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CREDIT SCORE ANALYSIS

by

Abby Kern

B.S., Southern Illinois University, May 2016

A Research Paper
Submitted in Partial Fulfillment of the Requirements for the
Master of Science

Department of Agribusiness Economics
in the Graduate School
Southern Illinois University Carbondale
August, 2017

RESEARCH PAPER APPROVAL

CREDIT SCORE ANALYSIS

By

Abby Kern

A Research Paper Submitted in Partial

Fulfillment of the Requirements

For the Degree of

Master of Science

in the field of Agribusiness Economics

Approved by:

Dr. Dwight R. Sanders

Graduate School
Southern Illinois University Carbondale
April 20, 2017

AN ABSTRACT OF THE RESEARCH PAPER OF

ABBY KERN, for the Master of Science degree in AGRIBUSINESS ECONOMICS, presented on APRIL 20th, 2017 at Southern Illinois University Carbondale.

TITLE: CREDIT SCORE ANALYSIS

MAJOR PROFESSOR: Dr. Dwight R. Sanders

A person's credit score defines their credit and lending ability throughout their life. Building a credit score takes time and multiple steps. However, there are not a lot of studies done that help define the effects different variables have on credit scores and the effects different variables have on interest rates. This study explores the effects of age, income, and debt to income ratio have on a person's credit score. It explores the effects credit score, amount of the loan, term of the loan and loan type (agriculture, real-estate, and consumer) have on the interest rate a lender offers a customer. This report will be helpful for those who are trying to improve their credit score as well as for lenders who want to know what influences interest rates. Using the results, consumers can focus on the main factors that influence their credit score. By doing so, they can work on those areas to improve their score. Also, professional banks can focus on the main variables that impact the interest rates they offer. This shows the lending field what actually determines the consumer interest rates.

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CHAPTER 1

INTRODUCTION

A credit score is a statistic used to determine a person's ability to pay back a loan. A credit score normally ranges between 300-850 with 300 being the absolute lowest and 850 being the best score possible. The higher the credit score number someone has, the easier it is to qualify for a loan. A credit score is based on information pulled from credit reports. "In 2007, the national average FICO score was 723, and 58% of Americans had a score higher than 700, per Fair Isaac" (Monitoring Your Credit Score and Credit Report).

"A credit report contains information about your credit such as loan paying history and the status of your credit accounts. Lenders use these reports to make lending decisions" ("What is a credit reprot?"). A credit report contains information based on all past lending. The information on a credit report includes one's ability to make payments in a consistent and timely manner, the amount of credit a person has available, the amount of credit currently being used, and if a debt or bill collector is trying to collect the money owed. A few other things a credit report may include are rental repayment information, liens, judgements, and bankruptcies. Credit reports are used by lenders to determine if they want to lend a person money or not, what interest rate they will offer, and whether the customer will be able to meet the terms.

There are three major credit bureaus used to determine peoples credit score and FICO score: Experian, Equifax, and TransUnion. The information each bureau uses to determine the credit report can differ. Everyone has the right to purchase a free credit report from each of these companies once a year. "A FICO score is a type of credit score created by the Fair Isaac Corporation. Lenders use borrowers' FICO scores along with other details on borrowers' credit reports to assess credit risk and determine whether to extend credit." (What is the 'FICO Score').

Experian is one of the top credit bureaus in the industry. They have been in business for more than 125 years and they pride themselves on helping people prosper. Experian supports customers from more than 80 countries. Experian maintains information of more than 220 million United States customers and more than 25 million US active businesses. Experian offers people five different products: Free Credit Report, Credit score, Credit Monitoring, the 3 Bureau Credit Report and Cores, and Identity Theft Protection. They also offer four different business activities: credit services, decision analytics, marketing services, and customer services ("What's Your FICO Credit Score?").

Equifax has been in business since 1898 and has become one of the top three credit bureaus in the business (Equifax - Credit Experts). Equifax offers many different products and packages to its customers: Credit Monitoring, Identity Protection Assistance, and Credit Score and Credit Reports. In each area listed above they offer multiple different options ranging in price to fit the customer’s needs offering different products to businesses and individuals ("Compare Our Most Popular Products").

TransUnion was established in 1968 and over the next four decades became one of the leading credit bureaus in the trade. The company endeavors to help people throughout the world access information which leads to a greater quality of life. TransUnion offers packages for businesses as well as individuals. There are four popular products the company offers: Credit Protection, Credit Lock, Credit Score Simulator, and Free Identity Protection ("Credit Scores, Credit Reports & Credit Check).

CHAPTER 2

REVIEW OF LITERATURE

David Durand is credited for establishing credit scoring in 1941. He identified different variables that helped lenders distinguish between good and bad loans. “Financial institutions use credit scoring to distinguish among good and bad borrowers. For many these entities, a good borrower is simply the one who pays back his loans” (Gutiérrez-Nieto et al., 691). Soon to follow in 1946, E. F. Wonderlic developed a credit score guide that helped define and narrow the variables of good and bad loans. The credit score guide helped to indicate the degree of risk a customer had. In the 1950’s scorecards were becoming a popular instrument being used. FICO or Fair Isaac Corporation was founded in 1956 and introduced its first credit scoring system in 1958 (myFICO). These scorecards were models that helped to determine if a customer will default on their loan compared to their current financial position. The late 1960s to early 1970s brought about technology that allowed for credit scoring models to be developed further (Thomas, Ebelman and Crook 2004). “There is no single, one-size-fits-all credit scoring system. Each business builds its own model, and there are many methodologies for building this model” (Eldeman 59). In the past couple decades, banks have been allowed to develop their own credit scoring models. For them to be allowed to do this, the model had to satisfy the regulators and be able to determine the minimum amount of principal to preserve to cover unexpected defaulted loans (Crook, Edelman, Thomas, 2005).

There were many challenges credit scoring had to face in the beginning though. The first being the numerical rating system was impersonal. People were treated as a number and not as an individual. Their credit score put them in a group of people the system thought they fit in to. Even though the person may be on time with all their payments, they could still be classified and

placed into a “bad risk” group. The second challenge was there should be a logical explanation between the credit performance and all the variables used in the credit scoring system. The credit scoring system should only use explanatory variables. Noel Capon noticed two types of errors in designing credit scoring systems: Type 1 and Type 2. Type I errors are good credit that is classified as bad credit and Type II errors are bad credit classified as good. The last challenge was discriminatory variables: race, color, sex, marital status and more. Some believed these variables had a large impact on their credit score and determined if they were denied or accepted for a loan. Many wanted the scorecards designed by credit scoring companies to adapt and design the scorecards so they would not be discriminated against indirectly (Thomas, Ebelman and Crook 2004).

The Equal Credit Opportunity Act (ECOA) of 1972 was created to prohibit “creditors from discriminating against credit applicants on the basis of race, color, religion, national origin, sex, marital status, age, because an applicant receives income from a public assistance program, or because an applicant has in good faith exercised any right under the Consumer Credit Protection Act” ("The Equal Credit Opportunity Act"). Any individual who believes they were victims of a discriminating credit transaction can file a complaint or file their own lawsuit. Many regulations have also been issued and these regulations provide the framework for fair lending. One downfall of this is, “despite laws outlawing discriminatory lending practices, it is possible that lenders use proxies for immutable characteristics in making their lending decisions, in establishing credit rates or in determining loan amounts” (Henderson et al. 461). Even though laws are put into place so discriminations won’t happen, it still occurs but the amount of times it transpires has been reduced.

