

# SPATIAL ANALYSIS OF RESIDENTIAL MORTGAGE DEFAULT IN A METROPOLITAN COUNTY

Lucy Delgadillo and Luke Erickson

---

## Abstract

*In this pilot study, research was conducted to explore the application of GIS technology to residential mortgage default. The purpose of this study was to examine the relationship between foreclosure rates and neighborhood characteristics in a metropolitan county in Utah. Neighborhood was defined as a discrete spatial entity that contains households and housing structures with similar characteristics, and is equivalent to a census tract. Regression analysis indicated that characteristics such as proportion of household units with second mortgages and racial composition of census tracts explained 80% of the variance of foreclosure rates among the communities. The geo-mapping analysis of Cache County showed that foreclosure rates were spatially differentiated. Clusters of foreclosures were prominent in the southwestern portion of the county.*

---

## Introduction

Homeownership has been one of the most “well supported domestic policy goals at all levels of government for more than fifty years” (Sullivan, Warren, & Westbrook, 2000, p. 200). This goal has become manifest in the home buying explosion of recent years, and in the continuous support of President Bush helping people achieve the American Dream of homeownership (U.S. Department of Housing and Urban Development, 2005). In fact, the national homeownership rate for the last quarter of 2004 was 69% (U.S. Department of Housing and Urban Development, 2004). Historically low mortgage interest rates, discounts of initial rates on adjustable-rate mortgages by lenders, low downpayment requirements, innovative financing alternatives, and relaxed lending standards have almost entirely dissipated the barriers to homeownership. Individuals who would not have qualified for a home mortgage a decade ago are now being loaned up to and even beyond 100% of their home’s value (Hagerty & Simon, 2005). While the increase in homeownership has been viewed as a positive trend, there are also negative repercussions that follow any “boom” cycle.

Lucy Delgadillo is Assistant Professor and Luke Erickson is a Graduate Student, Department of Family, Consumer and Human Development, Utah State University, Logan, UT.

Along with the increase in homeownership, Vickers and Timmons (2002) reported that loan delinquency and home foreclosure rates have risen to record levels. The ease with which consumers are able to overextend themselves financially, and the fairly recent emergence of semi-legal, predatory-type lending practices are among the contributors to the increasing delinquency and foreclosure numbers (Vickers & Timmons, 2002).

Utah has not escaped national trends. Over the past decade the state has consistently had one of the highest rates of foreclosure in the U.S. Utah's foreclosure rate of 2.05% for mortgages insured by the U.S. Department of Housing and Urban Development's (HUD) Federal Housing Administration (FHA) programs is second only to Indiana (2.13%). According to the Mortgage Bankers Association of America (2003), 4.74% of mortgages in Utah were in default during the fourth quarter of 2003.

The trends of increasing foreclosure and default rates experienced in Utah from 2002 to 2003 may prove destructive to already financially unstable households. Indeed, many households have a limited capacity to meet current mortgage obligations and equally limited home equity or emergency reserves. Not only would increases in foreclosures harm these financially vulnerable households, but they could weaken communities, lower home price appreciation rates in surrounding areas, and decrease overall wealth of many home buyers (Baxter & Lauria, 2000).

Additional evidence provided by Capone (2001) also suggests that characteristics of a census tract where a property is located are even more important than borrower characteristics when determining default risk. Neighborhoods with higher default and foreclosure rates are less appealing to conventional lenders, in which case subprime lenders usually fill in the gaps, but with higher interest rates and fees (Vickers & Timmons, 2002). Neighborhoods with many foreclosures experience lower home price appreciation, and often the situation creates a negative stigma for the entire neighborhood. Lower incomes, lower home values, and high default rates create the conditions for declining neighborhoods and weakening communities (Baxter & Lauria, 2000). Consequently, the purpose of this study was to examine the relationship between foreclosure rates and neighborhood characteristics in a metropolitan county in Utah.

