LOCATING THE NEED FOR FINANCIAL EDUCATION

by

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DEDICATION

For Ali the Adventurer, I'm ready to go.

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LIST OF ABBREVIATIONS

ACS   American Community Survey

FLEC   Financial Literacy and Education Commission

HEC   Homeownership Education and Counseling

HUD   Housing and Urban Development

KDE   Kernel Density Estimation

IDA   Individual Development Accounts

MCE   Multi-Criteria Evaluation

ABSTRACT

The goal of this thesis is to complete a raster-based site suitability analysis that identifies varying levels of need for financial education in the City of Malden Massachusetts. The research product is intended to help decision makers evaluate where to site financial education training events or invest in support programs for the communities or neighborhoods in need. The thesis begins by reviewing the current state of financial education and arguments for its application. Individual factors and supporting evidence that seek to identify individuals in need of financial education is organized. The data preparation steps and multi-criteria evaluation (MCE) spatial methodology used to create the final research output is detailed. The MCE results in the City of Malden indentify multiple regions with a high level of need for financial education. A review of these high need areas coincident with city zoning and a variety of geographic features highlights additional spatial relationships of interest. The author concludes the research by outlining how the final output can support deciding on locations for financial education events.

Chapter One: Introduction

The World Financial Crisis of 2008 affected the economic stability of the American financial market, government, communities, and individuals. Median family income levels during the 2007 to 2010 period dropped an average of 7.7% (Bricker 2012). By 2009, the US housing market had lost 28% of its value from its peak in 2006, and approximately four million families lost their homes to foreclosure (Angelides and Thomas 2011). In 2009 testimony before the House Financial Services Committee, Treasury Secretary Timothy F. Geithner, describing efforts to stabilize the US economy post collapse said, "we now know that millions of Americans were ... unable to evaluate the risks associated with borrowing to support the purchase of a home, a car, or an education. (Treasury Secretary Timothy F. Geithner Testimony 2009). Financial education surveys have attempted to quantify the American deficit in financial literacy concepts, and found only 18% of 1,700 American's were able to calculate basic compound interest and 56% could not properly differentiate the performance differences between stocks, bonds and mutual funds over-time (Lusardi and Mitchelli 2007).

As the prevalence of employer pensions continues to decrease, the responsibility for an individual's financial well-being is shifting from financial experts to each individual (Wiatrowski 2012)**.** The average level of American financial literacy in 2009 is likely well below that of the average financial expert, which puts at risk the financial well-being many Americans who are unprepared to make well informed financial decisions (Lusardi and Tufano 2009). The US Treasury Department's Financial Literacy and Education Commission (FLEC), created in 2003, were tasked with developing a national financial education strategy. Their 2011 Implementation Report seeks to continue the development of a wide variety of financial education resources and to expand

relationships with organizations that are focused on improving the financial literacy Americans (Commission 2011). Research in the delivery of financial education has indicated that many attendees prefer formal training sessions in a communal setting over internet based financial education resources (Corporation 2004). Since there is a place for seminar like financial education opportunities, the locations of these events becomes an important factor in delivering financial education. Current efforts by U.S. Bank to place financial education events are primarily dependent on the location their training partner's access to an available facility (Bank 2013). This partner facility approach to locating financial training events does not account for where those individuals in greatest need are located and might exclude segments of these populations if training locations are not easily accessible.

This research presents a spatial process that identifies the locations of populations with the greatest relative need for financial education. This additional spatial information could help the government, businesses, and non-profit agencies make informed decisions about how to locate financial education events to reach those in most need of this kind of education.

1.1 Research Questions and Study Extent

There were two questions in this research. First, which factors are most appropriate for identifying the need for financial education at a local scale? Second, what form of spatial analysis is the most appropriate for identifying the need for financial education? The City of Malden in Massachusetts is the spatial focus of this research and the areas in greatest need of financial education are identified in this research.

The City Malden is located approximately six miles north of Boston (Figure 1). According to the 2010 Census, Malden has an area of five square miles, a population of 60,374 and density of 11,780 people per square mile. According to 2010 census data, the City of Malden's non-white ethnicities make up 47.5% of the City's population. All of Malden's neighboring cities and towns have non-white ethnic populations below 31% and some as low as 10%. This makes Malden one of the most ethnically diverse communities behind the City of Boston, which has a non-white ethnicities making up 54% of the City. This City of Malden was interested in learning how they could support their residents struggling after the Financial Crisis of 2008 and was supportive of this research effort. Access to the local data, provided by the City GIS Department, City Assessors Department, and City Treasurer allowed for a very granular perspective of the financial behaviors and trends expressed by city residents to be examined.
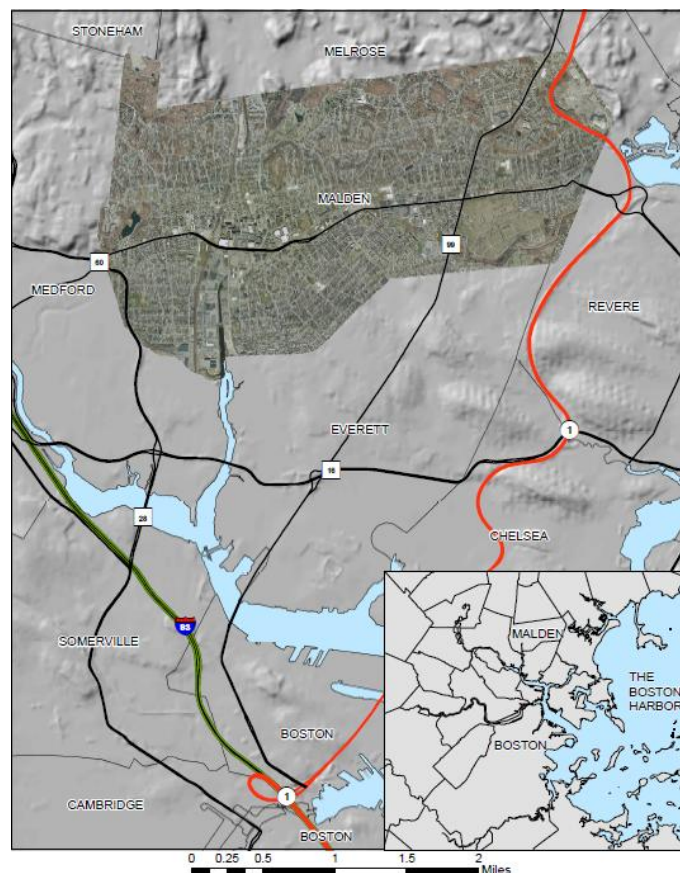
Figure 1: Regional View of the Study Area

Chapter Two: Literature Review

The need for financial education is a complex phenomenon. In chapter two, research is presented to both frame research efforts of the past and establish the current environment in which learning will take place. The review begins with the presentation of financial education efficacy research and the current state of financial education in America. Next, research outlining likely factors indicative of the need for financial education is presented. Finally, spatial methodologies and vulnerability studies are outlined to provide examples of research that could be adapted for this research effort.

2.1 Financial Education Background

Financial education is not a new concept. In the 1950s and 1960s, states began mandating the inclusion on personal finance, economics, and general consumer education into K-12 curriculum (Bernheim and Garrett 2003). Homeownership and mortgage counseling are also two kinds of financial education that have existed for quite some time. These two kinds of educational offerings are frequently provided by banks for interested new homebuyers. Retirement education grew in earnest starting in 1990, when employers began preparing their employees for the responsibility of investing for their own retirement (Martin 2007).

Even with these resources available today, making the "best" financial decision can still be a difficult proposition. Financial experts use a number of different economic modeling techniques and inputs specific to an individual's financial profile to make their "best" financial recommendation. Is the average American today prepared to make the necessary financial decisions, given the changing financial marketplace, without support? In an effort to assess the

financial literacy of Americans, many surveys have been conducted (Lusardi and Mitchelli 2007; Lusardi 2008; Lusardi and Tufano 2009). The survey results clearly and repeatedly indicate a large deficit in Americans' understanding of both basic and complex financial concepts across all demographics.

Many experts believe that financial education is a viable approach to support individuals that are unprepared to make informed financial decisions (Boshara et al. 2010; Lusardi and Mitchelli 2007). Research into the efficacy of financial-education programs, primarily through survey efforts, has documented a number of positive learning results. Homeownership education and counseling (HEC) has been shown to lower default rates and limit other adverse financial outcomes for HEC attendees (Martin 2007). Retirement education has been shown to increase the amount of savings of attendees by 18%, and the impact was greatest on lower income attendees (Lusardi 2004). Financial education has also been attributed to improvements in individual's health, when participants are exposed to saving techniques like health savings accounts or flexible spending accounts (Hastings, Madrian, and Skimmyhorn 2012). Financial education can teach individuals to ask questions about basic daily financial decisions, increasing the prevalence of comparison shopping habits. Finally, financial education allows individuals to increase their financial stability and more financially stable individuals can make for more stable communities (Harnish 2010).

To fill the gap in American's financial knowledge, there is a need for a large variety of financial education options. Financial education today spans a wide set of topic areas, including basic financial skills for young adults, homeownership and mortgages, basic saving and monetary concepts, and retirement planning. National organizations have been collaborating to develop financial education pedagogy and curriculum resources to aid in delivering impactful financial

education opportunities (Cordray 2013). These teaching methods have increasingly prescribed the inclusion of survey techniques in training to better document financial impact. However, often only anecdotal accounts of successes have been collected by researchers to date (Vitt 2005). Recent financial education research efforts have been able to quantify the value of the just-in-time paradigm for financial education (Fernandes, Lynch Jr, and Netemeyer 2014). Just-in-time education is an approach that advocates for the delivery of education at a time when the student has a current need for that particular educational subject. Their research attempted to quantified the impact financial education has on the quality of financial decision making. Their research results indicated financial education delivered more than 20 months prior to an individual's actual application the "learned" financial concepts, the final financial decision quality was no better statistically than those who had received no financial education. Their research also indicated that the quality of the financial decision-making was incrementally greater the closer the education was delivered to the application of the newly acquired financial knowledge.

Since 2008, the availability of financial education resources focused on foreclosure and mortgage refinancing has increased significantly. These resources are widely available online, provided by a number of agencies including the Housing and Urban Development Department, Federal Reserve Bank, The Home Ownership Foundation, Federal Housing Administration, Freddie Mac's Mortgage Resource Center, and the National Foreclosure Mitigation Counseling Program. These educational resources have been further adapted to meet specific state and local needs and they are available through local agencies and groups.

However, the great number of institutions seeking to provide web guidance had an unfortunate unintended consequence, fraudulent financial support websites. The increased prevalence of quality homeowner support information gave rise to fallacious financial support

services seeking to take advantage of vulnerable people in search of financial guidance to more confidently navigate the mortgage refinancing process (Leland 2009). Clear financial messaging and guidance is essential for a steady recovery and for the health of the financial systems in the future. Local community organizations and representatives are uniquely positioned to provide targeted financial education to those community members in need, leveraging local relationships and trust. By doing so, communities can financially strengthen and stabilize their populations.

Financial education is not an inoculation administered once to provide lifelong immunity from poor financial decision-making. Financial education is a life-long learning process, requiring personal commitment from individuals (Foundation 2013). Fortunately, there are tangible economic and personal benefits to participants that decide to invest their time in financial education.

2.2 Current Financial Landscape

The financial landscape has been changing for the average American and many of them are unaware of the implications. The amount of revolving credit available to individuals has increased steadily over-the past 30 years (Durkin 2000). This increased amount of readily available credit has allowed consumers to finance a variety of purchases that might have been otherwise out of reach. This economic freedom now makes it much easier for consumers to accumulate debts that are beyond repayment or even servicing.

Individuals today are increasingly more responsible for managing their own retirement investments. In 1985, 90% of Fortune 100 companies were offering defined benefit plans, which paid a guaranteed amount during retirement. In 2013, only 30% of Fortune 100 companies are

offering defined benefit plans (McFarland 2013). This shift away from defined benefit plans has been replaced by defined contribution plans, which do not provide a guaranteed benefits at retirement and require individual to make the appropriate monthly contributions over-time (OECD 2006). In additional to selecting the correct level of monthly investment, the question of where the money should be invested still remains. As more individual consumers enter the marketplace looking to invest for their retirement, the variety and number of investment options individuals have access to has also significantly increased. Consumers are required to evaluate investment portfolios containing varying levels of diversification, risk, and return (Lusardi 2008). Survey's targeted at assessing the readiness of Americans to make basic retirement investing decisions have shown that 56% of respondents are unable to differentiate the performance of stocks, mutual funds, and bonds overtime (Hilgert, Hogarth, and Beverly 2003).

The spending and saving habits of Americans over the past two decades have been changing. Federal Reserve Economic Data reports show American personal saving rates have dropped from 12.7% in November of 1980 to 2.9% in July of 2006 (Louis 2014). During this same time period the ratio of debt to income over the same time period has risen from 3:5 to 1:1 (Dynan and Kohn 2007). This downward saving trend reversed dramatically after the financial crisis of 2008, but Federal Reserve Bank data again shows the negative saving trend returned in 2011. The major causes for this financial spending and saving shift were increasing housing prices and financial innovation. Increasing housing prices required consumers to find more capital, which an increasingly innovative financial industry was able to provide to consumers. With more money invested in housing assets and consumers holding larger debts to service, consumer spending and financial health is now more sensitive to market fluctuations (Dynan and Kohn 2007).

During financial fluctuations, the availability of credit can also help households weather market downturns. However, this growing norm of indebtedness and necessity for credit puts many Americans at risk of financial distress during market fluctuations. Households that lose their ability to service their growing debt are at risk of great financial penalty and financial instability. Between 2003 and 2007, many Americans entered into sub-prime mortgage contracts with rates and conditions that were unsustainable. These sub-prime mortgage transactions were found to be the core reason for the Financial Crisis of 2008 (Angelides and Thomas 2011).

The availability of American credit and the increasingly complex financial marketplace has provided great opportunities to those knowledgeable enough to take advantage of these resources and investment instruments. Unfortunately, there are also Americans who are unprepared to navigate a more complex economic environment, but financial education can offer these individuals guidance and knowledge, improving their relative ability engage in more complex marketplaces.

2.3 A Response to the Financial Crisis of 2008

The Financial Crisis Inquiry Report of 2011 concluded that the financial collapse could have been avoided but stewards of the financial system had ignored the warning signs of the impending financial collapse (Angelides and Thomas 2011). Since the collapse, US government policymakers have debated approaches to avoid another market collapse due to sub-prime mortgage lending. One approach, developed by the Senate Banking Committee, has been proposed and was signed into law on July 21, 2010. The Dodd-Frank Wall Street Reform and Consumer Protection Act attempts to refine the way the mortgage sector of the banking industry functions, providing

greater consumer protections, and increasing the transparency of financial instrument for consumers (*Dodd-Frank Wall Street Reform and Consumer Protection Act* 2010). Unfortunately, legislation is only part of the solution; a fundamental problem remains largely unaddressed by the Dodd-Frank legislation. The American population is lacking the basic financial literacy skills required to make informed financial investment decisions (Commission 2012).

Surveys have shown that many Americans today are not equipped with the most basic financial concepts, like compound interest and its implications in managing debt and making mortgage decisions. This lack of skills severely impacts an individual's ability to make appropriate financial decisions for their future well-being (Lusardi and Tufano 2009). Many financial experts, educators, and researchers believe that financial education in its various forms can be a remedy for this American deficit in financial literacy (Hilgert, Hogarth, and Beverly 2003; Greenspan 2005; Morton 2005; Lusardi and Mitchelli 2007; Cordray 2013).