CHAPTER 3

WHY YOUR CREDIT SCORE MATTERS AND HOW IT WORKS

"The number, known as a credit score, is designed to predict the possibility that you won't pay your bills" (Weston 2012, 1). A higher credit score will qualify a customer to receive lower interest rates. With credit score cards being more defined and being more able to predict those who were more likely to default, credit scoring took off in the 1990's. Each U.S. citizen is allowed a free copy of their credit report from all three credit bureaus yearly. When requesting a free credit score, one major factor to look for is making sure it has a real FICO score. Many different companies may off a free credit score but the person is actually signing up for credit monitoring and other services, which end up not being free (Weston 2012).

Everyone has many credit scores and they are constantly changing. A credit score is like a glimpse of a person's credit at a specific time. When one requests their credit score they are requesting their credit report. A credit report lists many different factors: name, address, Social Security number, credit accounts, requests for credit, public records, and collections. Credit reports not only list the positives about the accounts but it also lists the negatives. There are five main factors that affect a FICO score and each provides a certain level of importance to the credit score. This first factor is payment history and this equates to around 35% of the score. Paying bills on time helps increase a credit score. An example would be a late payment which would be a negative mark which lowers a credit score. The score focuses on three main factors: recency, frequency, and severity. The second factor is how much an individual owes and this contributes to the score approximately 30%. Keeping account balances low helps improve a credit score. Those who use more of their credit limit or max out their limit become a high-risk customer and more likely to default. The third factor is credit history and this makes up about

15% of the score. The longer a person has had a particular credit account the better. The age of the oldest account and the average age of all accounts affect the score as well. The fourth factor is the last application for credit applied for which makes up 10% of the score. "The average American has not opened an account in 20 months" (Weston 2012, 22). The amount of accounts an individual has applied for recently, the amount of accounts one has opened, the amount of time that has passed since applying for the credit, and the amount of time that has passed since the account was opened all factor into a credit score. The fifth and final factor is the types of credit used which is 10% of the total score. To obtain the highest possible credit score, one should have both revolving and installment debts. By obtaining a major credit card, this also helps contribute to gaining or maintaining a very good score (Weston 2012). A higher credit score will allow a person to obtain new credit accounts much easier than if they have a lower credit score.

Table 1 displays the FICO score ranges. Experian breaks down the range of 300-850 into 5 different categories: Very Poor, Poor, Good, Very Good, and Exceptional. Experian breaks down the range for each category in their own specific way but Equifax and TransUnion also do the same. There is not a set and defined FICO score range each company uses so these ranges vary between each company's own opinion (Weston 2012).

CHAPTER 4

IMPROVING YOUR CREDIT SCORE

Credit scores are affected multiple ways and improving a credit score can be a long, tedious process. There are many steps to take to improve one's score. The first step is to start with is obtaining the FICO credit report. Once all three free credit reports are obtained, start with checking the identifying information. Make sure the credit report states your name, Social Security number, birth date, and address. Then review the credit accounts listed. Look closely at each account to make sure all the accounts listed are yours. One could be a victim of identity theft if there are many incorrect accounts listed. The accounts listed that are yours should have "the date you opened them, whether the account is still open or now closed, the type of account, the account number (typically abbreviated), your payment history, your credit limits, and your balances" (Weston, 53). Once the whole credit report is checked, a person should see who has requested their credit report lately, examine the collections and public records, and then dispute the errors.

Step two is paying bills on time. Paying bills has become much easier with the invention of the internet. To make sure one gets their bills paid on time, there are many different options. The first is by making a list of all credit accounts and when they are due, this allows the consumer to see when the account is due and when to send the payment. Second is setting up automatic reminders which pop up when it is time to make a payment. The third is automatic debt which allows companies to automatically take the payment out of an account at the same time every month. The fourth is recurring credit card charges, instead of the company taking the payment out of the bank account, the company charges a credit card each month. The fifth is online bill payment. Online bill payments require the person to go online to the company's

website or most banks have bill pay. Bill pay allows the bank customer to go online to the banks website and select which company they want to pay, how much they want to pay each month, and when they want the payment taken out and sent off to the company.

Step three involves paying down what they currently owe instead of moving balances around. A person should only use a small portion of their credit limit. Experts recommend people keep their credit at 30 percent of their credit limit or less ("How Do I Get and Keep a Good Credit Score?"). When a person has multiple credit cards they use and one has a large amount of credit used and the others have little to no credit used, it is wise to just pay down on the one card instead of moving some of the credit to the other cards. By prioritizing debt, start with the account with the most amount of credit used and pay it down or off first. Then move to the account which has the second most used credit. Avoiding consolidating debts help improve a credit score. The score looks at the difference between how much credit is used on one account and the maximum limit amount for that account. Another way to help pay off debt is by paying attention to how much is charged each month. At the end of every month it is ideal to pay off the credit card balances. If not able to pay off the credit balance, at least try to make the minimum payment. Finally, there are other ways to make money to help pay off debt. The first is by selling stuff, like having a garage sale or selling items no longer used on eBay. Another is trimming spending, like staying home more or by making a list of everything money is spent on over a few weeks then looking at the list and see what is necessary and what is not. The last way to make a little extra money is by obtaining an extra job.

Step four of improving a credit score is by not closing revolving accounts. A credit score is impacted by the length of time the oldest account has been open. By closing an old account, which can make a person's credit history look younger than it can actually is, this could lower

the score. By shutting down some credit accounts, this decreases the total available credit which makes the other balances have more impact on the credit score.

Step five is to apply for credit sparingly. The first credit accounts opened help start, build, and improve one's credit score. By only applying for necessary credit, this will help improve one's score. If a person applies for a lot of credit in a short amount of time, then the person is most likely going through hardships and their ability to pay back all the credit could have been reduced. (How do I get and keep a good credit score?). But how does one obtain credit if they don't have any? Check your credit report anyways. Sometimes people discover they were a victim of identity theft in which case they should clean up their credit report before applying for new credit. Another way to obtain credit is by opening a checking or savings account. Normally a debit card is offered with a checking account once the person has proven they are responsible with their new checking account. By using someone else's good name, a younger adult can obtain credit. By signing someone who is responsible with their credit as an authorized or joint user, the person with limited credit is more likely to be accepted for credit. Applying for credit while in college is also an option to gaining credit. Another way to get credit is to apply for an alternate card. If denied for a regular credit card, one should apply for a gas or department store card which are easier to acquire. A secure card requires a deposit money into the account and then one can only spend the amount of money on the card. The last way for one to start building their credit is by going to a bank and getting a small installment loan. By being on time with payments every month, this shows credit bureaus responsibility and in return helps increase the credit score (Weston 2012).

CHAPTER 5

CREDIT SCORE MYTHS

Since the beginning of credit scoring, many have had to guess what helped or hurt one's credit score. Many credit bureaus did not want to release the information they used to create the scorecards used to determine one's credit score. Because of this, many myths have been formulated. The next ten myths explain why one shouldn't believe them.

The first myth is closing accounts will help a credit score. By closing accounts, this reduces total credit limit and sometimes makes the account look younger. In addition, closing accounts normally will not help the score. This is because opening accounts affects the score anyways and closing the account will not reverse the damage. One should close an account if there is a spending addiction or if there are charged annual fees on a credit card that is not used.

The second is the idea of boosting ones credit score by having credit card companies lower the limits. This is off the mark because by lowering the limits, this narrows the space between the amount of credit currently used and the amount one can use, which in return lowers the credit score. However, one can help their score by paying down their credit amount, which increases the gap between the amount of credit currently used and the maximum amount one can use.