### **Gaps in Foreclosure Research**

Foreclosure studies in general have been scarce. This is due to the fact that foreclosure data are difficult to obtain because most are proprietary. A majority of the research on default and foreclosure has included factors that are expected to be related to either the equity theory, the ability-to-pay theory, or unexpected negative events known as trigger events (Anderson & VanderHoff, 1999; Delgadillo & Gallagher, 2006; Elmer & Seelig, 1998; Getter, 2003; Quercia & Stegman, 1992). While a reasonable amount is known about reasons for default and foreclosure,

a significant gap persists in understanding the relationship between foreclosure and community characteristics.

This study is innovative in two ways: (a) it contributes to our understanding of foreclosures as it explores the relationship between foreclosures and community neighborhood characteristics, and (b) it proposes to use spatial analysis to study the distributional patterns of foreclosure rates in Cache County communities. In this study, census tracts are used as proxies for neighborhoods. Census tracts are geographic units that are relatively homogeneous with respect to population characteristics, economic status, and living conditions, and arguably resemble typical neighborhood communities very closely. Census tracts are typically comprised of about 4,000 residents but they can range from 1,000 to 8,000 residents (U.S. Census Bureau, 2006).

HUD's Office of Policy Development and Research (PD&R) uses geographic information systems (GIS) to analyze neighborhood change and trends affecting housing markets. GIS is a computer-based system for the collection, storage, analysis, and output of information that is spatially referenced (Obermeyer & Pinto, 1994). Housing scholars and GIS experts have used spatial analysis to study real estate markets, home mortgage lending, and redlining (Anselin, 1998a; Blesky, Can, & Megboylugbe, 1998; Hillier, 2003; Rodriguez, Sirmans, & Marks, 1995; Thrall, 1998). However, GIS technology and spatial statistics have not been used in the specific context of foreclosures. Therefore, an objective of this article is to introduce these techniques and analyze foreclosure data in a geographic context.

## **Data Collection, Hypotheses, and Procedures**

### ***Data Collection***

The dataset for this study include all properties that were sold at judicial auction in Cache County, Utah, from January 2002 through December 2003, and census variables downloaded from the Federal Financial Institutions Examination Council (FFIEC) Census Report CD for 2003 (Federal Financial Institutions Examination Council, 2004).

### ***Research Questions and Hypotheses***

This study proposed to answer two general research questions:

- Are there geographic clusters of foreclosed properties in Cache County?
- What are the characteristics of community neighborhoods in Cache County that experienced high foreclosure rates in the years 2002-2003?

Given the fact that research on foreclosures and neighborhood characteristics is almost nonexistent, the following hypotheses are conjectural in nature.

1. *Foreclosure rates in Cache County are unevenly spread across census tracts.*

2. *Lower median census tract income is found in combination with reduced home values and increased residential mortgage foreclosure rates.*

Using a sample from New Orleans, Baxter and Lauria (2000) found that lower income levels and lower employment rates decrease the amount of owner-occupied housing because consumers have less money to support the debt. This causes the housing values of that area to fall, which increases foreclosure rates. This is due to borrowers having insufficient money to pay their mortgages and the lack of housing demand (Baxter & Lauria, 2000).

3. *The higher the number of occupied units with second mortgages or home equity lines of credit in a census tract, the higher the likelihood of residential foreclosures.*

According to Mitchell (2003) economists and researchers studying foreclosure and bankruptcy say that Utah residents have too much debt. This debt includes home equity loans and lines of credit. FHA borrowers make little or no downpayments on their homes and then have difficulty building equity in an almost depreciating housing market. Borrowers use up their equity to obtain second mortgages and lines of credit. Homeowners end up owing more on their homes than they are worth and this leads to foreclosure. Thus, home equity loans and second mortgages have some association with foreclosures.

4. *Neighborhood income is negatively correlated with foreclosure rates.*

Low neighborhood income has a negative effect on foreclosures. Using census tract median income, Van Order and Zorn (2000) found a strong and consistent relationship between neighborhood income and default. Thus, as neighborhood income decreases, foreclosures in that neighborhood increase (Van Order & Zorn, 2000). Similar findings were noted by Capone (2001), who found that census tract income levels outweighed individual income levels by two to one in determining the chance of default. The author reported that on average, low-income census tracts have a 15% higher default rate than moderate-income tracts, and 31% higher rates than middle-income census tracts (Capone, 2001).