2.4 Researching and Identifying Possible Factors

This research effort seeks to identify those areas where individuals need financial education. Financial education covers a variety of topics. Retirement planning education is focused on providing targeted financial guidance in advance of a need. Basic financial literacy education is more generic in focus seeking to serve a wide variety of attendees. Financial education can be remedial, designed to support those individuals navigating forward from a difficult financial situation, like foreclosure intervention efforts. Given the breadth of financial education topics, and the audiences served, it is difficult to identify metrics that have a clear relationship with the need for financial education. To address this problem, it was necessary to select additional logical proxy

criteria that would indicate a need for financial education. The proxy criteria included the following two factors categories:

1. Factors that are indicative of current financial distress

2. Factors that are indicative of the potential for financial hardship

If individuals are currently in some form of financial distress, remedial forms of financial education can improve financial decision-making abilities. By improving decision-making, these groups in financial distress have a better chance at avoiding financial distress in the future. Each financial decision made by individuals with the potential for financial hardship is also critical. Poor financial decision making by these individuals can make satisfying existing financial obligations impossible. When credit card, mortgage, loans or bills are left unsatisfied or paid, fees can be levied, wages garnished, or property seized. All of these outcomes make returning to a financial stability difficult. There is financial education designed to improve the basic financial decision making ability of individuals. This education could reduce the likelihood of these groups experiencing financial hardships. In the rest of this section, factors that fall into these two proxy categories are reviewed that identify areas in need of financial education.

2.4.1 Financial Distress Factors

Financial distress is a state individuals experience due to a wide variety of decisions, within an individual's control and many circumstances beyond the individual's control. This section will review study factors indicative of financial distress brought about in part by decisions within an individual's control and present supporting research for the categorization of such factors.

Assessing one's level of financial risk is a complex question, but there are events that can indicate current distress. Foreclosure and tax delinquency are two factors that indicate financial distress and can be used to identify those populations that would be well served by financial

education. There are situations where foreclosure and tax delinquency can occur for non-financial reasons; however, the financial stability of an individual is often a factor in the resulting foreclosure or tax delinquency event.

A housing foreclosure is a legal process by which a property may be sold and the proceeds of the sale may be used to satisfy an existing mortgage debt (Apgar et al. 2005). The foreclosure process begins after a series of missed payments on a mortgage. Foreclosure events significantly affect the credit score of those undergoing the process and it will stay on a credit record for 7 years. A low credit score can make getting a loan, insurance, or even a job more difficult, since in practice credit scores are used well beyond their intended purpose of evaluating the likelihood of loan repayment (Kingsley 2009). Foreclosures have also been occurring disproportionately in areas where there was a high density of sub-prime mortgage lending (Duda and Apgar 2004; Immergluck and Smith 2005). A single foreclosed property can negatively impact the value of neighboring properties within a half mile by 8.7% (Lin, Rosenblatt, and Yao 2009). Foreclosures negatively affect both individual consumers and communities. Understanding where these events take place most frequently can help communities target financial education and potentially reduce the negative impacts of foreclosure.

The Federal Reserve Bank of Cleveland completed research that examined the factors that contributed to housing price declines and found that foreclosure events occurred at the end of a longer decline in community and individual financial health. One or more of the following can often precede this downward financial trajectory, ending with foreclosure: tax delinquency, property abandonment, or vacancy events (Whitaker and Fitzpatrick IV 2011). These pre-foreclosure events were found to be just as important as foreclosure incidence when attempting to indentify the factors at play in decreasing home values (Whitaker and Fitzpatrick IV 2011).

Tax delinquency is similar to foreclosure in the sense that homeowners have missed tax payments over an extended period of time, which can result in municipality action to sell the property to satisfy the outstanding tax balance and any accrued fees. Tax delinquency can provide an earlier indication of financial distress because it often precedes foreclosure (Whitaker and Fitzpatrick IV 2011). Since the effectiveness of financial education increases when delivered in advance of financial hardship, tax delinquency is an especially valuable factor (Martin 2007).

When support is not available to owners of foreclosed, tax delinquent or vacant properties, they often abandon their property management responsibilities. This deferred maintenance can have a number of negative effects on the community as a whole. When properties are not cared for frequently, they can begin to look unsightly. This makes a neighborhood less desirable to prospective buyers. This series of events can ultimately reduce neighboring property values. If this lack of homeowner care, stemming from financial distress, is not addressed by the community or property owner, the downward trend can also lead to increased crime, vandalism and theft (Whitaker and Fitzpatrick IV 2011). Research has estimated the cost to local government per vacant or foreclosed property to be between $27,000 to $30,000 (Rogers and Winter 2009).

Both foreclosure and tax delinquency are factors that have significant impacts on the financial health of individuals and communities. By actively organizing foreclosure and tax delinquency data, communities will be better able to address property ownership issues and support communities that are struggling with targeted financial education opportunities. Since foreclosure and tax delinquency can indicate a state of financial distress stemming at least partly from poor financial decisions, this study used these factors as indicators of a need for financial education.

2.4.2 Potential for Financial Hardship Factors

There are a number of factors indicative of the potential for financial hardship; however, with the growing availability and variety of financial resources provided by FLEC, financial education can help an increasing variety of individuals with financial education needs become more financially secure. It should also be made clear that individuals that regularly struggle with finances are not necessarily bad financial decision makers. However, their even income to expense ratio and potentially limited exposure to an increasingly complex financial market place can make finding and maintaining financial stability difficult.

In 2010, America had 58.7 million individuals living with a disability. One in three of disabled Americans live in poverty which is double the national average (Brault and Census 2012; Institute 2012). The National Disability Institute has been working with 900 partner agencies to increase the financial stability of American's with disabilities. Through financial education and asset development assistance, this population has been able to become increasingly more financially independent and economically self-sufficient (Institute 2012). The Federal Government also recognizes the financial instability of this community and provides Supplemental Security Income to support disabled Americans and certain elderly populations. Given the current income disparity of disabled Americans and efforts to provide financial support to this group, it is clear disabled Americans are often at risk of financial hardship and good candidates for financial education.

Unemployment has also been a struggle for millions of American's after the Financial Collapse of 2008. In January 2014, the Bureau of Labor Statistics reported the current rate of unemployment to be 6.6%, which is a new 5 year low. However, this metric can mask the actual health of the job market. There is another metric known generally as underemployment which

includes individuals that are underpaid, underutilized, overeducated, over skilled, or overqualified for their current position (McKee-Ryan and Harvey 2011).

The rate of underemployment dropped from 17% in 2010 to 13% at the end of 2013. However, the underemployment rate is more than double the unemployment rate (Insititue 2011; Statitistics 2013). McKee-Ryan and Harvey (2011) have found that there is a positive relationship between underemployment and the intention to quit a job. They also found a positive relationship between the length of time an individual is unemployed and underemployment. Given large numbers of individuals who would categorize themselves as underemployed, the relationship between unemployment and underemployment, and the general desire of underemployed workers to quit these kinds of jobs, the potential return of these individuals to the unemployed segment is entirely possible. Currently, the federal government's Career One Stop Program provides unemployed individuals to a variety of educational resources and training opportunities. These opportunities, including basic financial skills training, and essential mathematics concepts, are critical for more advanced financial education. Providing unemployed job seekers with the skills they need to be successful is the goal of many unemployment-training programs. During unemployed phases, individuals sometimes will have more limited incomes. This reduction in income can increase the likelihood of financial distress. This qualifies unemployment as another potential factor in this research.

Educational attainment is valuable metric for examining an individual's level of financial knowledge. A review of common mortgage transactions with a broker has uncovered that less educated mortgage buyers were charged $1,500 more on average than college graduates (Campbell 2006). In another study, empirical evidence shows a negative relationship between the ability to perform basic calculations and the propensity to default on a mortgage (Fernandes,

Lynch Jr, and Netemeyer 2014). Financial literacy surveys have shown that less educated individuals struggled to grasp basic financial concepts, such as basic and compounding interest concepts, more than more educated individuals (Lusardi and Tufano 2009; Lusardi and Mitchelli 2007). Individuals with low levels of educational attainment are more likely to have difficulty evaluating financial products and managing debt obligations. The level of educational attainment also directly impacts individuals' life-time earning potential (Day and Newburger 2002). This lower earning potential can make it much more difficult for these individuals to save money. This reduced ability to amass financial reserves decreases the possibility of weathering negative financial fluctuations without suffering negative impacts. Financial education can help increase the savings rates of individuals with low educational attainment and reduce the likelihood these individuals will experience financial hardships.

Individuals with incomes at or below the poverty level are closer to financial hardship than most. With limited incomes, individuals living at the poverty level might struggle to save any money in an emergency fund. Having available an emergency savings fund for times of economic uncertainty is a common recommendation for all individuals and households (Brobeck 2013). However, the American public's saving habits overtime have become increasingly more relaxed. This trend increases the potential for greater financial hardship during economic downturns. The personal savings rate of Americans has decreased every decade by 28% on average since the 1960's (Louis 2014). Following the most recent financial collapse in 2008, personal savings rates increased greatly during 2009 and 2010. However, the 40-year-old trend of decreasing personal savings rates resumed in January 2011 and the negative trend has continued to May 2014.

The United States Government has recognized the importance of providing financial education and saving assistance to those in poverty (Clancy, Grinstein-Weiss, and Schreiner 2001).

In an effort to increase access to banking resources and incentivize saving habits, the US government has developed Individual Development Accounts (IDA). IDA accounts are provided to lower income individuals who often find it difficult to save using common banking resources because of minimum balance requirement for opening saving accounts active. To remove these barriers, the IDA program removed minimum account requirements set by commercial banks. To incentivize consistent savings habits, the federal government matched the funds saved by IDA account holders, providing immediate economic reinforcement of the value saving can provide. To get access to an IDA and receive the matching funds offer, the participant needs to attend a series of financial education seminars. The IDA program takes an applied approach to improving the financial literacy of each participant. Teaching individuals the discipline to save while solidifying basic financial literacy concepts connects the learning process to positive financial outcomes. The IDA program has successfully helped struggling families improve their financial decision-making skills, save for a down payment of a homes, and regularly save for college tuition.

In 2007, the ratio of US housing debt to disposable income hit an all time high of 130% (Glick and Lansing 2011). Since the financial collapse of 2008, the debt to income ratio has dropped from its peak, but the availability of credit remains at levels that supported the development of debt obligations higher than available disposable income. The Housing and Urban Development department provides small loans to homeowners and as of May 2013, the maximum debt to net income ratio that an individual can have if they are going to underwrite a loan is 43% (Galante 2013). Individuals that possess two mortgages and home equity loans are likely in a position in which their debt to net income levels are at or above what is considered financially healthy. Individuals with large amounts of debt to service are at risk of financial hardship if the

ability to service that debt is interrupted. The financial hardship in this case could come in the form of increased rates, fees, or even property seizure and foreclosure.

Many of the studies that have explored the financial health of Americans have captured demographic details about individuals. The ethnicity of the decision makers is one factor that has been evaluated for trends. During the lead up to the financial crisis of 2008, the Housing and Urban Development Department (HUD) made efforts to encourage lenders to provide lower income and minority populations with mortgages to purchase homes (Angelides and Thomas 2011). These groups traditionally have had difficulty meeting the minimum mortgage requirements in the prime mortgage market, but lenders developed the sub-prime mortgage category to meet the "needs" of these borrowers. This HUD-encouraged mortgage practice was a great success, and large number of sub-prime mortgages agreements were signed. Partly as a result, between 2007 and 2009, two and one half million foreclosures were completed (Bocian, Li, and Ernst 2010).

When looking at ethnicity, the rate of foreclosure for African Americans and Latino groups was 42% greater than for Non-Hispanic white populations (Bocian, Li, and Ernst 2010). Within the sub-prime mortgage market, these populations were also more likely to receive expensive loans and terms including prepayment penalties (Bocian, Ernst, and Li 2008; Bocian and Zhai 2005). Finally, survey's have documented a statistically significant relationship between ethnicity and low levels of financial literacy (Lusardi and Tufano 2009).

One of the largest single expenses an individual has is their housing costs. Understanding what an appropriate expenditure on housing is can help delimit individuals that are over extended and potentially compromising their own financial health. The concept of affordable housing began with the US National Housing Act of 1937, when income limits were established for access to

public housing programs (Schwartz and Wilson 2008). This housing affordability effort has worked

on defining the best income to housing expense threshold over the subsequent decades. Today

the conventional wisdom is that a maximum of 30% of an individuals income should be spent

housing costs (Schwartz and Wilson 2008). This factor is most important for lower income

populations, young people and the elderly to be aware of due to their more limited means.

However, the 30% rule still generally applies to all individuals. Individuals spending more than 30%

on housing costs are at greater risk of financial distress given their reduced ability to save and

invest.

2.5 Financial Vulnerability Research and Multi-Criteria Evaluation

In the previous section, a number of the factors that could indicate the need for financial

education were reviewed. To identify suitable locations, multiple factors are often combined to

calculate the scores that represent the magnitude of suitability (Eastman 1995). Several

researchers have attempted to combine multiple factors to measure financial risk.

The Local Initiative Support Corporation research used a number of public and private data

sources to develop their foreclosure risk score (Corporation 2013). The data sources include the US

Census Bureau, American Community Survey (ACS), Housing and Urban Development (HUD),

Mortgage Bankers Association, and the private loan analytics company LPS Applied Analytics. The

factors used to develop the foreclosure risk index include; housing counts, homeowner and tenant

occupancy data, mortgage foreclosure types, and loan performance metrics. The index

development process began by weighting, correcting, and normalizing the proprietary mortgage

data and then the loan data. The final foreclosure risk index by zip code area was an aggregation of

indices including the percentage of loan foreclosures weighted by foreclosure count, percentage of subprime loans weighted by subprime mortgage count, and percentage of delinquent loans weighted by delinquent loan count.

Italian researchers have developed a financial vulnerability indicator based up on financial survey data from Italian participants. The survey focused on capturing and understanding household debt trends, but also captured metrics on the inability to pay for basic monthly and daily items (Anderloni, Bacchiocchi, and Vandone 2011). The research concluded that the level of debt servicing is positively related to financial vulnerability and the relationship is stronger when households are holding unsecured debts.

Outside of academic research, MBD Credit Solutions has developed their own consumer financial vulnerability index, via quarterly consumer surveys, to evaluate the current state of consumer credit in South Africa (Solutions 2013). MBD Credit Solutions is the largest account receivables company in South Africa and has a stake in understanding the consumer's ability to pay their bills. The index is composed of four indicators, including income, expenditure, savings, and ability to service debt.

When it comes to the evaluation of multiple factors and the calculation of scores, one national scale research project sought to develop an index measure to locate populations vulnerable to environmental hazards by county (Cutter, Boruff, and Shirley 2003). 250 factors were initially identified by the study. After being tested for multicollinearity and the data normalized, the original 250 variables were reduced to 42 independent variables. Principal component analysis further reduced the 42 independent variables to 11 significant factors. These 11 factors were found to explain 76.4% of the variance in environmental hazard. The data source of all eleven factors was the 1990 decennial census at the county level. The eleven factors were personal

wealth, age, density of the built environment, single sector economic dependence, housing stock tenancy, race, ethnicity, occupation, and infrastructure dependence. Using an additive model, the researchers calculated an environmental hazard risk index for each county. An additive model was selected because no defensible method could be applied to weight the 11 factors.