The third myth is one can hurt their score by checking their credit report. By having lenders check ones credit report, this is putting out a hard inquiry which is counted against their credit score. Everyone should check their credit report once a year to make sure there is no false information reported because this false information will affect ones credit score. By obtaining a free credit report from each credit bureau, this does not put out a hard inquiry so this does not affect ones score.

The fourth myth is shopping around for the best rate can hurt a person's score. Hard inquiries are bad on a credit score. Dragging out the process of shopping around for rates can be detrimental to a credit score. The FICO formula ignores auto and mortgage related inquires made within thirty days. Therefore, if one has had five mortgage inquires and eight auto inquires within the thirty days then the formula would only count two inquiries total.

The fifth myth is to get a good credit score, one does not have to use credit. If a person has no credit or use credit very little, then the formula will not have enough information so a score will not be determined. One should not live in debt in order to get and keep a good credit score but the use of credit is necessary to obtain a credit score.

The sixth myth is to have a good score one, must pay interest. An individual does not need to always carry a balance on their credit card and paying just the interest will not boost a credit score. To have the highest possible score, one should have at least one revolving and one installment account.

The seventh myth is adding a 100-word statement to one's file can help boost their credit score. People have the right to provide a 100-word statement explaining the problem to the credit bureaus. By explaining the problem, lenders can see what has caused the score to be low. The statement does not affect one's score much because the formula cannot read it. The statements do not get coded so they can't be added to the formula.

Myth number eight is all closed accounts should read "Closed by Consumer." This proves the consumer closed the account instead of the creditor closing the account. Many lenders do not look through the credit report. They just check to see the score and then toss the report to the side.

Myth nine is credit counseling is worse than bankruptcy. A bankruptcy filing is the most detrimental to one's score no matter what. Credit counseling specializes in negotiating payment plans and lowering interest rates. People who are just keeping up with payments or can make the minimum should consider credit counseling instead of just filing for bankruptcy. Counseling is treated as an unbiased factor and does not impact a credit score.

The last myth, myth number ten, is bankruptcy will hurt a credit score so bad one will not be able to recover. Reestablishing credit will be a tough, slow process but it can happen if one is responsible with their credit. "If you start handling credit responsibly - paying your bills on time, not running up big balances, and not applying for a bunch of credit at once - your score will begin to recover" (Weston 2012, 80-81). Lenders do not like to cater to people with bad credit so stay patient until a lender who is willing to take the chance is found (Weston 2012).

CHAPTER 6

CREDIT CRISIS

"A credit crisis – being unable to manager your debts – can come on slowly as the result of overspending for many years. The balances on your accounts grow and grow; pretty soon you're able to make only the minimum payments, and then not even that" (Weston 2012, 83). There are a couple stages involved in handling credit problems.

Stage one is figuring out how to free up cash. Start with the easy stuff, the stuff that can be discarded with little effort. These things might include going out to eat less. Then go to the harder objects, the objects that involve more sacrifice to cut out. This could include selling an extra vehicle. Then the last-ditch things, which are the items one will only give up as a last resort. Last-ditch stuff can include a house. By selling unnecessary objects or obtaining another job, this is freeing up cash to put towards the credit crisis (Weston 2012).

Stage two involves evaluating all options. Stage two involves many different tasks also. The first task is to prioritize bills. Essential bills are those if failed to pay, will cause terrible consequences. These bills include mortgage payments and necessary medical payments. Important bills are those one should try to pay and if the payment is not paid, could cause bad consequences. These bills include insurance and income taxes. Nonessential bills are not secured and failure to pay these will damage your score but will not make an individual homeless. These bills include credit cards and gas cards. Task two is to match income to debt. Being able to cover the minimum payments is best but if not possible, then try to cut spending more. If the minimum payment can't be covered after cutting costs more, then consider other options. Task number three is deciding on a repayment plan. By prioritizing bills and limiting credit card use, an individual can slowly get themselves out of a credit crisis. One should try paying off their

accounts before they decide to allow them to be charged off. Charge offs lower credit scores significantly. Some people consider credit counseling during this time but make sure to choose a counselor who is creditable and reliable. Another option people opt for when they get too deep into debt is filing for bankruptcy (Weston 2012). “Bankruptcy allows us not only to discharge some taxes, it also allows us to clear out the other debts that are pre- venting our taxpayer from paying the priority tax debt” (Green, 8). Individuals can file for Chapter 7 and Chapter 13 bankruptcy. Chapter 7 bankruptcy involves “the bankruptcy trustee gathers and sells the debtor's nonexempt assets and uses the proceeds of such assets to pay holders of claims (creditors) in accordance with the provisions of the Bankruptcy Code” (Chapter 7 - Banktuptcy Basics). In other words, one must sell some assets to pay off creditors. “Chapter 13 offers individuals an opportunity to save their homes from foreclosure. By filing under this chapter, individuals can stop foreclosure proceedings and may cure delinquent mortgage payments over time. Nevertheless, they must still make all mortgage payments that come due during the chapter 13 plan on time” ("Chapter 13 - Bankruptcy Basics") . Coming up with and sticking to a five-year repayment plan is necessary. If this plan is not completed, then the case can either be dismissed which allows creditors to recommence collection of assets or converted to Chapter 7s.

Stage three requires a path to be chosen and acted upon. Choosing a pay-off plan is efficient if it is stuck too. If the pay-off plan is not stuck to, then this can cause an individual to burry himself or herself in more debt. Credit counseling is another good choice but make sure to choose a creditable counselor and paying debts is a long-term commitment. If the money needed to pay settlements is not spent, then choosing debt settlement is a good option. Finally, if bankruptcy is the best option, then file and make the best of the fresh start presented (Weston 2012).

CHAPTER 7

REBUILDING AND MAINTAINING A HEALTHY CREDIT SCORE

Rebuilding one's credit score is a slow, timely process. First start by repairing the credit report. By getting rid of any negative marks, this improves the score and makes one look less risky to lenders. By knowing each person's rights, one can affectively start rebuilding their score. An individual has the right to have the dispute investigated. The investigation normally takes place within thirty days and this process involves the credit bureau contacting the creditors about their errors. Once the error has been identified, everyone has the right to have the wrong data corrected. This data is then either corrected or if the provider can't verify it, then it is deleted. One also has the right to a written response. Once the investigation is complete, the bureau is required to provide a statement of its findings and a copy of the report if something was changed. One also has the right to include a statement with their report. This 100-word statement, clarified earlier in the paper, explains any problems with one's score. Finally, everyone has the right to sue. If a creditor does not respond to a dispute or continues to report inaccurate information, then a lawsuit is an option. Start by tackling all the accounts that have errors or are not yours. By taking care of those errors, this makes the credit report reflect one's credit history accurately. Once completed, start taking care of any unpaid debts. Also, start using the credit already available wisely. Applying for a secured card or having a cosigner will improve the chances of being accepted for a credit card. Only use credit cards when necessary, pay bills on time, and try to keep credit balances low. All those things help rebuild one's score (Weston 2012).