5. *Racial composition of the neighborhood is positively correlated with foreclosure rates.*

Baxter and Lauria (2000) examined the impacts of racial composition (percentage of non-White residents) and neighborhood transition on housing foreclosures in New Orleans. From 1987 to 1988 the number of foreclosures in New Orleans increased from 247 to 1,255. The authors used multivariate analysis and found that census block groups with higher foreclosure rates had larger Black populations than those with smaller rates. Further, Baxter and Lauria (2000) found foreclosure rates to be high among neighborhoods with a high concentration of Black residents and neighborhoods with a high racial composition. Census tract minority composition was also found by Capone (2001) to be an influential factor in determining risk of default. In fact, the neighborhood composition was found to be a more accurate tool of measuring risk than an individual borrower's race.

## Procedures

This study used descriptive statistics, Pearson correlations, regression analysis, and spatial analysis to answer the research questions and test the hypotheses.

**Regression analysis.** In the general form of a liner regression model, the dependent variable  $Y$  is assumed to be a function of a set of  $k$  independent variables in a population. The dependent variable in this study is the foreclosure rate per census tract, which was calculated as the number of foreclosed properties divided by the total number of owner-occupied housing units per census tract in percentage. The independent variables are population 5 years and over, minority percentage, proportion of households that reported income as self-employment, proportion of households with second mortgages per census tract, tract median family income, and outstanding balances of foreclosed properties.

**Spatial analysis.** This enables one to solve research problems by uncovering and analyzing trends and patterns. One assumption underlying this research is that the data are likely to be spatially correlated. The explanatory variables are not sufficient to fully explain the variation in the data. A spatial analysis consisting of exploratory spatial data analysis (ESDA) was conducted with the aim to better describe and fit the data. According to Anselin (1998b, p. 79), “ESDA is a collection of techniques used to describe and visualize spatial distributions, identify atypical locations or spatial outliers, discover patterns of spatial association (clusters or ‘hot spots’), and suggest spatial regimes or other forms of spatial heterogeneity.”

## Results

The descriptive and correlation analyses (Tables 1 and 2) supported hypotheses #2, #3, and #4, but not #5. By looking at the findings shown in Table 2, one could speculate that most foreclosures occurred in communities with young families (more likely to be first-time home buyers), households units with second mortgages, and households with self-employment income.

**Table 1. Descriptive Statistics for Variables per Census Tract**

Variable	<i>M</i>	<i>SD</i>
Foreclosure rate	.78	.58
Population 5 years and over (%)	22.56	8.52
Minority percentage (%)	8.84	5.92
Proportion units with second mortgages (%)	4.80	3.25
Proportion households with self-employment income (%)	17.79	7.59
Tract median family income (\$)	46,766.50	15,766.09
Outstanding balance property foreclosed in 2002 (\$)	105,205.46	48,625.97
Outstanding balance property foreclosed in 2003 (\$)	106,981.43	51,344.49

**Table 2. Correlations between Foreclosure and Independent Variables**

Variable	<i>r</i>
Population 5 years and over	.501*
Minority percentage	.287
Units with second mortgage	.779**
Households with self-employment income	.556**
Percent poverty level	-.381*

\* $p < .05$ ; \*\* $p < .01$

Results derived from the linear regression revealed that minority percentage and household units with second mortgages were statistically significant factors in explaining 80% of the variance in foreclosure rates across the communities as seen by an  $R^2 = .798$  (Table 3). The units with second mortgage variable was statistically significant at the .001 level showing a high beta weight of 1.09. The standardized regression coefficient means that the predicted foreclosure rate increases by 1.09 standard deviations with each one standard deviation increase in the units with second mortgage variable. In other words, an increase of 3.26% of households with second mortgages in a census tract will predict an increase in foreclosure rates by .58, other things being equal.