The most common approach to combine factors is the weighted linear combination (Eastman 1995). Weighted liner combination is an approach that multiplies each factor according to a weighting scheme and then takes the sum of these results to produce a suitability index for a particular location. Researchers have traditionally converted factor values to a numeric scale (e.g., 0-100), which is commonly called standardization, before they multiply each factor (Eastman 1995). This process of standardizing and weighting a number of factors to develop a suitability index is called Multi-Criteria Evaluation (MCE).

The MCE is a technique that is designed to cope with evaluating multi-criteria problems and can be useful spatial analysis tool (Carver 1991). However, the selection and weighting of the MCE criteria are critical to the outcome of the analysis. Since the selection and weighting decisions for each MCE criteria are based upon the viewpoints and biases of researchers or decision-makers, there is inherent uncertainty in the results that should be recognized. Clear criteria selection and weighting methodology is necessary when designing a MCE if the results are to be valued. There are a number of supplementary theoretical constructs to help optimize criteria selection and weighting approaches including: Bayesian Probability Theory, Fuzzy Set Theory, and Dempster-Shafer Theory (Stoms 1987). These approaches are beyond the scope of this research, but could be a valued addition by future researchers.

Standardization is a critical first step to prepare the criteria for the MCE. The standardization process re-scales the MCE criteria raw values to a zero to one scale. The re-scaling

process requires care by researchers to identify which criteria are indicative increased suitability and which are indicative of decreased suitability. Depending on the criteria, either standardization formula A or B is required, shown below. For criteria whose highest values indicate the highest suitability, standardization formula A is required. Standardization formula A will assign the highest value a score of one and the lowest value a score of zero. For criteria whose highest values indicate the lowest suitability, standardization formula B is required. Standardization formula B will assign the highest value a score of zero and the lowest value a score of one. With all the criteria in the MCE standardized and weighted as appropriate, the highest output values of the MCE are indicative to the greatest suitability given the criteria selected.

$$Standardized\ Value\ A = \frac{Raw\ Score - Minimum\ Raw\ Score}{Maximum\ Raw\ Score - Minimum\ Raw\ Score}$$

$$Standardized\ Value\ B = \frac{Maximum\ Raw\ Score - Raw\ Score}{Maximum\ Raw\ Score - Minimum\ Raw\ Score}$$

The MCE methodology has been used by a number of researchers with both spatial and non-spatial research objectives (Store and Kangas 2001) (Pohekar and Ramachandran 2004) (Raaijmakers, Krywkow, and van der Veen 2008). The research by Store (2001) used MCE to explore habitat suitability for endangered species and applied the standardization and weighting approach described by Carver (1991). The research by Pohekar (2004) used MCE to identify the best sustainable energy practice by evaluating 90 different sustainable energy practices. The Raaijmaker (2008) research sought to identify the perception of flooding risk using a variety of qualitative and quantitative criteria. The breadth of research that has leveraged the MCE approach to evaluate both spatial and non-spatial criteria extends well beyond what has been presented in this research. This robust method seems well suited for supporting the thesis research objective of identifying the areas in greatest need of financial education.

The financial landscape today is one of options and responsibility. Individuals seeking to navigate financial environments successfully will need some form of financial education. There are groups of individuals that have a greater need of financial education. Individuals currently in financial distress and those that are living closely to a state of financial distress are often the groups that have the greatest need for financial education. With a variety of criteria indentified to help locate these groups in need of financial education, MCE can be implemented to present a clear representation of the spatial need for financial education.

Chapter Three: Methods

This chapter presents the selected methods necessary to identify the areas in the City of Malden that have the greatest need for financial education. Ten datasets indicative of a need for financial education were processed, standardized, and combined to identify those areas in need of financial education. These factors include educational attainment, foreclosure incidence, tax delinquency incidence, poverty status, mortgage debt status, disability status, unemployment, housing vacancy incidence, high rent expenditure, and ethnicity. A synopsis of each dataset used in the spatial analysis is presented first. The data clean up and processing steps required to prepare each factor for the multi-criteria evaluation (MCE) are outlined next. Lastly, the MCE processing steps to combine each factor and produce scores representing the need for financial education are reviewed.

3.1 Outline of Data

Ten datasets were identified for use in the spatial analysis designed to identify the need for financial education. These ten datasets can be broken into three groups: ACS data, Census Data, and City Data. Seven of the datasets were from the 2008 to 2013 American Community Survey (ACS), one dataset was from the 2010 Census, and two of the datasets were provided by the City of Malden, a list of the datasets can be found in Table 1. A more detailed review of these processing steps for each of the three groups will follow.

Table 1 - Data Sources and Formats

Data	Data Type	Data Source
Low Educational Attainment	Vector Polygon	American Community Survey
Family Poverty Status	Vector Polygon	American Community Survey
Mortgage Debt Status	Vector Polygon	American Community Survey
Disabled Populations	Vector Polygon	American Community Survey
Unemployment	Vector Polygon	American Community Survey
Vacancy Status	Vector Polygon	American Community Survey
High Rent Expenditure	Vector Polygon	American Community Survey
Ethnicity	Vector Polygon	2010 Census
Foreclosure Occurrence	Vector Point	City Assessing Dept.
Tax Delinquency	Vector Point	City Treasurer Dept.

3.1.1 American Community Survey Data

Seven ACS datasets were used in this research. These seven datasets were collected as tabular data and then joined with census block group polygons. The census block group level was the highest spatial resolution available for the seven datasets. There were 52 census block groups within the City of Malden's boundaries. A review of the collection and processing of each of the seven ACS factors found to be indicative of a need for financial education will follow.

The ACS educational attainment data captured counts of the highest level of educational attainment achieved by individuals, ranging from no schooling attained to a graduate level attainment. The educational attainment counts were captured at one-year increments of schooling. The low educational attainment factor used in this research was the cumulative product of educational attainment counts for individuals indicating educational attainment between no schooling and a high school degree level of attainment. The final educational attainment factor contained a single counts of individuals with educational attainment less than or equal to a high school degree. The need for financial education using the educational attainment data was indicated by a raw count of individuals in each census block group. Each census block group raw

count required normalization to account for the variation in size of each census block group. The raw count data for each census block group was normalized by dividing the raw count by total population for each census block group. The higher the counts of individuals with educational attainment below the high school degree level the higher the need for financial education.

The family poverty data contained the count of families that have been below the poverty level for the last 12 months. Poverty level is determined by comparing annual income of a family to a set of dollar values called poverty thresholds that vary by family size, number of children and age of householder. If a family's before tax income is less than the dollar value of their threshold, then that family and every individual in it are considered to be in poverty. The ACS dataset field that contained the counts information was B17010e2. The need for financial education using the family poverty data was indicated by raw count of families in each census block group. Each census block group raw count required normalization to account for the variation in size of each census block group. The raw count data for each census block group was normalized by dividing the raw count by total population for each census block group. The higher the counts of families living at the poverty levels in a census block group, the higher the relative need for financial education.

The mortgage debt status data contained the count of housing units that had two mortgages and a home equity loan. The ACS dataset field that contained the counts information was B25081e6. The need for financial education using the mortgage debt status data was indicated by raw count of housing units in each census block group. Each census block group raw count required normalization to account for the variation in size of each census block group. The raw count data for each census block group was normalized by dividing the raw count by total population for each census block group. The higher the counts of housing units in a census block group, the higher the relative need for financial education.

The disabled population data contains the count of disabled adults between the age of 18 and 65. The ACS defines disabled adults as having one or more sensory, physical, mental, self-care, go-outside-home limitations. The ACS dataset field that contained the counts information was C23023e3. The disabled population data indicated a need for financial education by raw count of individuals in each census block group. Each census block group raw count required normalization to account for the variation in size of each census block group. The raw count data for each census block group was normalized by dividing the raw count by total population for each census block. The higher the counts of disabled individuals in a census block group, the higher the relative need for financial education.

The unemployment data contains the count of adult individuals between the age of 18 and 65 that have not worked in the past 12 months. This categorization was assigned to all respondents who indicated they worked less than 2 weeks out of a 12-month period. The ACS dataset field that contained the unemployment counts information was B23022e25. The need for financial education using the unemployment data was indicated by raw count of individuals in each census block group. Each census block group raw count required normalization to account for the variation in size of each census block group. The raw count data for each census block group was normalized by dividing the raw count by total population for each census block group. The higher the counts of unemployed individuals in a census block group, the higher the relative need for financial education.

The vacancy status data contains the count of housing units that are currently vacant without rental or sale contracts pending. The ACS dataset column that contained the vacancy counts information was B25002e3. The need for financial education using the vacancy data was indicated by the raw count of housing units in each census block group. Each census block group

raw count required normalization to account for the variation in size of each census block group. The raw count data for each census block group was normalized by dividing the raw count by total population for each census block group. The higher the counts of vacant housing units in a census block group, the higher the relative need for financial education.

The high rent expenditure data contained the count of renter occupied units in each census block group spending greater than 35% of their gross income on rent. The ACS data captures rent spending for a number of different spending ranges. This research extracted all renter occupied unit counts for those categories that where renter are spending greater than 35%. The ACS dataset columns that contained the renter occupied unit counts were B25070e8, B25070e9, and B25070e10. The need for financial education was indicated by the raw count of renter occupied units in each census block group. Each census block group raw count required normalization to account for the variation in size of each census block group. The raw count data for each census block group was normalized by dividing the raw count by total population for each census block group. The higher the counts of renter occupied units in a census block group, the higher the relative need for financial education.

The census block group boundaries are delimited based upon population. Densely populated regions will have smaller area census block groups and more sparsely populated regions will have larger area census block groups. Each of the seven ACS dataset has been aggregated into the census block group regions. The respective size of each areal unit will affect the raw counts of individuals, households, housing units and families and ultimately has the potential to influence the outcome of this research. This issue is known as the modifiable areal unit problem and was described in detail by Stan Openshaw (Openshaw 1983).

Working with the statewide source ACS data set required great effort to extract the data of interest and organize appropriately for processing. Care should be taken to validate the data join processing of the tabular ACS data and the census block group geometry. Another consideration for researchers is to evaluate of the margin of error associated with each factor. The ACS makes estimates of how the entire population of a census block would respond to a particular survey question based upon a sample of respondents from that census block group. The ACS margin of error is variable between data and care should be taken during ACS factor selection to evaluate the margin of error for each factor.

3.1.2 2010 Census Data

Ethnicity census data from the 2010 decennial census was used in this research. The Massachusetts census summary file, in a tabular format, was joined with census block polygons. The census block aerial unit provided the highest spatial resolution available for the ethnicity census data. There were 780 census block groups within the City of Malden's boundaries. A review of the processing steps required to prepare the ethnicity data for use in this research will follow.

The 2010 census data contains a wide variety of ethnicity data that describes the density of a number of different ethnicities. The two specific ethnic groups and their densities were of interest to this study. The raw count of African Americans and Latinos populations by census block group was collected. Since research has shown that these two ethnicities are more likely to have low financial literacy skills, the counts of individuals by census block were summed together, creating a single raw count. Each census block raw count required normalization to account for the variation in size of each census block. The raw count data for each census block was normalized by dividing the raw count by total population for each census block. The need for financial education using the ethnicity data was indicated by the raw count of individuals in each census block. The

higher the counts of individuals meeting the ethnicity criteria in a census block group, the higher the relative need for financial education.

The 2010 census block is another areal unit that has been defined based upon population. This approach to areal aggregation based upon population creates a situation where the modifiable areal unit problem (MAUP) could influence the interpretation of the ethnicity data. Awareness of the potential MAUP is critical to the interpretation of the MCE results.

3.1.3 City Data Processing

The City of Malden's Assessing Department and City Treasurer provided tabular foreclosure incidence and tax delinquency incidence data respectively. The GIS department also provided parcel point centroid data for this research effort. The tabular foreclosure and tax delinquency datasets were joined with the parcel centroid point vector data to provide a spatial representation of the incidence of housing foreclosures and tax delinquent individuals. A detailed review of the foreclosure and tax delinquency point data processing steps is presented in this section.

The City of Malden provided access to foreclosure and tax delinquency data for this study. The City Assessing department archives yearly historic property assessment datasets. The archived assessing data includes wide variety of property specific characteristics: the recent sale price, current lot size, number of bathrooms and a unique identification code. The archived assessing data was consistently captured on January 1st of each year and the data was maintained in a CSV format. In the archived assessing data, the attribute of most interest was the non-arms length property sale transaction information. The non-arms length attribute recorded a property sale or land sale that occurred between a buyer and seller, who both had an existing relationship. A family member to family member property transaction is a common example of a non-arms length transaction.

Homeowners and banks are also an example of an existing buyer and seller relationship. Foreclosure proceedings result in the transfer ownership from the homeowner to the bank, which classifies as a non-arms length transaction. The archived assessing data for the 2008 and 2013 period was examined and the non-arms length transaction fields were extracted from each of the yearly assessing dataset into a non-arms length transaction data table. The non-arms length data was then examined in detail to identify records indicating a foreclosure transaction was the last property sale transaction for that year. These foreclosure records were extracted with a unique parcel identifier field.

Using the unique parcel identification, the yearly foreclosure data was joined with the copies of the city's parcel centroid point dataset. The resulting 5 years of individual foreclosure point records were merged into one single point dataset that ultimately contained 323 foreclosure events.

The final foreclosure dataset contained many coincident points. In order to avoid an over-estimation of the number of foreclosure events in a particular location, a data validation step was required. The validation assessed if the previous year's foreclosure event had the same owner information or not. If the same ownership information was found for a property exhibiting many foreclosure transactions, it was assumed that the foreclosure events were more likely a single foreclosure event initiated by the same owner. When multiple owners were identified in the same parcel, it was assumed that two or more foreclosure events occurred. A single point in the center of the parcel experiencing foreclosure would represent a single foreclosure event. When multiple foreclosure events occur for a specific parcel these central points in a single parcel become stacked. Those parcel centroids with stacked points and a single unique ownership record were reduced to a single centroid point. Those properties that had two or more unique foreclosures

during the study period were manually unstacked and given non-coincident placement within the source parcel. There was only one property in the 5 year data sample reviewed where one property owner foreclosed on their home, the bank resold the property to a new owner and that owner went into foreclosure.

The tax delinquency records were maintained by the City Treasurer. The tabular record contained property owners that owed outstanding taxes on their property. This list contained tax delinquent homeowners that had been paying down their delinquent taxes for many years and those homeowners who as recently as the 2013 tax year became tax delinquent. Even though the initial delinquency status could have started up to 30 years prior, this research will include all outstanding tax delinquency records regardless of the delinquency start date because each tax delinquency record indicates an currently tax delinquent property. The tax delinquency data also contained the repayment status, property owner information by address, and the parcel ID for the property in tax delinquency.

The tax delinquency property records were joined with the city parcel centroid dataset. Similar to the foreclosure parcel centroid processing, any coincident tax delinquency points were evaluated to determine if it was appropriate to count each tax delinquency parcel centroid point as its own instance of tax delinquency. To assess this, the parcel centroids with stacked points were evaluated to determine if more than one owner was in tax delinquency for a particular property. There were no stacked tax delinquency points that had multiple unique occupants in a delinquent tax state. The resulting total of tax delinquencies records used in the study was 332.

