33.00%
28	28.44%	1.00%	28.00%	33.00%
29	28.54%	1.00%	29.00%	33.00%
30	28.77%	1.00%	30.00%	33.00%
31	28.82%	1.00%	31.00%	33.00%
32	28.89%	1.00%	32.00%	33.00%
33	29.09%	1.00%	33.00%	33.00%
34	29.20%	1.00%	34.00%	33.00%
35	29.32%	1.00%	35.00%	33.00%
36	29.34%	1.00%	36.00%	33.00%
37	29.52%	1.00%	37.00%	33.00%
38	29.54%	1.00%	38.00%	33.00%
39	29.66%	1.00%	39.00%	33.00%
40	29.68%	1.00%	40.00%	33.00%
41	29.72%	1.00%	41.00%	33.00%
42	29.84%	1.00%	42.00%	33.00%
43	29.92%	1.00%	43.00%	33.00%
44	29.94%	1.00%	44.00%	33.00%
45	30.05%	1.00%	45.00%	33.00%
46	30.07%	1.00%	46.00%	33.00%
47	30.29%	1.00%	47.00%	33.00%
48	30.34%	1.00%	48.00%	33.00%
49	30.35%	1.00%	49.00%	33.00%
50	30.40%	1.00%	50.00%	33.00%
51	30.44%	1.00%	51.00%	33.00%
52	30.52%	1.00%	52.00%	33.00%
53	30.61%	1.00%	53.00%	33.00%
54	30.74%	1.00%	54.00%	33.00%
55	30.79%	1.00%	55.00%	33.00%
56	30.92%	1.00%	56.00%	33.00%
57	31.42%	1.00%	57.00%	33.00%
58	31.55%	1.00%	58.00%	33.00%
59	31.60%	1.00%	59.00%	33.00%
60	31.63%	1.00%	60.00%	33.00%
61	31.66%	1.00%	61.00%	33.00%
62	31.74%	1.00%	62.00%	33.00%
63	31.82%	1.00%	63.00%	33.00%
64	31.91%	1.00%	64.00%	33.00%
65	32.18%	1.00%	65.00%	33.00%
66	32.41%	1.00%	66.00%	33.00%
67	32.48%	1.00%	67.00%	33.00%
68	32.49%	1.00%	68.00%	33.00%
68	32.49%	1.00%	69.00%	33.00%
69	32.50%	1.00%	70.00%	33.00%
70	32.61%	1.00%	71.00%	33.00%
71	32.77%	1.00%	72.00%	33.00%
72	32.85%	1.00%	73.00%	33.00%
73	32.91%	1.00%	74.00%	33.00%
74	33.02%	1.00%	75.00%	33.00%
75	33.07%	1.00%	76.00%	33.00%
76	33.13%	1.00%	77.00%	33.00%
77	33.14%	1.00%	78.00%	33.00%
78	33.17%	1.00%	79.00%	33.00%
79	33.28%	1.00%	80.00%	33.00%
80	33.41%	1.00%	81.00%	33.00%
81	33.51%	1.00%	82.00%	33.00%
82	33.51%	1.00%	83.00%	33.00%
83	33.90%	1.00%	84.00%	33.00%
84	34.44%	1.00%	85.00%	33.00%
85	34.45%	1.00%	86.00%	33.00%
86	34.51%	1.00%	87.00%	33.00%
87	34.51%	1.00%	88.00%	33.00%
88	34.94%	1.00%	89.00%	33.00%
89	35.04%	1.00%	90.00%	33.00%
90	35.12%	1.00%	91.00%	33.00%
91	35.69%	1.00%	92.00%	33.00%
92	36.02%	1.00%	93.00%	33.00%
93	36.33%	1.00%	94.00%	33.00%
94	36.49%	1.00%	95.00%	33.00%
96	36.84%	1.00%	96.00%	33.00%
97	37.33%	1.00%	97.00%	33.00%
98	37.48%	1.00%	98.00%	33.00%
99	37.50%	1.00%	99.00%	33.00%
100	38.00%	1.00%	100.00%	33.00%