Maintaining a healthy credit score is key, once a credit score is obtained or rebuilt. There are many dos and don'ts when it comes to maintaining a healthy score. Starting with the dos. Paying off credit card balances at the end of every month keeps a customer from paying a lot in

interest every year and allows flexibility during harder times. Another do is to have an emergency fund. Keeping enough money stored away in a savings account to cover a couple months' takes a burden off when faced a situation where there will not be enough income for those couple of months. Having enough money to cover expenses for a couple months' gives one time to try to find a new source of income or get through the problem, which is inhibiting one from working. The last do is making having sufficient insurance. Insurance helps cover the costs during medical visits and emergencies. In addition, having at least liability insurance on one's home and automobile will keep oneself from getting sued (Weston 2012).

The first don't is to not buy more house than one can pay for. By keeping the mortgage payment to 25 percent or less of monthly income, this allows an individual to keep back what should be enough to cover everything else. The next don't is to not take out too much student loan debt. Many students take out the loans without realizing how much all together they have taken out. By the time graduation rolls around, the student realizes they are way over their head in student debt and cannot find a job that allows them to make the payments. Another don't is to not let fixed expenses consume all income earned. Keeping fixed expenses low allows one to have more money to go towards "wants" and savings. The last don't is to not wipe out one's retirement or borrow against the home equity to pay off credit cards. Transferring debt from one account to another does not decrease the amount owed. By wiping out the retirement account, an individual is putting themselves and their family in a potential hardship once it comes time for him or her to retire (Weston 2012).

CHAPTER 8

DATA AND METHODS

The research procedures for this analysis uses data collected from 100 different loans made from 2014-2016 from Buena Vista National Bank. The data consists of a list of 100 loans: 50 consumer loans, 25 are agricultural loans, and 25 are real-estate loans. The data set includes the following variables: credit score, amount of the loan, term of the loan in months, loan type, age of the customer, income per month, interest rate customer received, and debt to income ratio. By comparing the different variables to the customer's credit score, the objective is to see if age, income per month, and debt/income ratio affect a person's credit score. Another aim is to see if credit score, amount of the loan, term of the loan, and loan type influence the interest rate the lending company offers the customer.

A multiple regression model was used to show the relationship between variables. The Ordinary Least Squares (OLS) estimator will be applied to determine the explanatory variables coefficients. The purpose of OLS is to estimate the parameters of linear regression models. The purpose of OLS estimator is to minimalize the sum of squared errors. Doing this will produce the line of best fit. The line of best fit is a line that best displays the points in a scatter plot. Knowing the basic OLS regression assumptions is important and needed. The first assumption is the regression model should be linear in the parameters. This means the dependent variable is a linear combination of the independent variables and the error terms. The second assumption is the observations were collected using random sampling. The number of random samples taken should be more than the number of parameters. The third assumption is the mean of the error terms should be zero and there will be no relationship with the independent variables. The fourth

assumption is no perfect multicollinearity, no correlation between error terms. There should be no relationship between the independent variables and there should be no correlation between error terms and previous error terms. The fifth assumption is the error terms all have the same variance, or homoscedasticity. The linear regression model become heteroscedastic and delivers incorrect estimates if the variances are not constant. The sixth assumption states the error terms be normally disturbed.

Multiple hypothesis tests will be completed in this study. A t-test will be done for each for each independent variable. This method will be used to determine whether the estimated beta coefficient is statistically different from zero. Failure to reject the null hypothesis means the estimated coefficient has no significant effect on the dependent variable. Rejection of the null hypothesis means the independent variable has a significant impact on the dependent variable. A p-value of less than or equal to 0.05 indicates rejection of the null hypothesis. A p-value of 0.05 or larger indicates failure to reject the null hypothesis. A p-value helps determine the significance of the results found.

Along with the t-test, an F-test will also be completed to test the hypothesis R-square (R^2) value equals zero. R^2 demonstrates the explanatory value of the estimator model. Failure to reject the null hypothesis means the independent variables do a poor job in explaining variation in the dependent variable. Rejection of the null hypothesis happens when the calculated test statistic is greater than the critical value.

The data collected will be tested in two regressions. The first relationship being estimated is:

Credit Score = f (age, income per month, and debt/income ratio)

(1a) Credit Score = $\beta_0 + \beta_1$(age) + β_2 (income per month) + β_3 (debt to income ratio) + ε_i

Hypothesis Tests for (1):

1. H_0: $\beta_1 = 0$
2. H_0: $\beta_2 = 0$
3. H_0: $\beta_3 = 0$
4. H_0: $\beta_1 = \beta_2 = \beta_3 = 0$

Using the equation (1a), credit score was a set function of the three independent variables: age, income per month, and debt/income ratio. The expected sign of the coefficient for age will be positive, indicating an increase in the age of the customer will result in a higher credit score. Young adults are more likely to have lower credit scores because they have not been building their credit for very long. As people age, they acquire credit cards, installment loans, and revolving loans which if they stay current with their payments, their credit score will continue to increase or stay around a constant, good credit score. The income per month coefficient is expected to be positive. As a person’s income per month increases, the customer becomes able to afford more. People are then more likely to upgrade to nicer material things when their income rises. When upgrading, customers loan amounts increase and staying current with the new loans will in turn help increase an individual's credit score or it will plateau at a good score. The expected sign for debt to income ratio (DTI) will be negative. As an individual’s debt to income ratio increases, the person will then be spending more of their income on the debt they have accumulated. The lower the DTI ratio a

consumer has the less risky they are to lenders. Most lenders prefer their clients to have a DTI or 15% or lower.

The second relationship being estimated is:

Interest Rate = *f* (credit score, amount of the loan, term of loan, agriculture loan, real-estate loan)

(2a) Interest Rate = $\beta_0 + \beta_1$ (credit score) + β_2 (amount of the loan) + β_3 (term of loan) + β_4 D(Agriculture Loans) + β_5 D(Real-Estate Loans) + ε_i

Hypothesis Tests for (2):

1. H_0: $\beta_1 = 0$
2. H_0: $\beta_2 = 0$
3. H_0: $\beta_3 = 0$
4. H_0: $\beta_4 = 0$
5. H_0: $\beta_5 = 0$
6. H_0: $\beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = 0$

Using the equation (2a), interest rate was a set function of the four independent variables: credit score, amount of loan, term of loan, and loan type. The expected sign of the coefficient for credit score will be negative, indicating a higher credit score will result in a lower interest rate. The higher the credit score an individual has, proves to lenders one is responsible with their money. An example would be making payments on time and only applying for credit that is needed to name a few. The expected sign of the coefficient for the amount of the loan will be positive. The more money the customer is asking for will result in a higher interest rate offered. Some banks offer a set rate, which depends on economic growth, for real-estate loans which make up a lot of the bank's loan portfolio. When growth is high, the demand for money increases

which pushes interest rates up. When economic growth is low, the demand for money decreases which pushes interest rates down. Consumer loans are more likely to have a wide range of rates offered because the amount asked for is normally lower and the banks goal is to not only help the customer but to also make money on the loan. For the bank to do that, they charge a higher rate because every loan given costs the bank so much money to make the loan so they charge a higher interest rate so they can make that money back. The term of the loan coefficient is expected to be negative as well. The longer the term of the loan, the lower the interest rate the bank will offer. Banks want people to take out the loan they are seeking through their bank and so they try and give people the best interest rate for the term amount they can afford. The expected sign of the coefficient for agricultural loans will be negative. Also, the expected sign for real-estate loans will be negative. These two types of loans will have a negative coefficient because these types of loans will receive a lower interest rates compared to consumer loans. Banks normally have a constant real-estate loan interest rate they off to customers. It will have very little variation. Also, agricultural loans are offered a semi-constant interest rate for the equipment and revolving lines, naming a few examples of agriculture loans. The variation in the interest rates will be larger than real-estate loans but much smaller than consumer loans.