3.2 Outline of Methods

With the factor input data clearly defined, these data were processed by the following steps: (1) Prepared and normalized the ACS, census data, parcel based data; (2) Rasterized the ACS and census data; (3) Ran kernel density estimations for foreclosure and tax delinquency data; (4) Standardized all factor data; (5) Combined all the data through an evenly weighted multi-criteria evaluation (MCE) analysis.
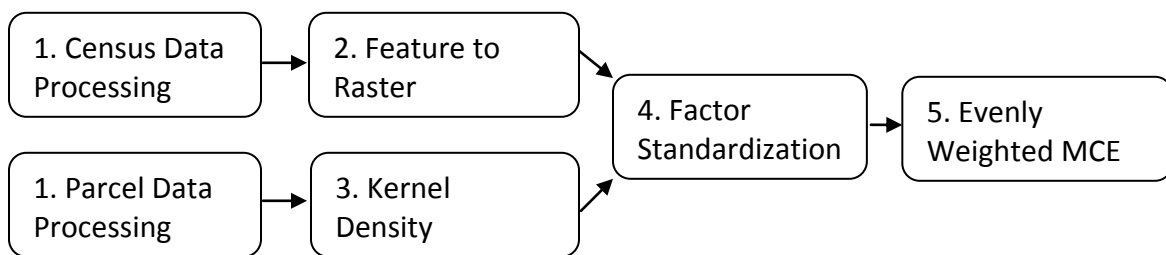
1. Census Data Processing	→	2. Feature to Raster	

4. Factor Standardization → 5. Evenly Weighted MCE

1. Parcel Data Processing	→	3. Kernel Density

Figure 2: Methodological Flowchart Diagram

Step one was important to the success of the research. All downstream processes relied upon accurate data processing efforts. The specific tabular data of interest from the ACS and 2010 Census were organized, and then the repetitive joining and normalization were completed. The city tabular data were also processed, and then each dataset was joined with the parcel point centroid data.

Step two was required to prepare the ACS and census data for the MCE processing. The conversion from polygon to raster was completed. The raster data cell size was set to 5 meters, to provide enough spatial resolution to delimit census block groups and census block from adjacent regions. Step three was required to create a surface that could represent the city point vector data in a continuous way. Step four was necessary to rescale the normalized raw counts and density measures onto a zero to one scale. This scaling method allowed an even comparison to be

completed between any of the factor. In step five, the evenly weighted MCE process was completed to produce a single output representing areas in need of financial education.

3.2.1 Normalization and Standardization of Factors

Each of the ACS and 2010 Census data used in this study contained the raw counts of the following factors; educational attainment, foreclosure incidence, tax delinquency incidence, poverty status, mortgage debt status, disability status, unemployment, housing vacancy incidence, high rent expenditure, and ethnicity. However, each of the raw counts needed to be normalized to accomplish the evenly weighted MCE process. Given each census block group or block varies in size by the population density of a given area, a population based normalization approach was appropriate to ensure the raw counts for any given factor was relative to the population of the census areal unit. The normalization process produced a ratio by dividing the raw count for each enumeration unit by the total population of the enumeration unit. For example, if the raw count for a particular census block group and the total population of the block group were 10 and 100 respectively, the normalized value was 0.1.

When comparing the normalization ratio values between ACS and Census factors, the highest and lowest ratio values varied greatly between each factor. This variation in normalization value was due to the wide variations in population and raw count values for each factor. In the normalized state, combining all the factors ratios evenly would favor those factors with the higher scores over those with lower scores. This variability in the normalized factor value ranges did not support the evenly weighted analysis goals of this research. To compare all the factors evenly, the ratio measures needed to be further standardized.

The standardization process was conducted to convert all normalized values onto a zero to one scale. This allowed for an even comparison between factors to be completed without concern

over the scale and range of raw score values. The highest or lowest suitability values in any given dataset will have the same standardization value, allowing an even comparison between all factors.

The standardization formula selection was dependent on whether the factor data values represent an increase or decrease in the need for financial education. The *standardized value A* calculation ensured the highest score in a factor data range was equal to one and the lowest score in the data range was equal to zero. The *standardized value B* calculation ensured the lowest score in the data range was equal to one and the highest score is equal to zero. The *standardized value A* formula was applied to all the ACS, 2010 Census, and city data factors in this research since the highest raw count and density measures in each factor was indicative of a greater relative need for financial education. The lower raw score and density measures were indicative of a lower relative need for financial education.

$$Standardized\ Value\ A = \frac{Raw\ Score - Minimum\ Raw\ Score}{Maximum\ Raw\ Score - Minimum\ Raw\ Score}$$

$$Standardized\ Value\ B = \frac{Maximum\ Raw\ Score - Raw\ Score}{Maximum\ Raw\ Score - Minimum\ Raw\ Score}$$

3.2.2 Kernel Density Estimation

The foreclosure and tax delinquent parcel centroid datasets required a Kernel Density Estimation (KDE) process, which was conducted to make inferences about the greater population of incident points in areas where no actual incident point data existed. Each point represented one incident in the datasets. If two incidents occurred in the same parcel, that parcel contained two points. In this KDE process, a search radius was defined to determine the maximum extent any given point had an influence on any nearby point. Accordingly, a distance for the foreclosure and a distance for the tax delinquency were set at 425 meters and 433 meters respectively. Overlapping radii that surrounding each point were then totaled, higher values indicating a greater number of coincident radii. In addition, four points were placed outside the city boundary in both the foreclosure and tax delinquency datasets. These four points do not correspond with actual foreclosures or tax delinquency incidents. However, they were necessary to extend the bounding box of the KDE processing output to cover the entire bounds of the city. The cell size of the output raster data was 5 meters. The two surfaces produced provided an estimation of the distribution and density of the foreclosures or tax delinquency incidents.

To include the two KDE raster surfaces in the MCE analysis, the standardization method that was applied to each cell value in the KDE surfaces to allow for an even comparison between all the factors in the analysis.

3.2.3 Evenly Weighted Multi-Criteria Evaluation

After all the factor values were rasterized and standardized, they were aggregated to produce a single surface that represented areas in need of financial education. To combine all ten factors, a weighted linear combination method was used. Given the lack of an informed method of assigning weights to factors related to the necessity of financial education, an evenly weighted

approach was used in this study. Each of the ten factors was given a weighting factor of one. This weighting strategy resulted in unaltered standardized values before the factors were combined. The resulting raster surface with 5-meter cell size contained the sum of all the standardized factor values. This output indicated where there highest relative need for financial education was located in the City of Malden. Higher values were indicative of areas in greater relative need for financial education and the lower values were indicative of areas in lower relative need for financial education. The interpretation of these results will be covered in Chapter 4.

Chapter Four: Results

Identifying the spatial distribution of need for financial education was the goal of this research. Research efforts identified ten factors that can indicate a need for financial education. The tabular factor data required joining with the appropriate spatial features, the raw data values required normalization, and the normalized values needed standardization in preparation for an evenly weighted multi-criteria evaluation (MCE). In this chapter, the data preparation results for each research factor are evaluated in detail. Afterward, the evenly weighted MCE result is presented and the spatial distribution of high and low need areas for financial education is documented.

4.1 Foreclosure and Tax Delinquency Results

Foreclosure and tax delinquency data were prepared for the evenly weighted MCE using a Kernel Density Estimation (KDE) method. The KDE processing effort produced two raster surfaces found in Figures 3 and 4. The source data points for the KDE surfaces are present in Figures 3 and 4. The KDE results were thematically classified using a Jenks natural breaks optimization method. This data classification technique optimizes the selection of classes to reduce the variance within a particular class and maximize the variance between classes (Jenks 1967). This classification method is appropriate given the left skewed distribution of the standardized values presented in the histograms in Figures 5 and 6. The break values for the foreclosure and tax delinquency figures vary since the break values are a product of the unique distribution of standardized value data in each dataset.

To further compare and contrast the expression of the foreclosure and tax delinquency point densities, a method used to quantify point feature clustering tendencies was applied.

Nearest neighbor analysis was used to evaluate how clustered or evenly dispersed each point dataset was relative to a random distribution of points (O'Sullivan and Unwin 2003). The results of the analysis produced z-scores that indicated how clustered or evenly distributed each point dataset was. Negative nearest neighbor analysis z-scores less than -1.96 indicate a statistically significant clustering trend. Positive nearest neighbor analysis z-scores greater than 1.96 indicate a statistically significant even dispersion of points trend. The nearest neighbor analysis produced a z score of -9.54 for foreclosure point dataset and a z-score result of -8.86 for the tax delinquency dataset. Both the foreclosure and tax delinquency data sets are clearly exhibiting statistically significant clustering trends. Relatively speaking, the tax delinquency data is more evenly dispersed than the foreclosure data.

The statistically significant clustering of points identified by the nearest neighbor analysis intuitively equates to high-density areas in both of the KDE results. Some of the largest high-density KDE clusters in both the foreclosures and tax delinquency data sets are identified in Figures 5 and 6 using black numbered boxes. The relative density of these point clusters is graphically presented using a red to green scale. Red areas indicate the highest densities of points in the KDE and green areas indicate much lower densities of points. The red areas, indicating a high needs for financial education, cover much less area than green lower relative need areas. The histograms in Figures 5 and 6, located below the map figures, provide a graphical depiction of the distribution of need. The histogram vertical axis shows the count of raster cells in the KDE surface. The horizontal axis presents each of the nine Jenks natural break classifications of standardized values. The red, high need areas make up a very small percentage of the entire raster surface. The tax delinquency KDE has ninety-two 5m x 5m raster cells identified in the highest need classification bin, this equates to 0.56 acres. The high need areas numbered one through three in

the foreclosure Figure 5 and one through four in the tax delinquency Figure 6, will be referred to as "cluster" during the result analysis and discussion. The largest foreclosure clustering occurs primarily in center of the City and just south of the City center in a largely residential area, identified as cluster Area 1 and cluster Area 3 in Figure 5. The large tax delinquency clusters in Area 1 and Area 3 also fall in the same location as the foreclosure clusters. However, tax delinquency cluster Area 2 and Area 4 are located in the eastern part of the city as well, north and south of the industrial rail line.
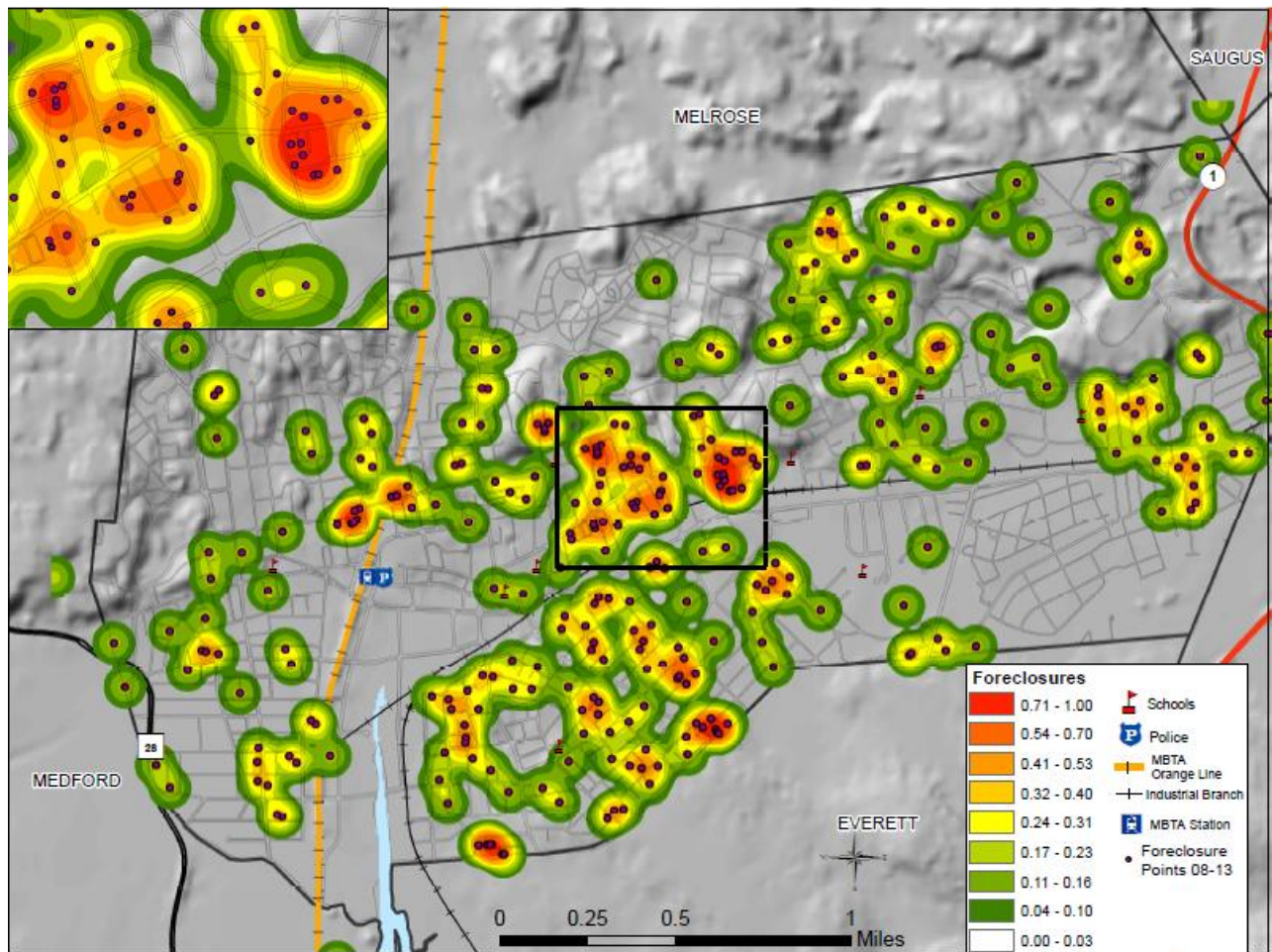

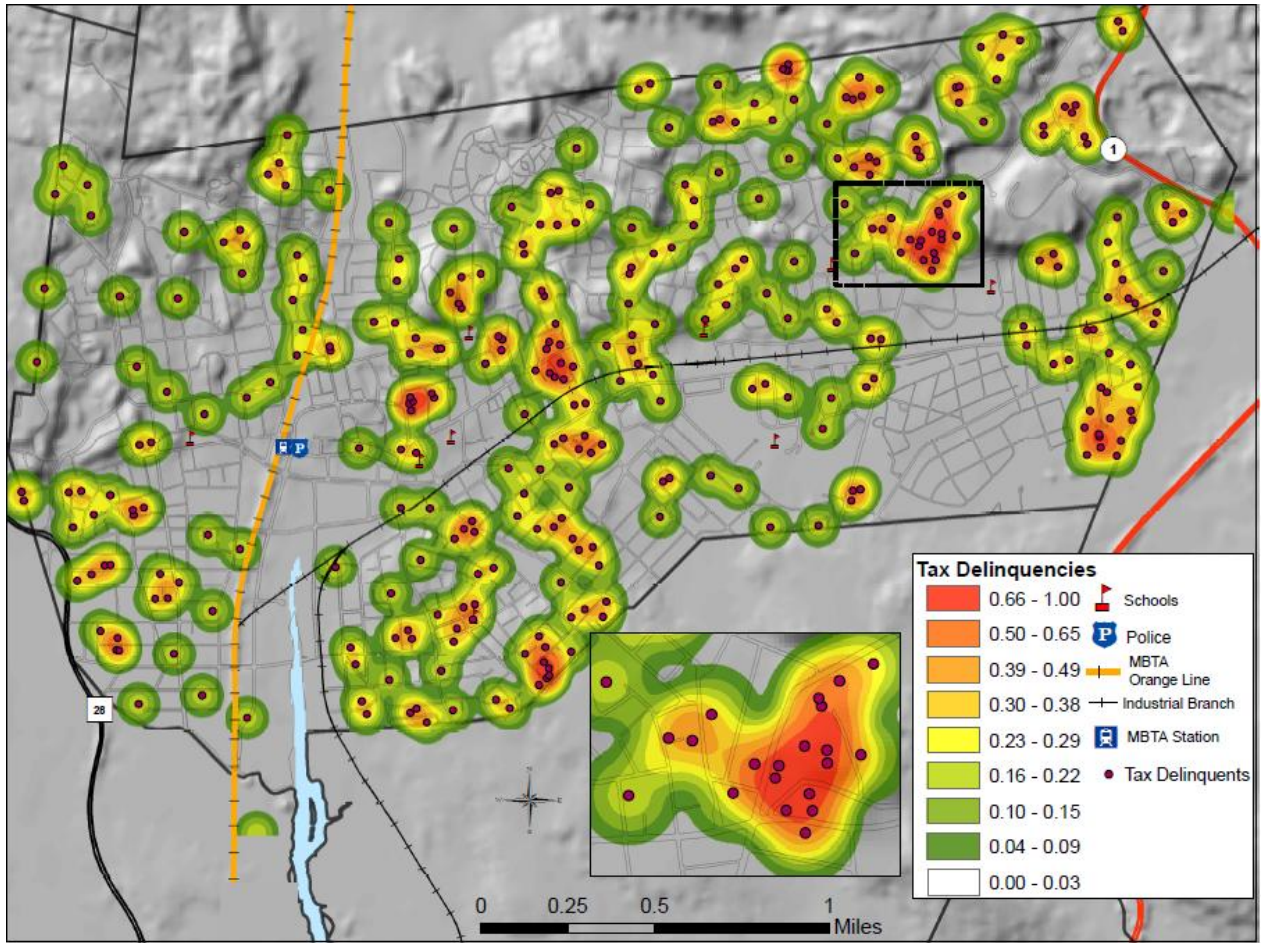**Figure 3: KDE of Foreclosure Occurrence with Source Foreclosure Point Data Shown**