In a closer examination of the data, it was observed that the two census tracts with the highest foreclosure rates were located in the cities of Smithfield and Hyrum. Smithfield is a growing community, predominantly White (6.6% minority) with many young families (41.5% households are married with children under 18 living at home), and in which 11.2% of households hold second mortgages. On the other hand, Hyrum has a 15.5% minority population, which is almost triple the county minority population of 6.3%, 57.3% married households with children under 18 years old, and 8.2% of households have second mortgages.

**Table 3. Linear Regression of Community Factors Related to Foreclosure**

Variable	<i>B</i>	<i>SD</i>	$\beta$
Population 5 years and over	-.001	.000	-.245
Minority percentage	.460	.015	.464**
Units with second mortgage	.195	.026	1.086**
Poverty level percent	-.008	.010	-.104
$R^2$	.798		

\*\* $p < .01$

Spatial analysis was conducted to answer whether or not there are geographic clusters of foreclosed properties in the Cache County area. Figure 1 shows that foreclosure rates were spatially differentiated, which supports hypothesis #1.

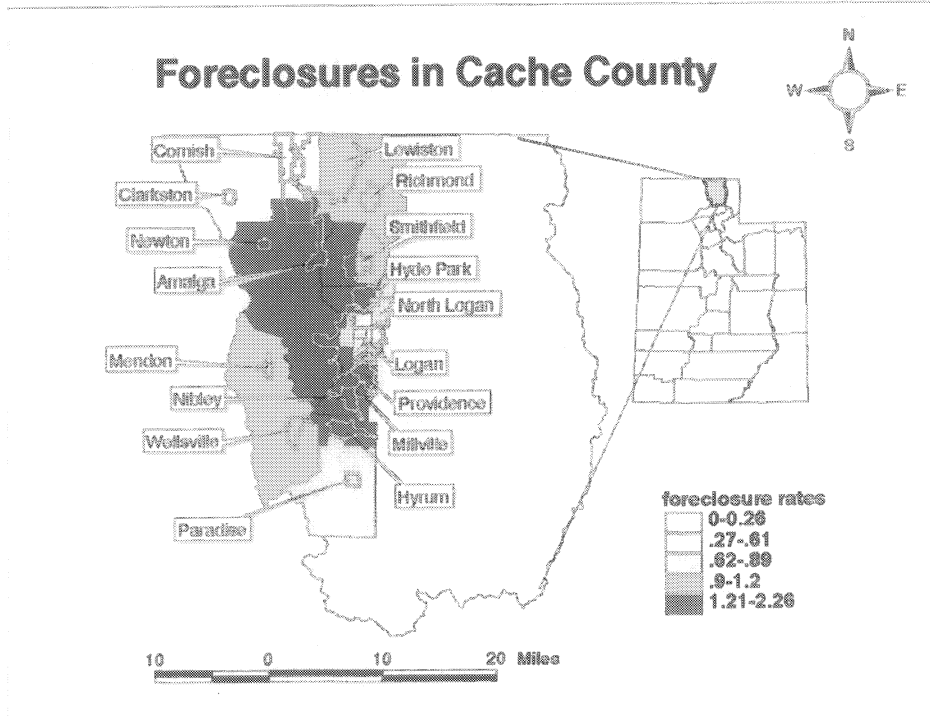


Figure 1. Foreclosures in Cache County, Utah, 2002-2003

Clusters of foreclosures were notorious in the southwestern part of the county. The geo-mapping analysis of Cache County allowed the researchers to identify which census tracts had the highest foreclosure rates. As expected, the foreclosure rates were not evenly spread among census tracts.