Dummy variables were used in this relationship. A dummy variable can take the value of 0 or 1 to indicate the presence or absence of an effect would alter the outcome. In this study, the type of loans used were consumer, agriculture and real-estate loans. Agriculture and real-estate loans were used as the dummy variables. Each will be used to compare their impact compared to the base which is the consumer loans.

CHAPTER 9

RESULTS

The following OLS estimation was used for this study and the test statistics are shown below the coefficient estimates for the first relationship.

(1a) Credit Score = 640.678 + 0.863(age) + 0.005 (income per month) – 97.131 (debt to income ratio) + ε_i

An explanation of the variables is provided in Table 2. As expected, the coefficients for both age and income per month are positive. The coefficient for age indicates a one-year increase in age will result in a 0.863 increase in credit score. The coefficient for income per moth indicates a one dollar increase in income per month will result in a 0.005 increase in credit score. As expected, the coefficient for debt to income ratio was negative. The coefficient for debt to income ratio indicates a 1% increase in the debt to income ratio will result in a decrease of 97.131 in credit score. The R^2 for this estimated model is 0.13, which means 87 percent of the variation in credit scores is not explained by age, income per month, and debt to income ratio. Since 87 percent of the variation in credit scores is not explained by age, income per month, and the debt to income ratio this means there are other variables that affect a credit score.

The critical value used for the t-tests conducted was +/- 1.990. Age had a test statistic of 1.99, so the statistical decision is to reject the null hypothesis. By rejecting the null hypothesis, this means age did have a statistically significant effect on credit score. The test statistic for income per month was 2.475, so the statistical decision is to reject the null hypothesis. By rejecting the null hypothesis, this means income per month did have a statistically significant effect on credit score. The test statistic for debt to income ratio was -1.468, so the statistical

decision is to fail to reject the null hypothesis. By failing to reject the null hypothesis, this means the debt to income ratio did not have a statistically significant effect on credit score. The F-statistic for the null hypothesis of H_0 $\beta_1 = \beta_2 = \beta_3 = 0$ is 4.88, which is greater than the critical value of 2.49, so the null hypothesis is rejected.

The following OLS estimation was used for this study and the test statistics are shown below the coefficient estimates for the second relationship.

(2a) Interest Rate = 0.140479 – 0.0000787 (credit score) + 0.00000000636 (amount of the loan) – 0.0000942(term of loan) – 0.021821 (Agriculture Loans) – 0.029339 (Real-Estate Loans) + ε_i

An explanation of the variables is provided in Table 2. As expected, the coefficient for credit score and term in months was negative. The coefficient for credit score indicates a one-point increase in credit score will result in a 0.00008 decrease in interest rate. The coefficient for term in months indicates a one-month increase in the term will result in a 0.00009 decrease in interest rate. The coefficient for amount of the loan was positive, as expected. The coefficient for amount for the loan indicates a one-dollar increase in loan amount will result in a 0.000000006 increase in interest rate. The coefficient for agriculture loans and real-estate loans was negative, as expected. The coefficient for agricultural loans indicates agricultural loans will result in a 0.022 decrease in the interest rate compared to consumer loans. The coefficient for real-estate loans indicates real-estate loans will result in a 0.029 decrease in interest rate compared to consumer loans. R^2 for this estimated model is 0.60, which means 60 percent of the variation in interest rates is explained by credit score, amount of the loan, term of the loan in months, agriculture loans, and real-estate loans.

The critical value used for the t-tests conducted was +/- 1.990. Credit score had a test statistic of -3.755, so the statistical decision is to reject the null hypothesis. By rejecting the null hypothesis, this means credit score did have a statistically significant effect on interest rates. The test statistic for amount of the loan was 0.157, so the statistical decision is to fail to reject the null hypothesis. By failing to reject the null hypothesis, this means amount of the loan did not have a statistically significant effect on interest rates. The test statistic for term of loan in months was -2.547, so the statistical decision is to reject the null hypothesis. By rejecting the null hypothesis, this means the term of the loan did have a statistically significant effect on interest rates. The t-statistic for agriculture loans was -5.7804, so the statistical decision is to reject the null hypothesis. By rejecting the null, this means agricultural loans have a statistically significant effect on interest rate compared to consumer loans. The t-statistic for real-estate loans was -6.605, so the decision is to reject the null hypothesis. By rejecting the null, this means real-estate loans have a statistically significant effect on interest rate compared to consumer loans. The F-statistic for the null hypothesis of H_0: $\beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = 0$ is 28.5861, which is greater than the critical value of 2.21, so the null hypothesis is rejected.

CHAPTER 10

DISCUSSION

The results of the credit score model show a distinct relationship between credit score and age, income per month, and debt to income ratio. The debt to income ratio displayed to be the only dependent variable that did not have a significant effect on credit score. The amount of debt compared to income may be high but by making payments on time or only missing a few, then one's debt will not affect the credit score. As stated above, the average credit score of people is 723. In this study, the average credit score found was 683. Per Table 1, a score of 723 falls in the higher part of category Good and a score of 683 falls in the lower part of category Good. By having a Good credit score, this will get a loan, but by having a Very Good or Exceptional credit score, this will help obtain a loan with a lower interest rate. "The procedure of credit scoring is very important and significant for banks as they need to discriminate whether good financial position from bad financial position in terms of their creditworthiness" (Almansour 2015, 114).

The results of the interest rate model also showed a relationship between credit score, amount of the loan, term of loan in months, and the type of loan. The amount of the loan, agriculture loans, and real-estate loans were the variables that did not have a significant effect on the interest rate. The amount of the loan shouldn't affect the interest rate offered because one's credit score will help determine what rate will be receive a well as the current federal open market. The amount of the loan is just an amount being requested and doesn't impact one's credit score because of this. The agriculture loans were compared to the consumer loans in this study, so the agriculture loans had a smaller effect on the interest rate offered compared to the consumer loans. This is because agricultural lines of credit normally receive of semi-constant

interest rate compared to consumer loans. Also, real-estate loans are normally offered a constant interest rate that does not fluctuate a whole lot. Consumer loans are normally unsecured so banks offer a higher rate so they can cover their basis and still loan the money.

A possible limitation for this study was the paper only examines 100 loans. The information for each loan was obtained from a small community bank in Southern Illinois. The bank has eight branches but the loan information was gathered from only one branch. In addition, the loan information gathered from the loans were loans that were accepted and given in the past two years. The results found may not necessarily apply to all of Illinois or the United States. Although credit scores range from person to person all over the United States. Also, interest rates offered are determined by the federal open market and what the bank thinks would be fair to offer a customer.

Credit scores will always impact the interest rate offered to consumers. Even if there is a minor impact, credit scores will influence interest rates. Interest rates in general are determined by the federal open market but banks can fluctuate with their interest rates they offer to consumers. Credit scores will always be impacted by age and income per month. The impact may be small but there is still any impact.

Interest rates, however, are influenced by the credit scores and the term of the loan in months offered. A person’s credit score will impact a person’s interest rate offered because the higher the credit score one has will help one obtain a lower interest rate. Higher credit scores prove one is responsible with money and payments are made on time. Also, the number of months the loan is offered does affect the loan. Whether a loan is need for twelve months of one hundred and twenty months, the interest rate offered will fluctuate compared to the federal and community interest rates offered.