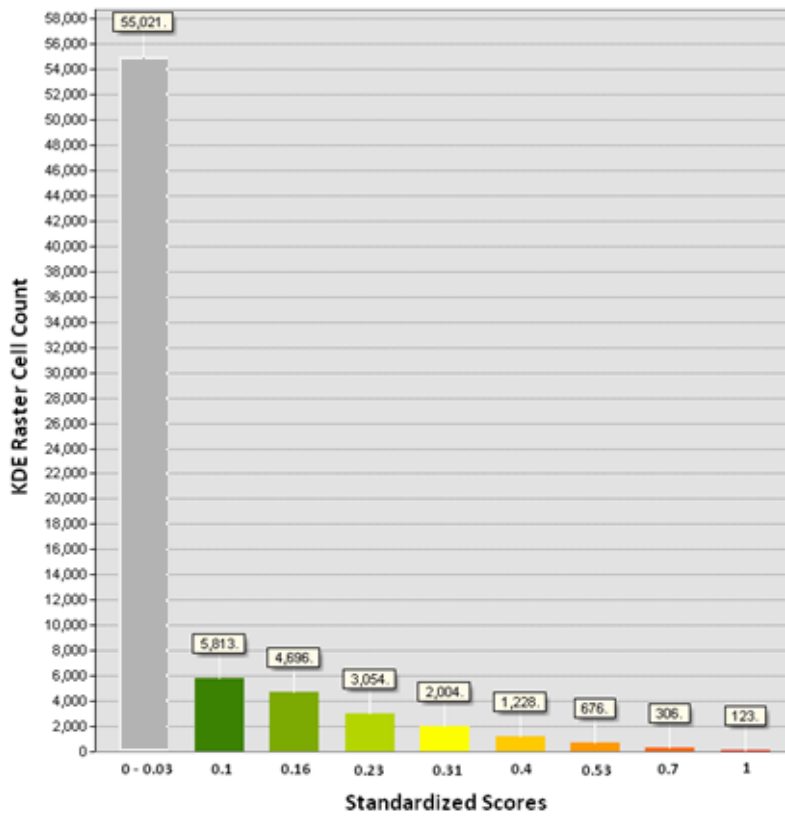**Figure 4: KDE of Tax Delinquency Occurrence with Source Delinquency Point Data Shown**
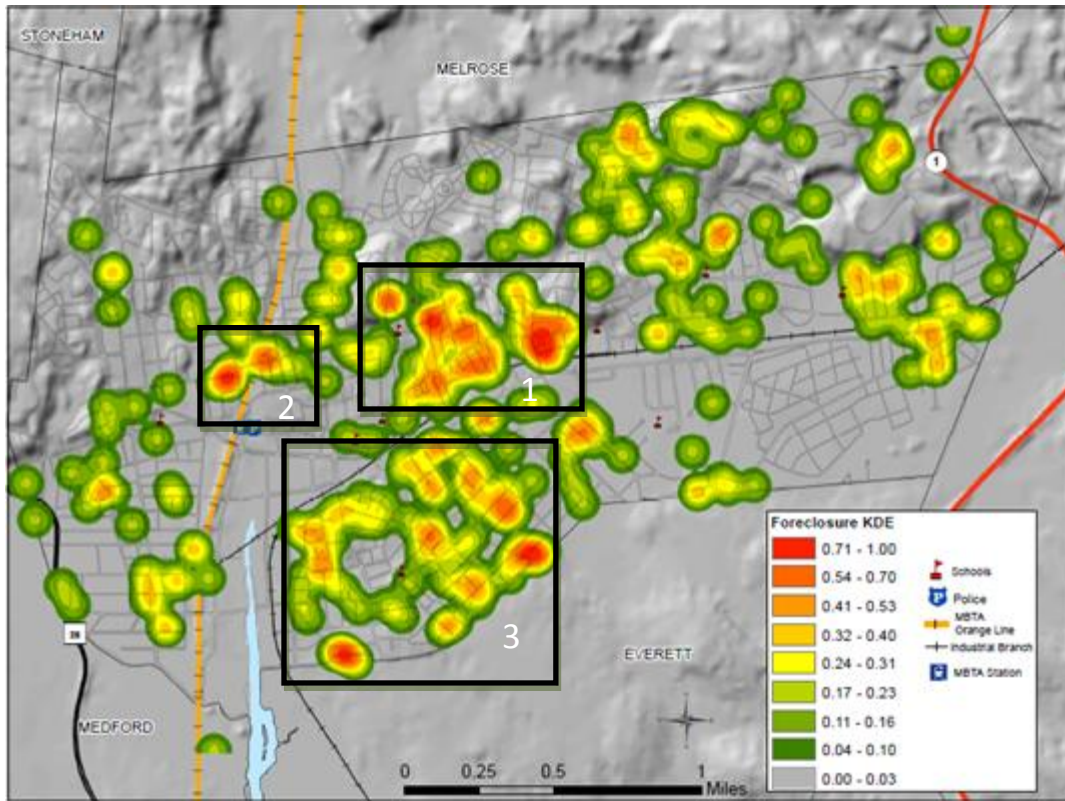
43

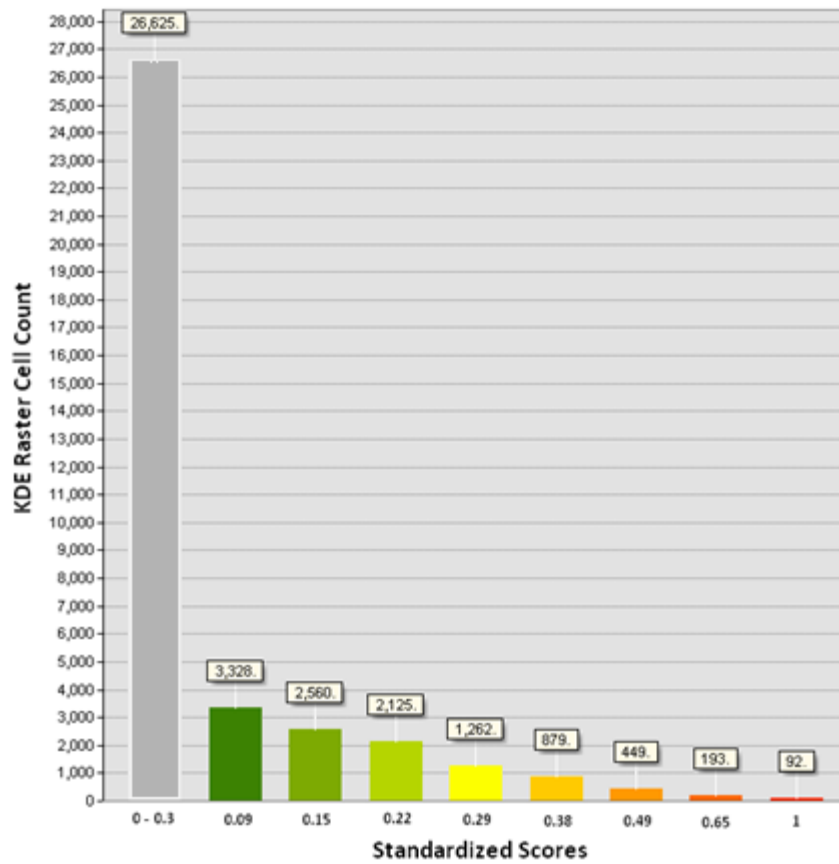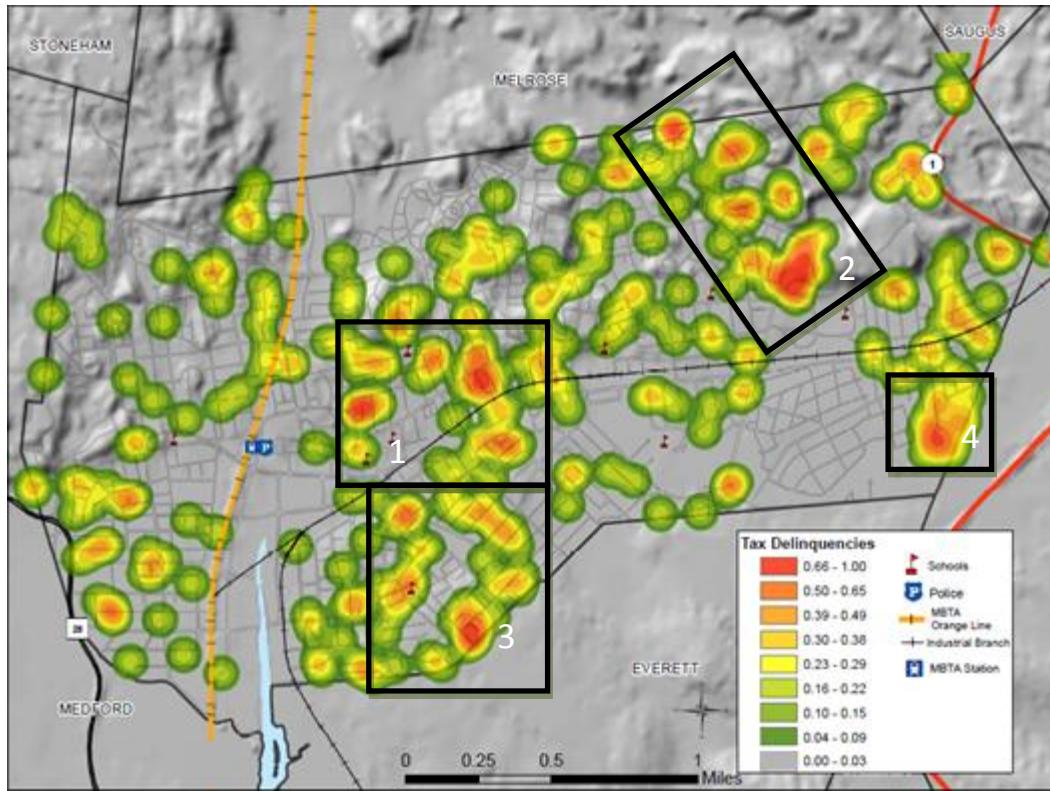**Figure 5: Results of the Foreclosure KDE Processing**

Figure 6: Results of the Tax Delinquency KDE Processing

4.2 Census Data Results

Each of the ACS and Census factor datasets required normalization, rasterization, and standardization to produce the results described in this section. The standardized factor values are presented in each of the census figures. Each figure was thematically classified using an equal interval data classification method with nine classes in each map and histogram.

The factor output for high rent expenditure indentifies two census block groups that have standardized values in the highest equal interval class. Both census block groups are west of the Orange line. The histogram in Figure 7 is a representation of the number of raster cells that fall into each of the equal interval standardized value classes and provide insight into the distribution of data. The Figure 7 histogram shows the majority of the high rent expenditure factor values falling in the standardized value classes 0.11, 0.22, and 0.33 and very few census block groups scored in the highest standardized value classes 0.78, 0.89, and 1. The histogram appears to be left skewed. The mean standardized value of 0.31 aligns with this visual assessment of the histogram. Those high need areas that have high-standardized values greater than 0.67 cover approximately 3 acres of the city and are located close to the Orange line.

This could be an indication that individuals are willing to pay more for rent when they live in close proximity to convenient mass transportation into Boston. The eastern most third of the City has low standardized values falling between classes 0.11 and 0.44.   This lower rent expenditure trend could be a function of the distance from the desirable mass transit options further west.
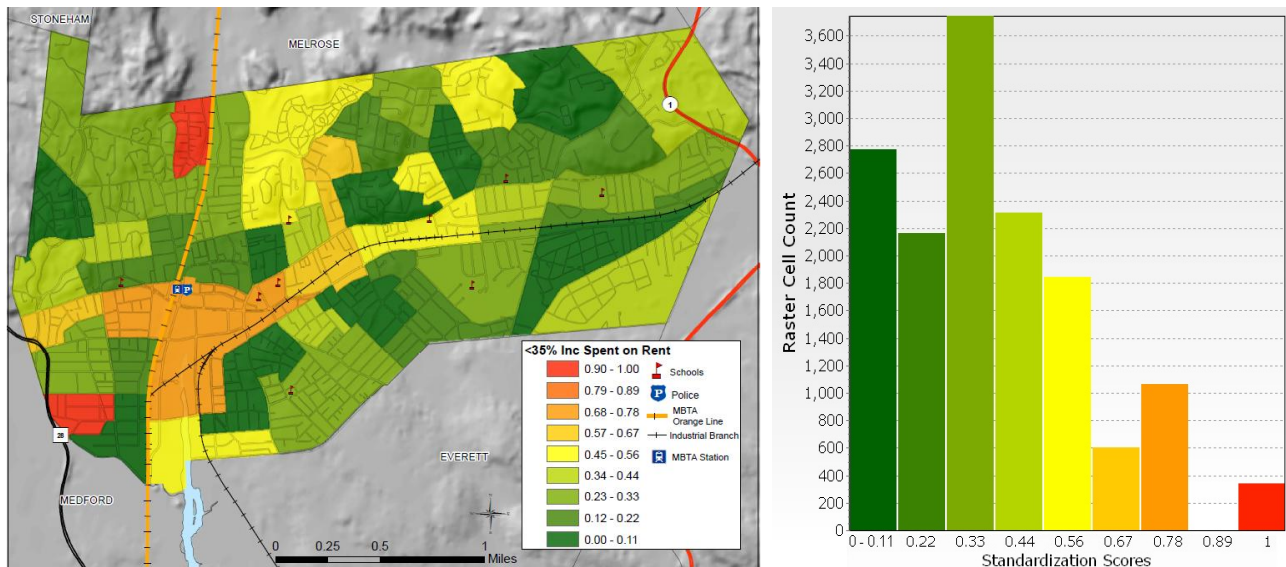
Figure 7: Households that spend greater than 35% of their income on rent. (left) An equal interval color map representing the standardized score for the factor by census block group. (right) A histogram of raster cell count verses the standardized value distribution. The x-axis indicates the upper bound of each bin.