The next step in the analysis was to identify which census tracts were the most affected. If foreclosure rates would have been evenly distributed, all census tracts would have had a mean ratio of foreclosures of 0.78% ( $SD = 0.58\%$ ) (Figure 1). The analysis showed that several census tracts had foreclosure rates one standard deviation above the mean. Given this cut-off point, four census tracts in Cache County (2.01, 4.03, 11.01, and 14.00) showed foreclosure rates above 1.36% ( $M + SD$ ). Census tract number 2.01 (located in the Smithfield area) had the highest foreclosure rate (2.27%) in the county during the time period the study was conducted. One unexpected finding in this research was that the four census tracts with higher foreclosure rates were considered middle-income census tracts as classified by the census. A middle-income tract is defined as one in which the median family income percentage is greater than 80% and less than 120% of the area median income. The median family income for the county was \$43,907 (Table 4).

**Table 4. Census Tracts with the Highest Rates of Foreclosures**

<b>Census tract</b>	<b>Tract median family income (%)</b>	<b>Tract median family income (\$)</b>	<b>Minority percentage</b>
2.01	103.72	45,542	6.62
4.03	113.51	49,840	5.34
11.01	118.51	51,910	5.99
14.00	101.38	44,513	15.51

Source: FFIEC Census Reports 2003

### **Discussion and Future Research**

On the basis of these findings it appears that high rates of foreclosures differ from community to community and, by proxy, the causes of foreclosures might also vary among communities. In this study, high foreclosure rates in census tracts in a metropolitan county in Utah were associated with high minority percentages and with high numbers of units with second mortgages. There are good theoretical reasons for expecting positive correlations between foreclosure rates and minorities. Perhaps the racial composition of the census tract is just a proxy for some other variables such as low income, the propensity to be subject to trigger events, few job opportunities or job layoffs, predatory lending, or drastic house price changes in the area.

The second mortgage variable was also statistically and practically significant. The main implication of the significance of this variable concerns the oversupply of credit available to homeowners. Why are homeowners borrowing against the equity of their homes? Are they obtaining second mortgages just to avoid mortgage insurance? A mortgage that is subordinate to the original first mortgage is a good alternative to refinancing when one has an original first mortgage loan with a low interest rate. A second mortgage will give the borrower a lump sum of funds to use as needed. However, if borrowers take a second mortgage in lieu of making a downpayment, they could possibly face severe financial consequences of their choices. Many people who seek second mortgages to avoid mortgage insurance are not financially sound to begin with. Many spend more than they make each month and fill in “the gap” by using credit cards.

The results of this study reaffirm the importance of pre-purchase counseling as a preventive tool for foreclosure. Even though these data do not provide information at the borrower level, the results shed light on some policy issues. For example, this research is directly relevant to HUD’s goal of strengthening communities and providing the means to improve economic conditions in stressed communities. Although lending policies cannot be developed for foreclosures which occur due to trigger events, early intervention programs can be developed and delivered in specific communities where they are most needed. As this research shows, the resources would best be allocated to neighborhoods with high rates of

second mortgages, higher percentages of minorities, and high concentrations of young families. Partnerships among nonprofit organizations, the lending and real estate industry, and community development can bring capital resources to the areas in need of assistance. These resources would help improve the infrastructure for the strategic delivery of workforce housing and for financial management and counseling services.

Although the results of this study are limited in nature, the unique methodology and analyses employed in this project can be replicated in studies of other geographical areas in the U.S. The results emerging from this exploratory study require further testing in other communities. A high priority for future research would be to provide better evidence regarding the association between minorities and foreclosures. Are minorities more likely to default because of market failures, including information asymmetries and predatory practices? Or are they more likely to default because of low paying jobs, unaffordability issues, and/or trigger events? Another research priority that needs to be studied soon is: What is the impact of the oversupply of home-based credit to first-time home buyers, including new mortgage products such as interest-only mortgages, which enhance the ability to borrow more than what borrowers can really afford? Finally, there is certainly a need to study the use and abuse of second mortgages and home equity lines