EXHIBITS

Table 1: FICO Score Ranges

Credit Score	Rating	% of People	Impact
300-579	Very Poor	17%	Credit applicants may be required to pay a fee or deposit, and applicants with this rating may not be approved for credit at all.
580-669	Fair	20.2%	Applicants with scores in this range are considered to be subprime borrowers.
670-739	Good	21.5%	Only 8% of applicants in this score range are likely to become seriously delinquent in the future.
740-799	Very Good	18.2%	Applicants with scores here are likely to receive better than average rates from lenders.
800-850	Exceptional	19.9%	Applicants with scores in this range are at the top of the list for the best rates from lenders.

Citation: ("What is a Good Credit Score?" 2016).

Table 2: Summary Statistics

Number of Observations: 100				
	Mean	**Standard Deviation**	**Minimum**	**Maximum**
Credit Score	683.18	79.02555	518	817
Age	48.3	17.3639	20	82
Income Per Month	5322.39	4109.85202	753	26167
Debt/Income	0.2499	0.11818	0.01	0.5
Interest Rate	0.06966	0.022723	0.0225	0.119
Amount of Loan	34252.47161	54302.52901	502.48999	300000
Term of Loan in Months	47.84	55.12167	2	360
Type of Loan	1.75	0.83333	1	3
	Sum	**Variance**	**Skewness**	**Kurtosis**
Credit Score	68318	6245.03798	-0.18848	-0.71699
Age	4830	301.50505	0.20052	-1.16094
Income Per Month	532239	1.68909D+07	2.46141	0.43068
Debt/Income	24.99	0.013967	0.044397	-0.74937
Interest Rate	6.96605	0.00051633	0.21215	-0.83953
Amount of Loan	3425247.161	2.94876D+09	2.97498	9.61194
Term of Loan in Months	4784	3038.39838	4.07412	20.12015
Type of Loan	175	0.69444	0.50093	-1.38056

Table 3: Credit Scores Ordinary Least Squares Output

Dependent Variable: Credit Score Mean of dep. var. = 683.180 R-squared = .132362		Number of Observations: 100 F (zero slopes) = 4.88174		
Variable	**Estimated Coefficient**	**Standard Error**	**t-statistic**	**P-value**
Constant	640.678	32.3483	19.8056	[.000]
Age	0.862896	0.434673	1.98516	[.050]
Income Per Month	4.72E-03	1.90E-03	2.47538	[.015]
Debt/Income Ratio	-97.1309	66.1514	-1.46831	[.145]

Table 4: Interest Rates Ordinary Least Squares Output

Dependent Variable: Interest Rate Mean of dep. var. = 0.069660 R-squared = 0.603259		Number of Observations: 100 F (zero slopes) = 28.5861		
Variable	**Estimated Coefficient**	**Standard Error**	**t-statistic**	**P-value**
Constant	0.140479	0.013979	10.0492	[.000]
Credit Score	-7.87E-05	2.10E-05	-3.7545	[.000]
Amount of Loan	6.36E-09	4.04E-08	0.157466	[.875]
Term of Loan in Months	-9.42E-05	3.70E-05	-2.54696	[.012]
Agriculture Loans	-0.021821	3.77E-03	-5.7804	[.000]
Real-Estate Loans	-0.029339	4.44E-03	-6.60454	[.000]