The disabled adult factor indentifies four census block groups with standardized scores in the highest classification of scores (Figure 8). The histogram in Figure 8 is presenting a bi-modal distribution with the highest number of raster cells falling in standardized classifications 0.22 and 0.89. This bi-modal representation in the 1st and 3rd quartile of standardized values is unlike any of the other factors data distributions. The difference in cell counts between each equal interval classifications is very small, with the largest difference equaling 2,000 5m x 5m cells or a 12-acre difference in area. The high and low scores present across the city in no discernible pattern. The data indicates that the disable population is spread throughout the city. Educational event planner should consider accessibility issues when planning financial educational events in the City of Malden.
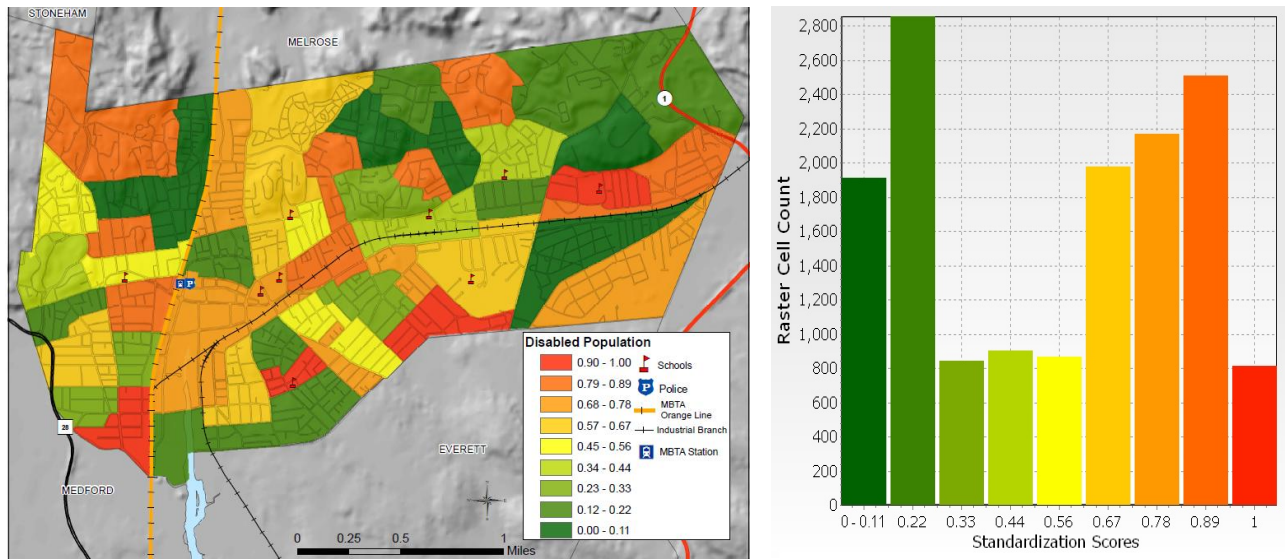
47

Figure 8: Disabled Individual between the ages of 18 and 65. (left) An equal interval color map representing the standardized scores for the factor by census block group. (right) A histogram of raster cell count verses the standardized value distribution. The x-axis indicates the upper bound of each bin.

The mortgage debt status factor is unique among the census data when considering the total number of respondents that met the survey criteria (Figure 9). The mortgage debt status factor's raw ACS data contains the count of housing units that have two mortgages and a home equity loan. Fifty-eight total housing units spread across four different census block groups during the 2008 to 2013 time-period indicated they met the survey criteria. Due to very few housing units meeting the criteria, only four census block groups have standardized scores above zero. Two of these block groups are located in the northwestern corner of the city near the Orange line. The other two block groups are located in the center of the city south of the industrial branch rail line. Of the four groups, one block group falls in the highest standardized value class equal to one. However, this is expected because the standardization formula ensures the highest raw score receives a standardized score of one. The high-standardized value block group is located in a residentially zoned part of the city south of the branch line and adjacent to the southern town boundary (Figure 16).

Given the small number of housing units meeting the survey criteria and the fact that the standardization formula must assign a value of one to the highest value in the dataset, researchers should carefully evaluate if it is appropriate to include factors with limited results. This research has determined the mortgage status factor to be a valuable indication of need for financial education, but the impact of the mortgage status factor on the final MCE will be isolated in only a few block groups but make a strong contribution to the final MCE score in those areas.
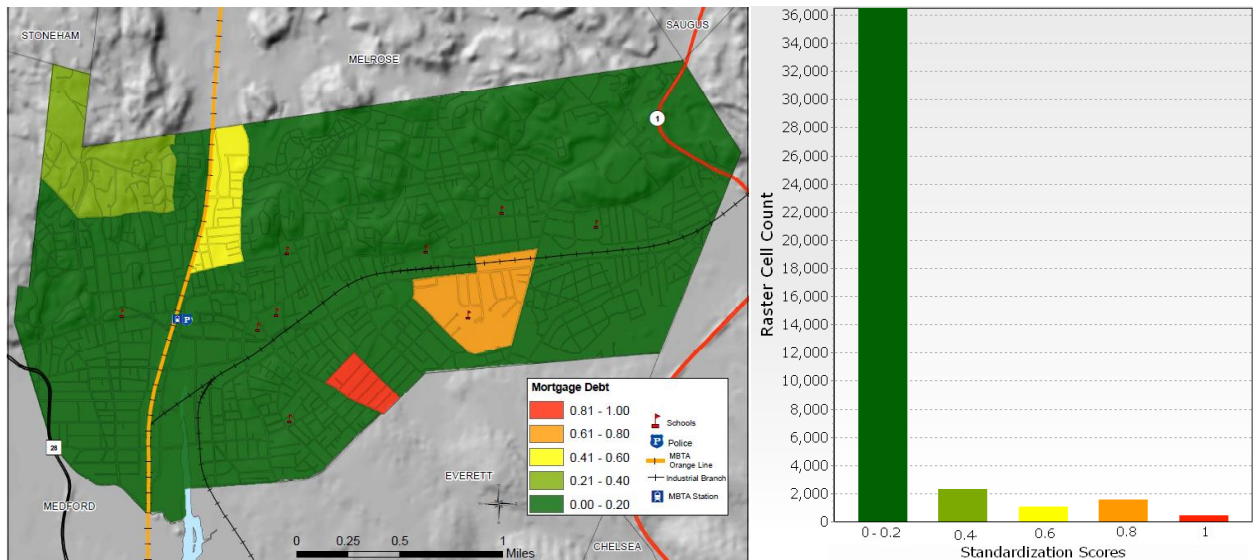

Figure 9: Number of Individuals with Two Mortgages and a Home Equity Loan (left). An equal interval color map representing the standardized scores for the factor by census block group. (right) A histogram of raster cell count verses the standardized value distribution. The x-axis indicates the upper bound of each bin.

The ethnicity factor is the only factor from the 2010 census that was aggregated on the census block level (Figure 10). The ethnicity factor data is showing where there are large numbers of African American and Latino individuals living in a single location. The histogram in Figure 10 shows a heavily skewed left distribution with 80% of the cell values falling in the lowest two standardized value classes equal to 0 - 0.11 and 0.22. Focusing on the spatial distribution of the remaining 20% of the cell values with standardized values above 0.22, there appears to a general organization around the Orange line in the western side of the city. There are only two census blocks in the highest standardization class equal to one. The highest need census blocks are

located near the city center, just north and south of the industrial branch rail line. The distribution of values makes a strong statement that there are no large clusters of both African American and Latino populations living in the same location. It is possible that African Americans and Latinos prefer to inhabit separate neighborhoods, which would require additional research to validate. If this is the case, separating the two groups might provide a better indication of the racial or ethnic hotspots.
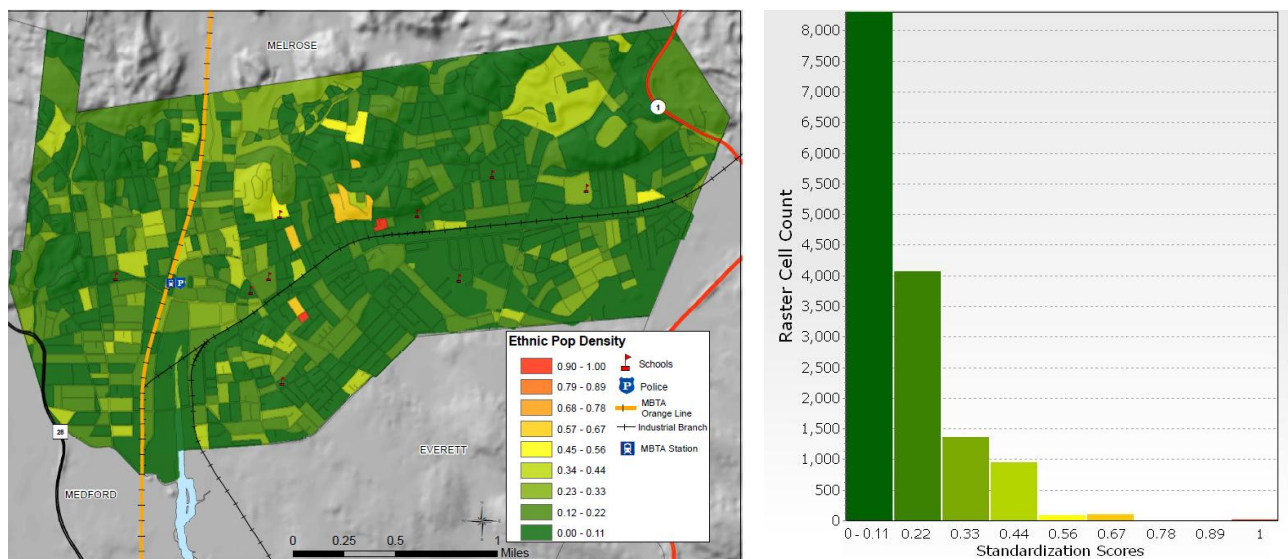

Figure 10: Number of African Americans and Hispanic Individuals (left). An equal interval color map representing the standardized scores for the factor by census block group. (right) A histogram of raster cell count verses the standardized value distribution. The x-axis indicates the upper bound of each bin.

The educational attainment factor has a standard score distribution most closely matching a Gaussian distribution (Figure 11). This bell curve like distribution can be clearly seen in the Figure 11 histogram. The normal distribution observed in the histogram is also support by the fact that the first quartile value, mean and third quartile values fall roughly at 0.25, 0.5, and 0.75 respectively. The standardized value class equal to 0.56 has double the amount of cell values of the next highest class of 0.44, which makes for a very tall and narrow bell curve. The data distribution has produced four census block groups that fall into the highest standardization value class. Spatially, the educational attainment score values appear to be higher to the south and

west. There also seem to fewer individuals with low educational attainment in northeast of the city. Two of the four highest need areas have schools within the same census block group boundary. The other two high need areas located west of the Orange line are adjacent or in close proximity to a school. This could be an indication that those with limited educational attainment come to value formal education and situate themselves in close proximity to educational resources.
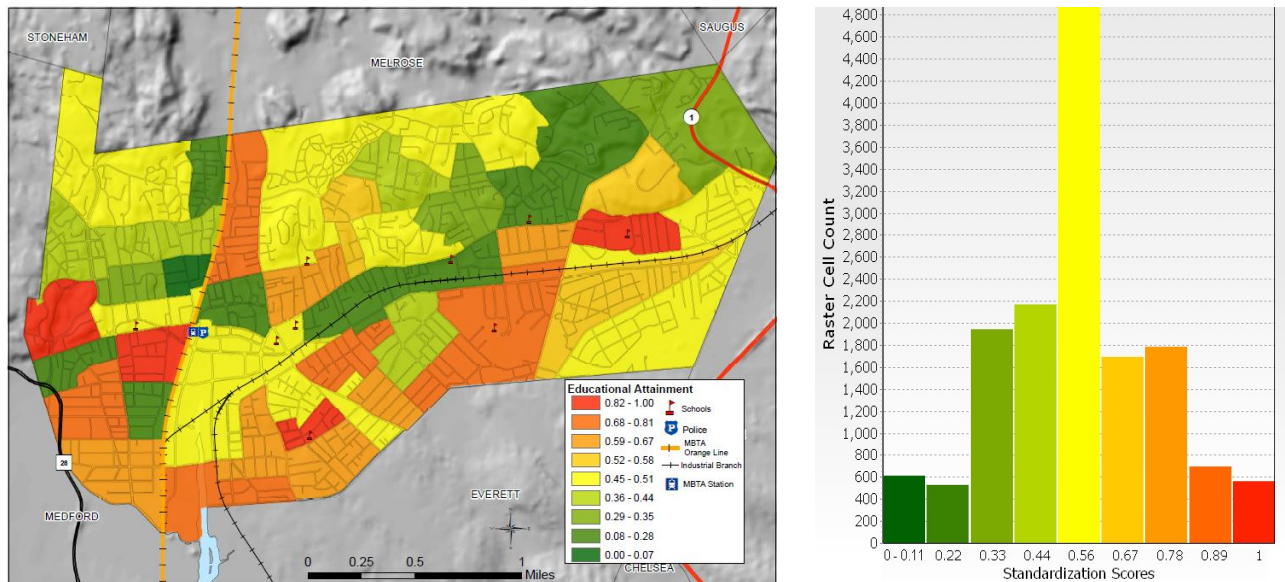

Figure 11: Individuals that have not attained a High School Degree (left). An equal interval color map representing the standardized scores for the factor by census block group. (right) A histogram of raster cell count verses the standardized value distribution. The x-axis indicates the upper bound of each bin.

The factor identifying family poverty status has a distinct left skew shown in the Figure 12 histogram. This left skew distribution leaves very few census block groups with high standardized values and has resulted in only one census block group being classified in the highest score category. The largest census block group in the city, measuring 0.35 square miles, falls into the standardized value class equal to 0.78 for households below the poverty level. This particular block group contains the largest contiguous business and industrial zones (Figure 16). Those census block groups that fall into the standardized value class equal to 0.56 ultimately have a higher raster cell counts than the standardized value class equal to 0.78 and are coincident with

residential areas. The highest need area block group also happens to be bounded north and south by block groups with the lowest level of need, an unusual juxtaposition of need. There could be an opportunity to leverage local community knowledge to support neighbors in the highest need of financial guidance or support.
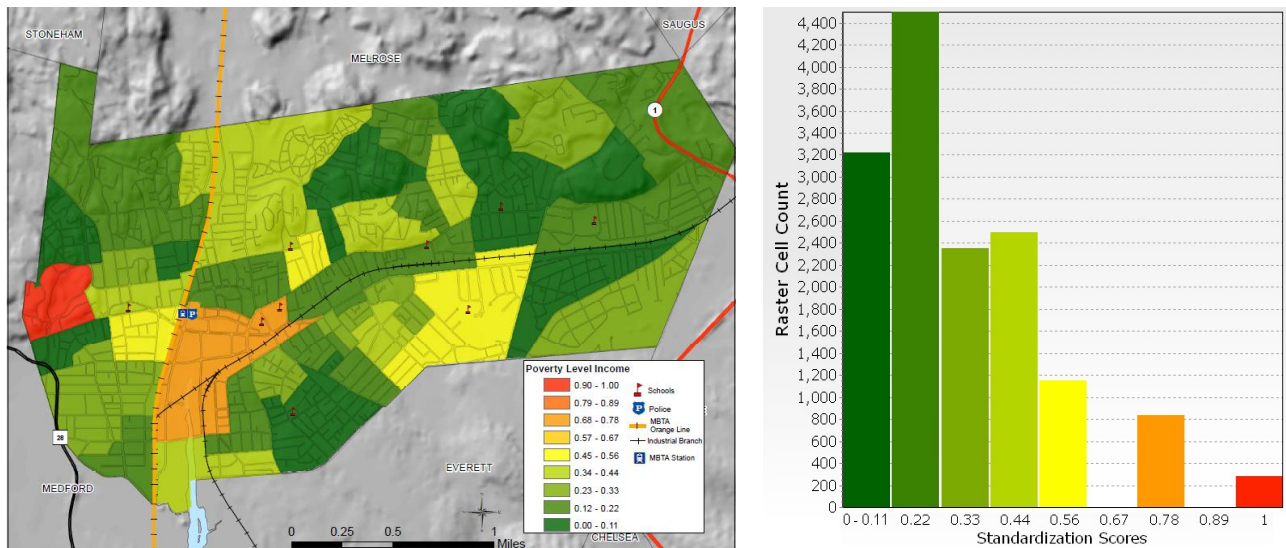

Figure 12: Households with Incomes Below the Poverty Level for the previous 12 months (left). An equal interval color map representing the standardized scores for the factor by census block group. (right) A histogram of raster cell count verses the standardized value distribution. The x-axis indicates the upper bound of each bin.