### References

- Anderson, R., & VanderHoff, J. (1999). Mortgage default rates and borrower race. *Journal of Real Estate Research, 18*(2), 279-289.
- Anselin, L. (1998a). GIS research infrastructure for spatial analysis of real estate markets. *Journal of Housing Research, 9*(1), 113-133.
- Anselin, L. (1998b). Exploratory spatial data analysis in a geocomputational environment. In P. Longley, S. Brooks, R. McDonnell, & B. Macmillan (Eds.), *Geocomputation – A primer* (pp. 77-94). Chichester, UK: Wiley.
- Baxter, V., & Lauria, M. (2000). Residential mortgage foreclosure and neighborhood change. *Housing Policy Debate, 11*(3), 675-695.
- Blesky, E., Can, A., & Megboylugbe, I. (1998). A primer on geographic information systems in mortgage finance. *Journal of Housing Research, 9*(1), 5-31.
- Capone, C. A. (2001). *Research into mortgage default and affordable housing: A primer*. Retrieved February 3, 2005, from [www.liscnet.org/resources](http://www.liscnet.org/resources)
- Delgadillo, L., & Gallagher, A. (2006). Borrowers and mortgage related factors associated with FHA foreclosures. *Family and Consumer Sciences Research Journal, 34*(3), 204-222.
- Elmer, P. J., & Seelig, S. A. (1998). Insolvency, trigger events, and consumer risk posture in the theory of single-family mortgage default. *Journal of Housing Research, 10*(1), 1-25.

- Federal Financial Institutions Examination Council. (2003). *Census report CD* [Computer software]. Washington, DC: U.S. Census Bureau.
- Federal Financial Institutions Examination Council. (2004). *Census report*. Retrieved February 8, 2004, from [www.ffiec.gov/webcensus/ProcessMain.htm](http://www.ffiec.gov/webcensus/ProcessMain.htm)
- Getter, D. (2003). Contributing to the delinquency of borrowers. *Journal of Consumer Affairs*, 37(1), 86-100.
- Hagerty, J. R., & Simon, R. (2005, November 16). Is getting a home loan becoming too easy? *The Wall Street Journal*, pp. C1, C4.
- Hillier, A. (2003). Spatial analysis of historical redlining: A methodological exploration. *Journal of Housing Research*, 14(1), 137-167.
- Mitchell, L. (2003, September 4). More Utahans losing homes. *The Salt Lake Tribune*, pp. E1-2.
- Mortgage Bankers Association of America. (2003). *National delinquency rate for Utah*. Data purchased from the Mortgage Bankers Association of America.
- Obermeyer, N. J., & Pinto, J. (1994). *Managing geographic information systems*. New York: Guilford Press.
- Quercia, R. G., & Stegman, M. A. (1992). Residential mortgage default: A review of the literature. *Journal of Housing Research*, 3(2), 341-380.
- Rodriguez, M., Sirmans, C. F., & Marks, A. P. (1995). Using geographic information system to improve real estate analysis. *Journal of Real Estate Research*, 10(2), 163-173.
- Sullivan, T. A., Warren, E., & Westbrook, J. L. (2000). *The fragile middle class*. New Haven, CT: Yale University Press.
- Thrall, G. I. (1998). GIS applications in real estate and related industries. *Journal of Housing Research*, 9(1), 33-59.
- U.S. Census Bureau. (2006). *Ask Dr. Census*. Retrieved February 6, 2006, from [www.ask.census.gov](http://www.ask.census.gov)
- U.S. Department of Housing and Urban Development. (2004). *Housing today, Fall 2004*. Retrieved March 2, 2005, from [www.hud.gov/offices/hsg/hsgtoday/ht\\_arch.cfm](http://www.hud.gov/offices/hsg/hsgtoday/ht_arch.cfm)
- U.S. Department of Housing and Urban Development. (2005). *Budget FY2006*. Retrieved March 3, 2005, from [www.whitehouse.org/omb/pdf/Housing-06.pdf](http://www.whitehouse.org/omb/pdf/Housing-06.pdf)
- Van Order, R., & Zorn, P. (2000). Income, location and default: Some implications for community lending. *Real Estate Economics*, 28(3), 385-404.
- Vickers, M., & Timmons, H. (2002, October 7). The housing boom's dark side. *Business Week*, pp. 119-124.