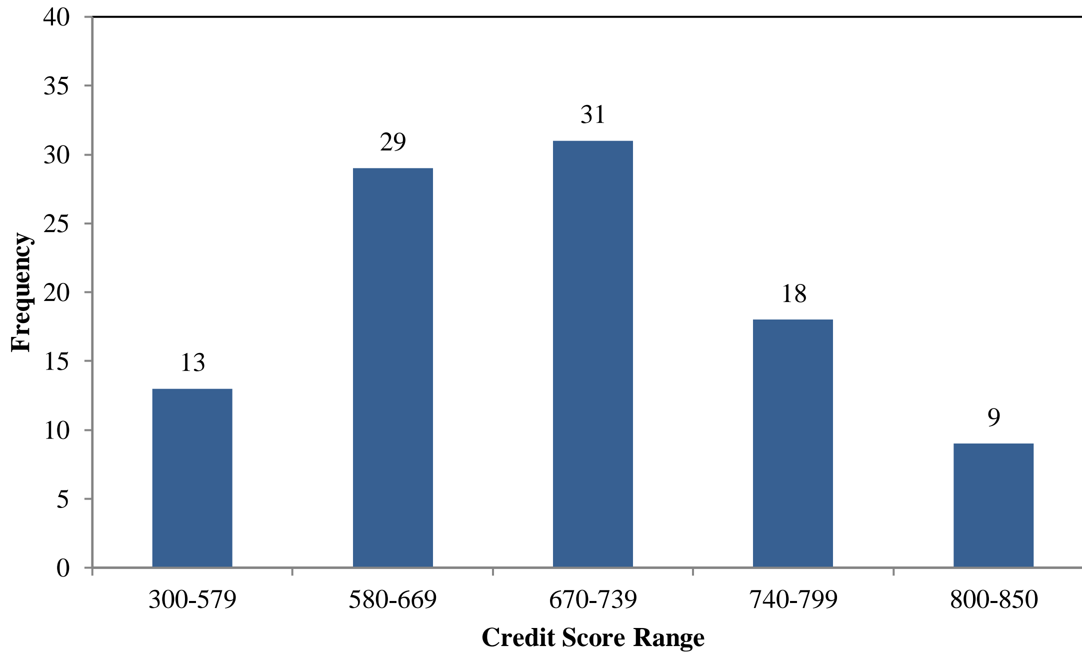

Figure 1: Credit Score

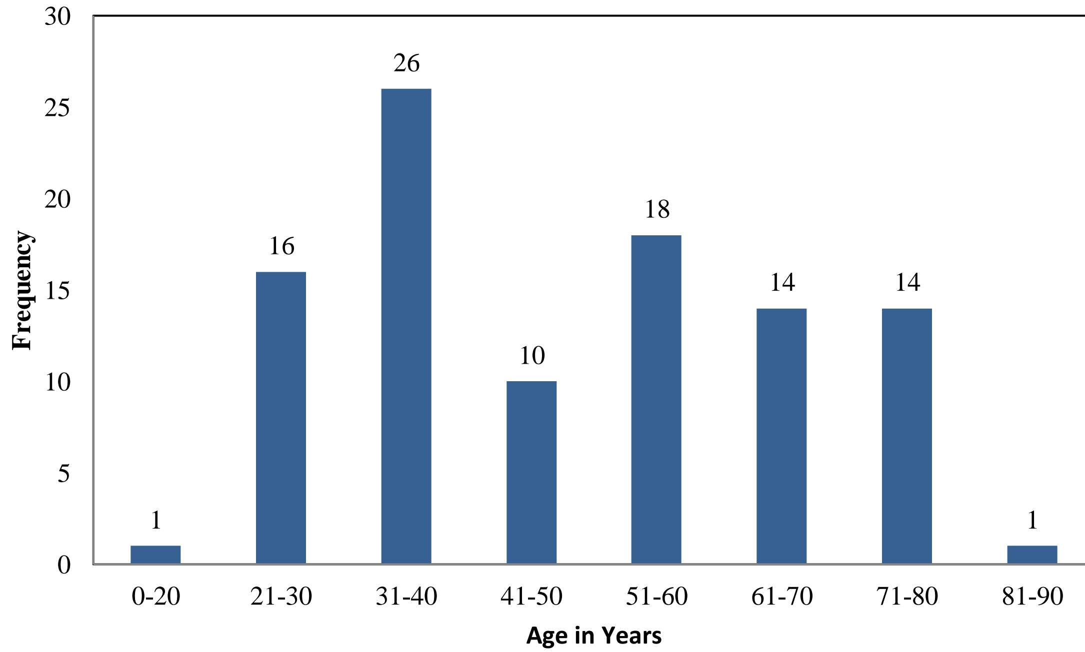

Figure 2: Age of Customer

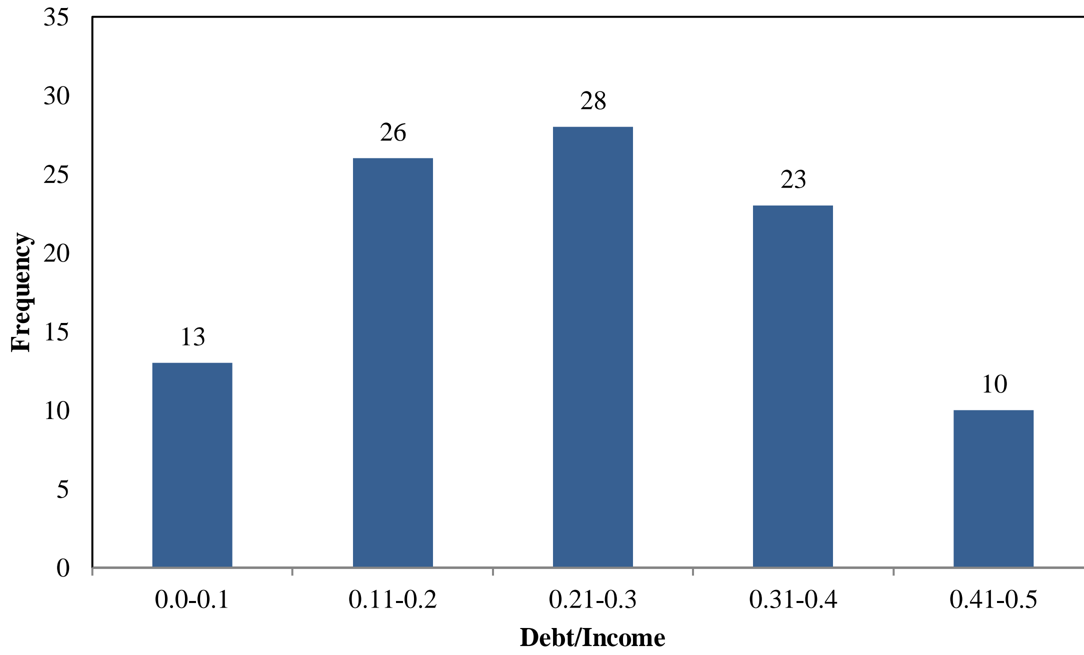

Figure 3: Debt/Income Ratio

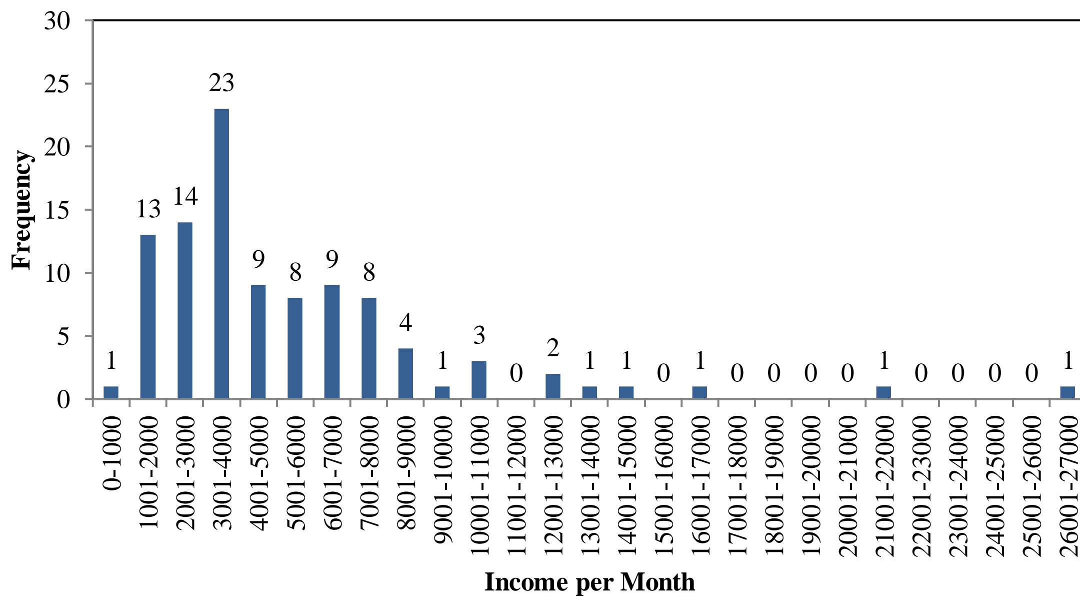

Figure 4: Income

Interest Rate

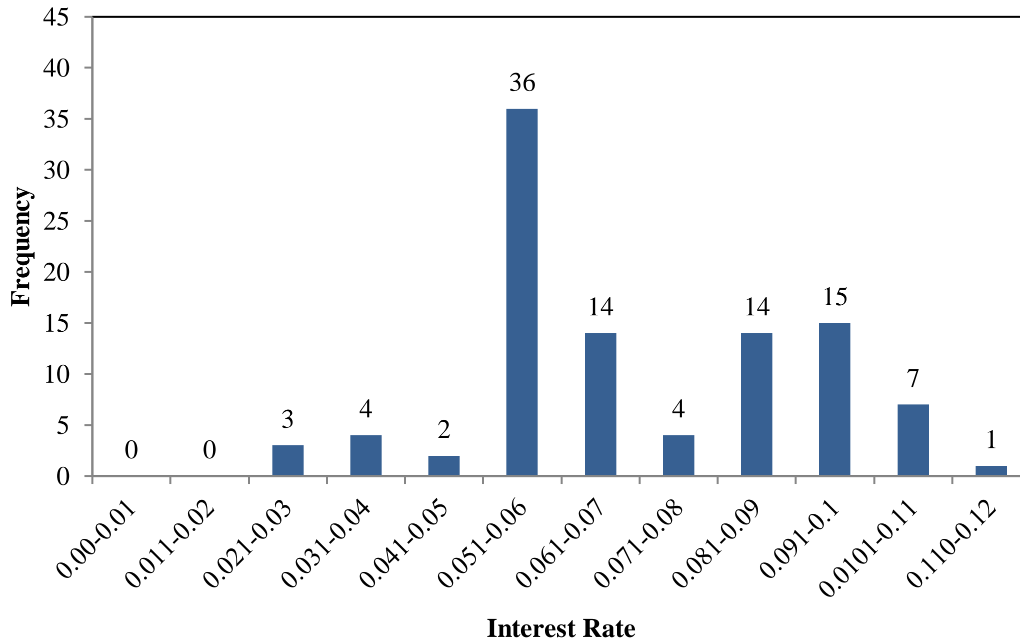

Figure 5: Interest Rate

Amount of Loan

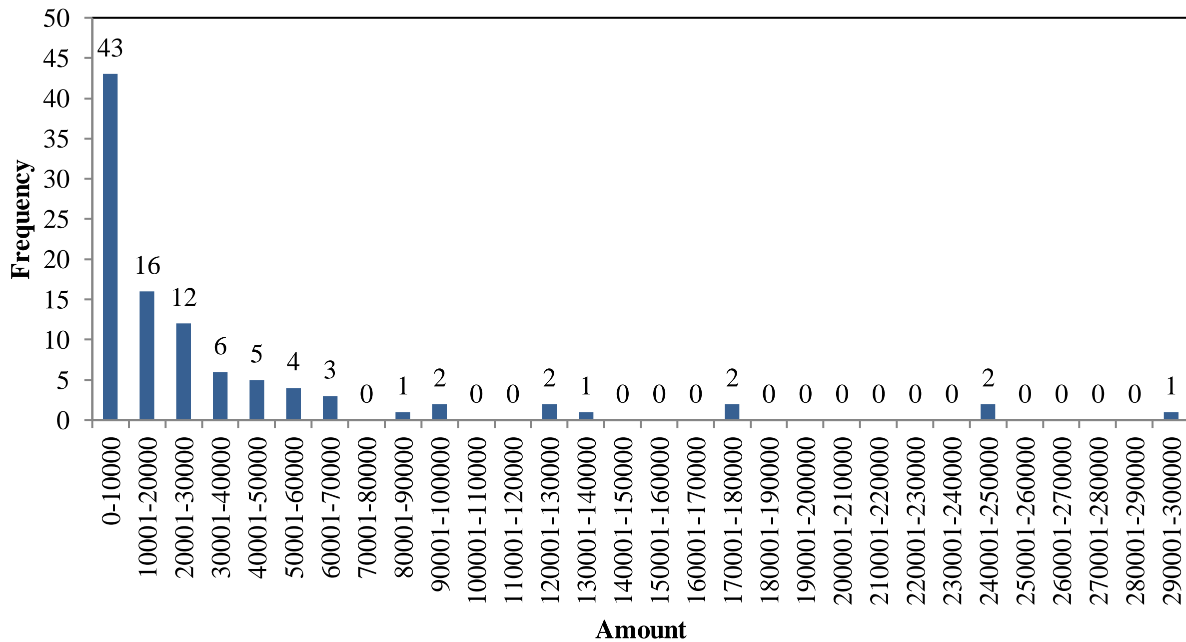