The unemployment factor has strong left skew, with 63% of the raster cell values falling in the lowest third of standardized value classes 0.11 , 0.22, and 0.33 (Figure 13). Similar to the high rent expenditure and mortgage debt status factors, this left skew leaves only one census block group classified in the highest need class category. This area with the highest need for financial education is coincident the largest census block group, which is also the business and industrially zoned area of the City of Malden (Figure 16). There are three census block groups with standardized value in the class equal to 0.67. Two of these three block groups are adjacent or coincident with industrially zoned areas of the city. Given the proximity these high need areas are to industrial zones, could the individuals in these areas be experiencing unemployment because the industrial areas are no longer offering the jobs that once attracted individuals to the location?
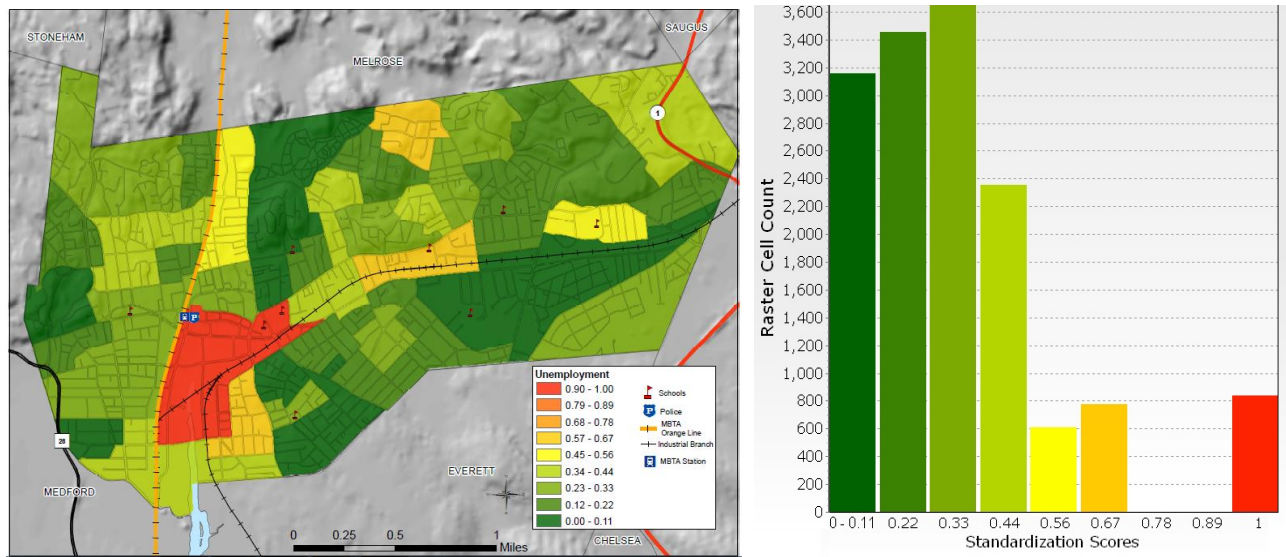
Figure 13: Individuals that have not worked in the past 12 months (left). An equal interval color map representing the standardized scores for the factor by census block group. (right) A histogram of raster cell count verses the standardized value distribution. The x-axis indicates the upper bound of each bin.

The final census factor to review is the housing vacancy factor, which like the unemployment factors has left skewed standardized values (Figure 14). The spatial distribution of census block groups with standardized values in lowest class equal to 0 - 0.11 are found in the center of the city. This distribution is different from the other ACS factors that have often expressed higher standardized values in the center of the city. This distribution could be due to the value of real estate and rental space in the center of a city just outside of Boston. A wide distribution of census block groups in standardized value classes greater than or equal to 0.56 are coincident or adjacent to the industrial branch, Orange line, and the major roadway Route 60 (Figure 1). Properties adjacent to major transportation pathways with lots of traffic might be more difficult to keep occupied with tenants or owners.
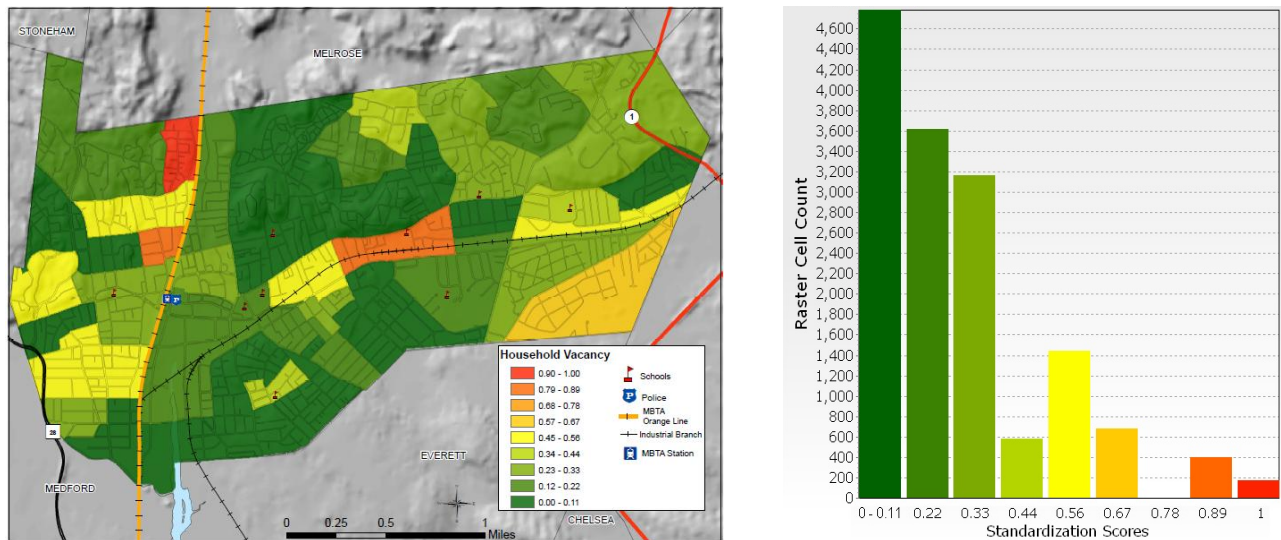
Figure 14: Number of Housing Units Currently Vacant (left). An equal interval color map representing the standardized scores for the factor by census block group. (right) A histogram of raster cell count verses the standardized value distribution. The x-axis indicates the upper bound of each bin.

The census factors collectively had a number of similarities. The data distribution was often left skewed with the majority of raster cell values falling in the lowest three standardized value equal interval classes. On average, the center of the city had a higher need for financial education. The transportation corridors also have a role to play in many of the different factor expression and should be an important feature to consider and review. The zoning of the city also seems to have a relationship with the expression of need for financial education, but additional review is required. Collectively, these ten factors will provide insight into the need for financial education.

4.3 Evenly Weighted Multi-Criteria Evaluation (MCE) Output Review

Ten factors, each indicative of the need for financial education, were combined to produce the evenly weighted MCE output shown in Figure 15. An equal interval data classification approach was used to represent the MCE results. The areas with highest cumulative standardized values indicate where the greatest relative need for financial education is located in the City of Malden.

The highest possible value that could be produced by the MCE is a standardized value of 10. This is a function of the ten factors used in the MCE, each having the highest possible score of one. The lowest possible score that could be produced by the MCE is a standardized value of 0. The highest need areas are symbolized using orange and red thematic representations and a selection of some of the "high need areas" are highlighted in Figure 15 using numbered black circles and ellipses. The Figure 15 histogram for the MCE shows a slight left skew with a sharp drop as the cumulative standardized values increase. This histogram shows that the highest need class contains only 12 5m x 5m cells or 300 m^2 of area. This area is just south of Salem Street, north of Playstead Road, and between Hyde Street and Cross Street. This area contains 22 residential structures. This area of highest need is identified in Figure 15 as Area 1. Area 1 is coincident with the highest scoring census block from the Ethnicity data and the densest cluster of foreclosure data (Figures 5 and 10).

It was necessary to expand of the definition of great need for financial education beyond the single highest need area with the highest MCE cumulative value, since it would not be effective to target financial education to just 22 residences. A review of those areas that have cumulative MCE standardized values greater than 3.24 and greater than 4.19 was conducted. High need areas with scores greater than 3.24 covered 1.2 square miles of the city of Malden, which is 23.5% of the total land area of the city. High need areas with scores greater than 4.19 covered 0.2 square mile of the City of Malden, which is 3% of the total land area of the city.

Since the MCE analysis is an expression of all the individual factors identified in the previous sections, similar spatial traits are present in the MCE output. The highest need areas are coincident and adjacent to the orange line, branch industrial rail line, and Route 60. The city center, business districts and industrial districts express a higher relative need for financial education when compared to regions east and west of the center of Malden (Figure 16). An

isolated area in the east of the city, identified in Figure 15 as Area 3, has expressed higher needs for financial education. This is primarily a product of the tax delinquency, educational attainment, and disabled adults data. One of the largest areas in need for financial education, identified as Area 2 in Figure 15, is also coincident with a single census block group. The high MCE value in Area 2 is primarily the product of the unemployment, family poverty status, disabled population, and high rent expenditure factors. The majority of the factor data used in the MCE analysis is from the ACS, which has well-defined census block group boundaries. However, there are a number of scattered high need areas with less boundary uniformity. These areas of high need are a function of the spatial distribution of the foreclosure and tax delinquency KDE data.

The incidence of low scores with values lower than 1.33 are found in the southeast adjacent to the industrial rail, northwest adjacent to the western most boundary, and in the northeast corner adjacent to the City of Saugus. More generally, these areas seem to be primarily in the northern half of Malden. Low standardized scores areas should be interpreted as having a lower immediate need for financial education.
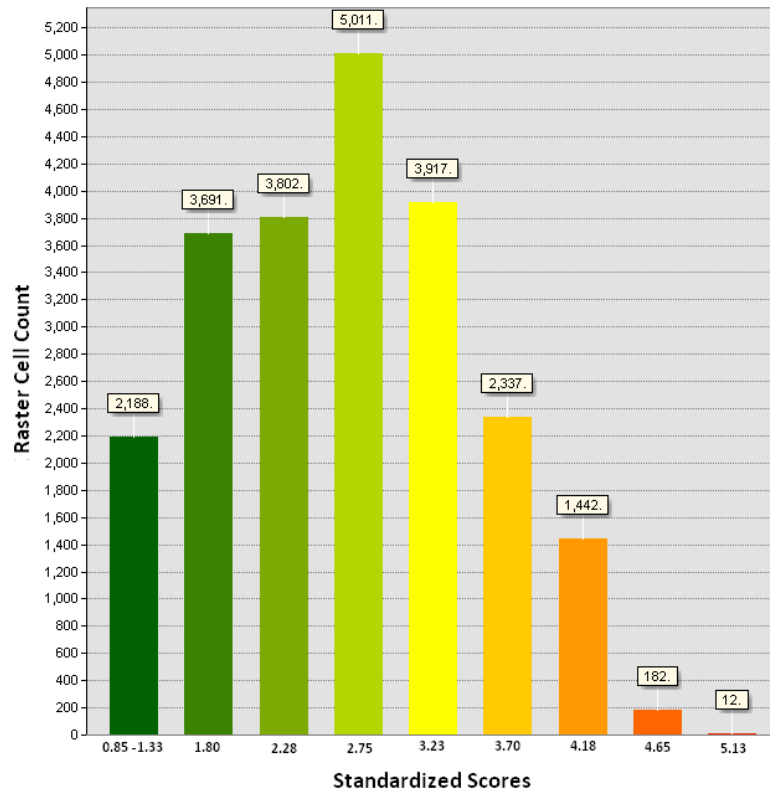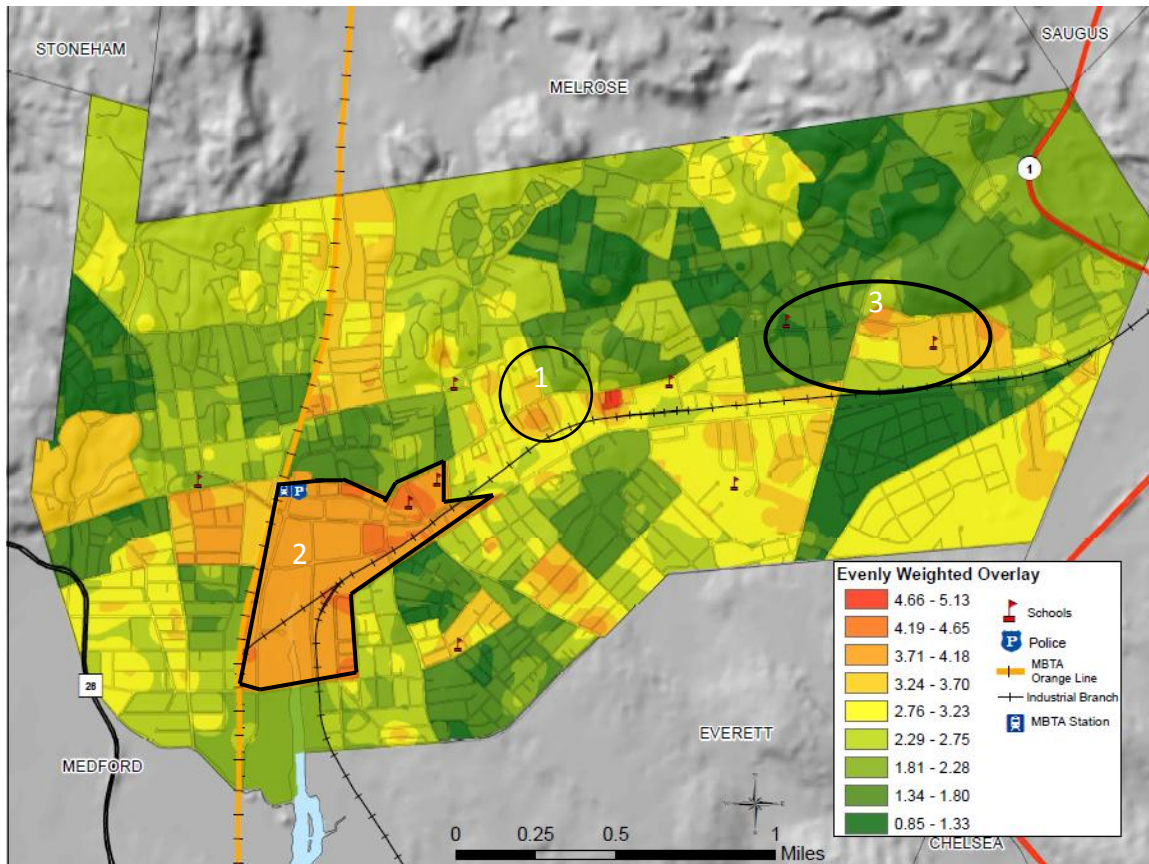
Figure 15: Evenly Weighted MCE Overlay Output and High Financial Educational Need Areas

Chapter Five: Discussion

An individual's pursuit of financial education should never be complete. In response to the increasingly complex financial systems, individuals are required to maintain a minimum level of personal financial security. Being prepared for financial changes and turmoil requires self-study throughout one's life, ideally with the study focused on answering the most pressing financial questions. Efforts to increase the availability and diversity of financial education resources are underway; however, the question of where there is the greatest need for financial education remains. The focus of this research is to identify those areas in the City of Malden that have the greatest need for financial education using a variety of socioeconomic and demographic factors. These factors include educational attainment, foreclosure incidence, tax delinquency incidence, poverty status, mortgage debt status, disability status, unemployment, housing vacancy incidence, high rent expenditure, and ethnicity. By properly formatting, normalizing, standardizing, and combining these factors using evenly weighted MCE, one can identify those regions that have a high need for financial education.