Figure 6: Amount of the Loan

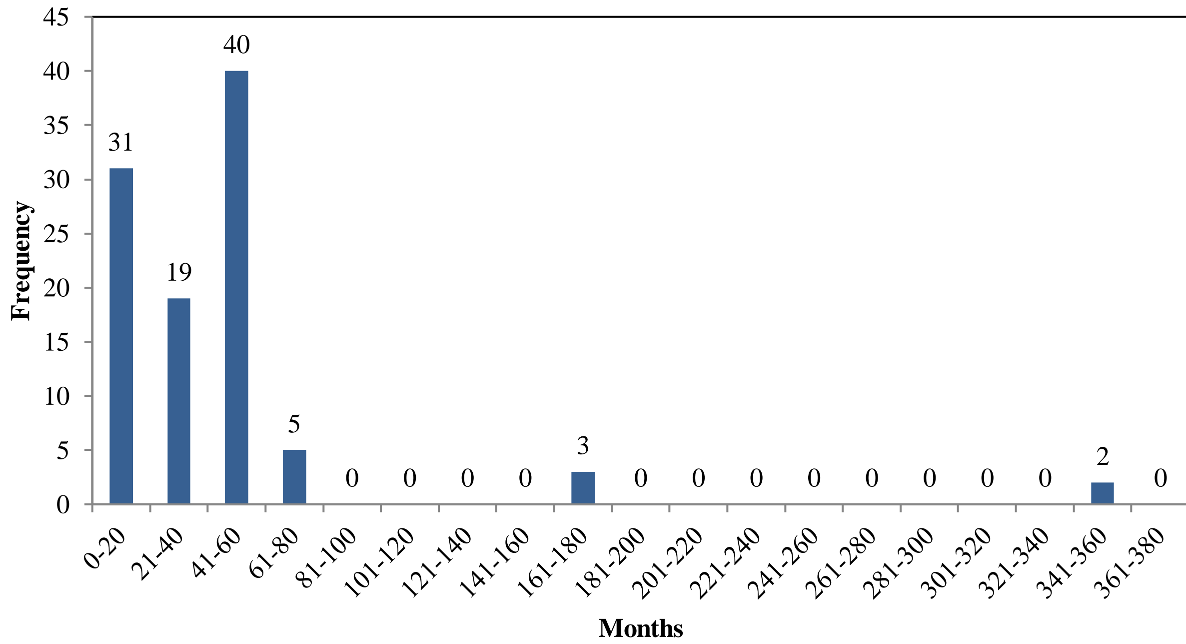

Figure 7: Term of the Loan in Months

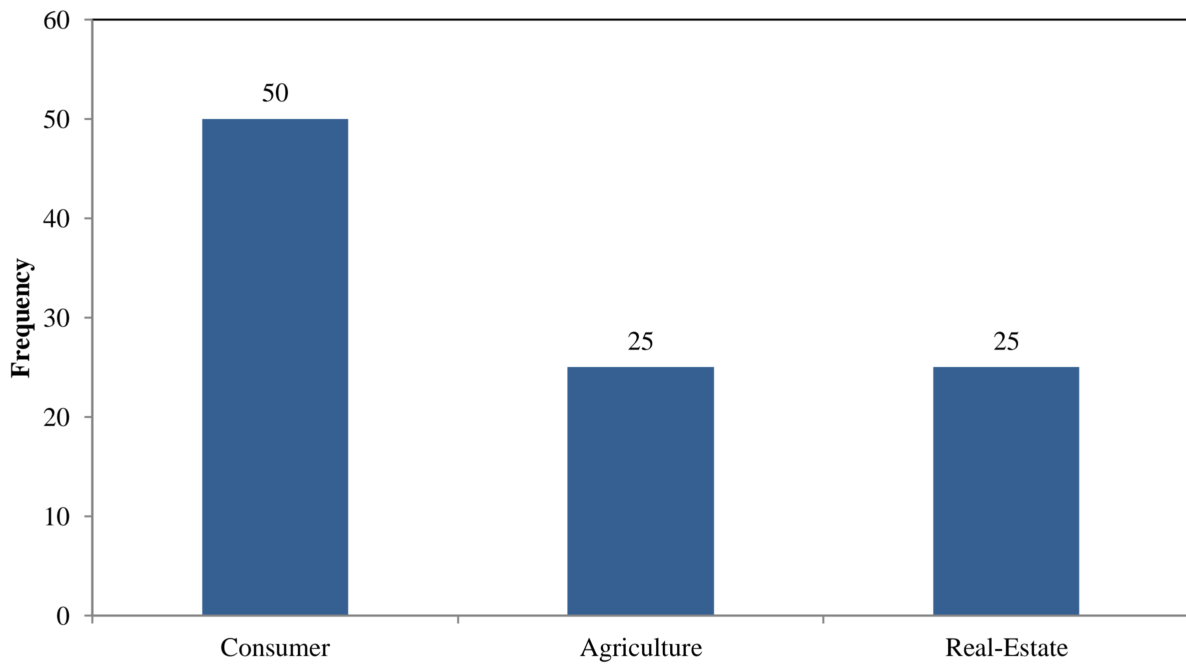

Figure 8: Loan Type

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Southern Illinois University
Bachelor of Science, August 2016

Research Paper Title:
Credit Score Analysis

Major Professor: Dr. Dwight R. Sanders