5.1 Evenly Weighted MCE Analysis Discussion and Application

The final evenly weighted MCE result is a product of all the research factor variations in need for financial education. At a high level, the city center, commercially intensive area in the southwest, and isolated residential areas throughout Malden are expressing high need for education. In aggregate, the MCE results are helpful to focus financial education support efforts. However, evaluating the appropriateness of each high need MCE area requires researchers to return the individual factors. Additionally, users should understand that the MCE results or

individual standardized factor values are not to be interpreted as a binary decree of need for financial education. The analysis outputs should be interpreted as a continuous spectrum of need for financial education, with some areas needing more support than others do.

The range of values produced by the MCE indicates the relative need for financial education. The MCE results can help focus financial education support efforts in the areas of greatest relative need. To do so, decision makers must first decide what standardized values best define the greatest need for financial education in a given geographic study area. This decision is best made by reviewing the results produced by the MCE closely.

The MCE is a decision making tool that can help direct financial education efforts. Understanding which factors are impacting the MCE in a given area provides additional context to the need for financial education. The sub sections following will provide additional discussion of the individual factors and their impacts on the final MCE results.

5.1.1 Foreclosure and Tax Delinquency Significance

Beyond the clustering analysis and density of points, the expression of the foreclosure points in the context of the City, provides another aid to interpret the KDE output. Figures 5 and 6 show high-density clusters of the foreclosure and tax delinquency data points respectively. These clustered areas intersect often with a number of differently zoned areas, which can be used for a number of different purposes and have different owners. High-density cluster Area 3, in both the foreclosure (Figure 5) and tax delinquency (Figure 6) factors, occur in a residential zoned area (Figures 16). The coincidence of residential homeowners with foreclosure and tax delinquency occurrence aligns with the research goal of indentifying individual homeowners who are currently in financial distress.

Reviewing the high-density cluster Area 1, for both the foreclosure (Figure 5) and tax delinquency (Figure 6) factors, you see a more mixed presentation of zoning intersecting with the clustering areas. Specifically, there are industrial zones in close proximity to the industrial branch rail line and more mixed use buildings with both commercial and residential zoning along the main east to west city thoroughfare, Route 60 (Figure 1). Given these variations in zoning and the KDE factor clustering, additional effort was focused on understanding if these variations might influence the need for financial education in these areas. This analysis focused on identifying additional property and owner details for each of the individual points within high-density foreclosure clusters.

A trend was identified that might explain the incidence of high-density clusters in foreclosure Area 1, was located near the city center highlighted by a black bounding box (Figure 5). These clusters were located in business zoning areas. The source foreclosure points in high-density cluster Area 1 were primarily commercial property foreclosures. The differentiation of a commercial foreclosure was identified by reviewing the source assessing data, which original provided the non-arms length sale information.

The tax assessing information also contains the legal owner name and other billing information that allowed for a differentiation between residential and commercial owners. The reasonable assumption was made that when Limited Liability Corporations (LLC) and other business name information was found in the assessing information, it was quite likely that these properties in foreclosure were commercial entities not individuals. The original justification for using the foreclosure factor in this research was that each foreclosure point was an individual decision maker in financial distress, whose financial distress could be alleviated marginally with financial education. Since the reasons for a commercial foreclosure are likely different from

residential foreclosures, additional research is required to evaluate if it is appropriate to keep commercial foreclosures in the foreclosure factor dataset. Fully understanding the presentation of factor data is critical if informed decisions are to be made about how to implement financial education events.
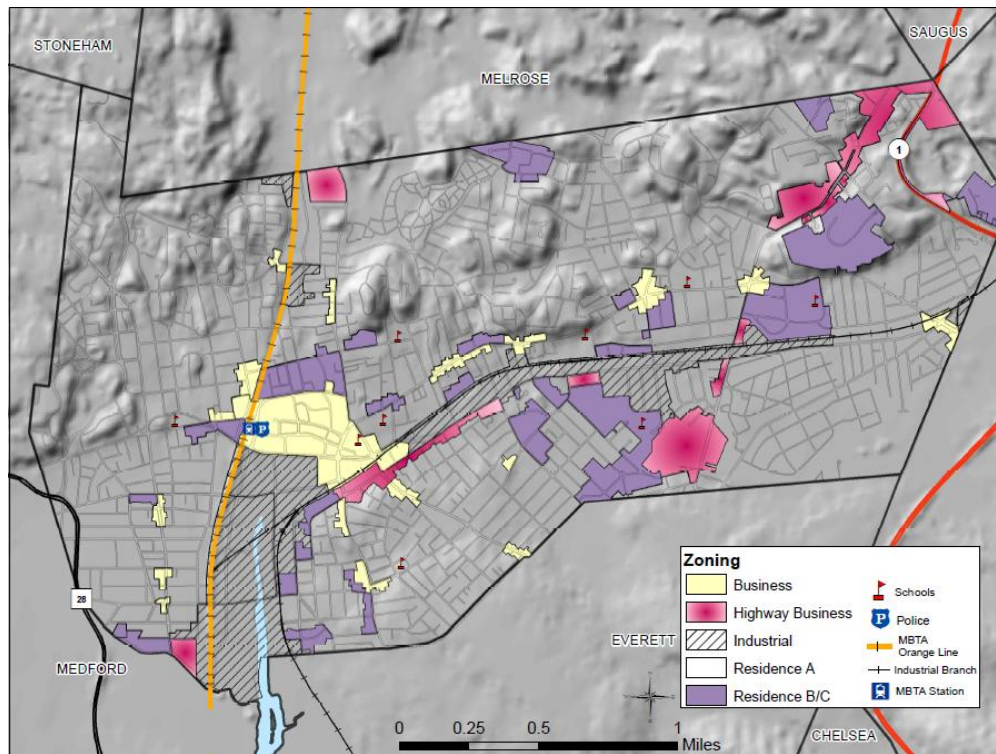
Figure 16: The City of Malden 2014 Zoning Map. All the zones are mutually exclusive and Residential A zoning has a hollow thematic representation which covering the remaining city area

5.1.2 Census Factor and MCE Output Discussion

The MCE high value Area 2 (See Figure 15), is the largest census block group in the City of Malden. After reviewing all the factors in the Area 2, the unemployment factor (Figure 14), household income below poverty level factor (Figure 13), and the high rent expenditure factor (Figure 7), all presented with high scores in the same area. These particular scores contributed greatly to the final MCE score in Figure 15. When reviewing more closely this particular census block group to identify where the individuals in this large census block group were living, the zoning map (Figure 16) quickly helped identify that this area is primarily zoned for commercial and

industrial activities. Area 2 has 19.2 acres zoned for residential zones B/C and 204 acres zoned for industrial and business activities. Accordingly, only 9.4% of Area 2 has residential housing for City of Malden residents, each of which is eligible to respond to the ACS. Given the ACS factors listed above are primarily responsible for defining both the need for financial education and the bounds of Area 2, this research concludes that spatial representation of need for financial education in Area 2 to be misleading. Those individuals that are in need of financial education are most likely located in the non-commercial and business properties and not over the entire extent of the census block group. Since zoning policies vary from city to town, researchers should be careful to understand if mixed residential / commercial zoning is present in order to assess where individuals in need of financial education are actually located.

From a city level perspective, the proximity of Malden to Boston likely has an impact on the demographic distribution of Malden residents and consequently the need for financial education. The City of Malden is separate from Boston, but is well within the "Boston Metro Area". Malden has many mass transportation options for commuting into Boston. With an average home price of $278,000 and an average price per square foot of $215, Malden has some of the most reasonable real estate when compared to its neighboring communities and given its proximity to Boston (Trulia 2014). This mix of characteristics has made it very attractive to a number of different populations, building what is now a very diverse community. To support some of the most needy in this diverse community, City of Malden has 577 public housing units spread across 8 housing projects (Layfield 2014). Four of the larger housing projects in Malden are in areas expressing a high need for financial education. This coincidence of housing projects with the high need for financial education areas is a potential method for validating the MCE analysis.

The relationship transportation corridors have with high MCE value areas was explored for additional insight into the MCE results. There are two rail lines that transverse north to south and east to west through the City of Malden. There is also a state highway, Route 60, which passes east to west through the city as well (Figure 1). Adjacent to these transportation corridors you also find zoning for industrial use and a highway businesses (Figure 16). These industrial and business zoned areas are then adjacent to the residential areas. When placing differently zone areas in close proximity, the abutting zones are common areas where negative externalities likely result in decreased property values (Ohls, Weisberg, and White 1974). When reviewing each individual factor's high standardized value areas and the MCE high value areas, a pattern of adjacency between these high value areas and transportation corridors is clear. The explanation for exactly why this spatial relationship exists requires additional research. However, the combination of reduced property values, close proximity to transit corridors, and the need for financial education is interesting and another potential metric for evaluating the MCE output.

The focus on high MCE value areas should also be shifted to the lower MCE value end of the spectrum to help validate the model is running as expected. When investigating the three areas of the MCE that had lower than average standardized values, the south western most area adjacent to the industrial branch rail line, it intersects almost completely with the Holy Cross Cemetery. Given the inhabitants of this area, it logically makes sense why this area is being assigned lower scores. The other two areas with low MCE values are in close proximity to public parks and the tax assessing records indicate the last home sale price to be above the average Malden home price of $278,000 (Trulia 2014). One of these areas is adjacent to the northern town boundary and in the Northwestern corner of the city. The other area is west the Orange line and adjacent to the western town boundary. The greater level of relative affluence in these areas and

potentially increased level of education would equate to a reduction in the standardized scores for these low MCE value areas.

5.2 Implications and Limitations

The large question that remains after evaluating the results of this research is if the evenly weighted approach is the best methodology, given the factors selected. Identifying which factor(s) best indicate the greatest need for financial education is an open question to be studied. An argument could be made that the foreclosure and tax delinquency points should have a higher weight because they more closely relate to actual financial decision-making events. However, how to establish the degree to which any of the factors are weighted is a much more difficult question.

Another one of the study weaknesses is the relatively small number of factors identified that indicate a need for financial education. The Cutter et al. (2003) study started with over 200 factors and reduced the number based upon factor analysis. The methodologies used to identify factors in their study are viable, but additional effort to study financial decision-making and financial education efficacy could help inform the factor selection criteria.

This study sorted through all the readily available free data that might indicate a need for financial education. During this effort, the sources of the private data that could support research on financial education were identified. The Mortgage and Bankers Association keeps detailed loan payment information. This mortgage data could further assist in identifying financially stable or unstable individuals. A membership with the National Realtors Association brings access to data about the financial health of a particular community or neighborhood. Credit card companies possess individual spending habits and payment history. This information could help identify how

fiscally responsibility an individual is by providing a window into spending and payment habits. This data could also help identify the individuals that are overleveraged with credit card debt. If more financial data with good spatial resolution was available, the MCE output could provide a more robust expression of need for financial education.

5.3 Spatial Significance and Next Steps

The Consumer Financial Protection Bureau estimated that federal, state, and local government, financial institutions, nonprofit organizations, charitable foundations, and others in 2013 spent $670 million providing financial education services. Even though this amount of spending equates to only about two dollars per American, there is currently a lack of financial literacy and a great need for financial education in America today. Given this level of investment, it was surprising that this research effort was unable to identify any attempts by governments or researchers to develop spatial methods to understand where there was the greatest need for financial education. This research captured readily available local and national data and applied a straightforward MCE method to see if any patterns of interest were present to assist in the identification of need for financial education. With additional methodological refinements from new research, additional factor data from private sources, and an expanded study area, this research has the potential to increase the effectiveness of financial education spending.

In addition, the MCE output presented in this research would benefit from review by local experts from the City of Malden. Ideally, representatives with expert community knowledge could provide additional local insight beyond the review provided in this thesis. Unfortunately, this research effort was unable to complete an extensive review with the City of Malden staff.

However, the City of Malden GIS experts reviewed the research result. They were confused by the identification of high need for financial education in areas with large volumes of business and commercial zoning. When a discussion about the inclusion of commercial foreclosure incidents in the KDE analysis was raised, the City GIS experts thought that was a mistake. They thought that commercial foreclosures should be removed from the foreclosure dataset because individuals and business can act very differently.

The next step forward from this research is to use the resulting MCE surface indicating the relative need for financial education to organize the delivery of targeted financial education offerings. Successful educational training events require partners that can organize and communicate with the intended audience for the financial education training opportunity. Partners should be able to identify the critical factors that their potential attendees most require, like convenient hours or days for training and best learning settings. These kinds of critical training factors can contain additional spatial information, which could be leveraged to identify the most appropriate training locations. To gauge the potential success of new partners, considering the proximity of each partner or their training events to the areas in high need of financial education could be valuable indicator of success. The identification of free training locations like, religious institutions, community centers and other common meeting places would lend itself to a proximity analysis to each high need area. The training partners should also consider the availability of mass transportation and handicapped accessibility to each training event, especially in an urban context.

5.4 Summary

In this thesis, the factors and the method for identifying the relative need for financial education was developed and applied for the City of Malden, Massachusetts. The method was able to identify a number of high need areas spread throughout the City of Malden. Other communities could use these factors and apply this methodology as a starting point for addressing their community's need of financial education services. The preliminary research review by the City of Malden was positive, but further evaluation is required.

Decision makers today at many levels understand that there is a place for financial education; however, the best delivery methods and format are still areas under investigation. Financial education research is focused on quantifying the efficacy of financial education, while also trying to learn from already successful efforts. As more information is collected by researchers and qualitative financial education lessons documented, the factor identification research used in this research could be further refined.

This research has also exposed the fact that very limited spatial analysis has been completed in the pursuit of understanding the spatial patterns associated with financial decisions and financial knowledge. Additional efforts to provide spatial context to our financial systems and the decisions being made by individual financial actors could aid many different groups seeking to make more strategic business decisions. Even though there is room to improve this study, the factor selection and the spatial analysis methodology are applicable for use by other cities and towns.

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