The Geography of Liquor and Crime Through Regression Analysis

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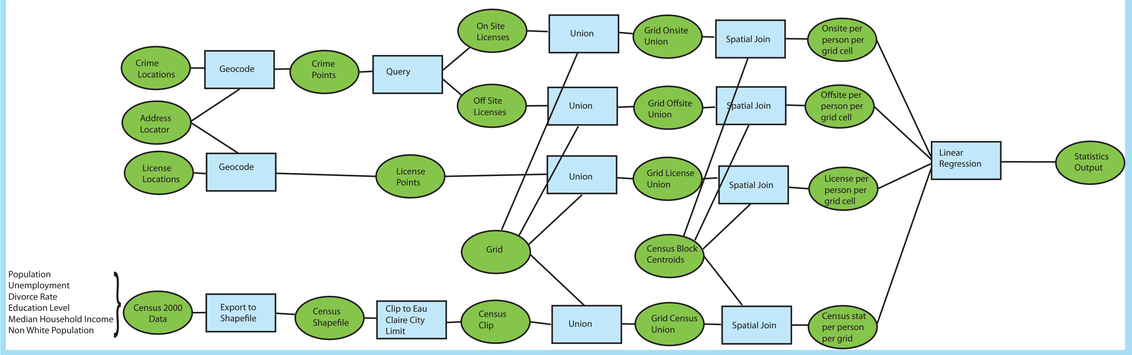
Introduction

Many Studies conducted throughout the United States have found that liquor license distribution is positively correlated with an increase in crime rates. In order to explore this relationship in Eau Claire, WI we compiled city crime data, census data, and liquor license data in a geographic information system and performed regression analysis in order to examine the correlation between crime rates and liquor license density. A sampling grid for the study area, the City of Eau Claire, was generated and all variables were aggregated to the sample grid cells of size .32 square miles. Variables include average household income, unemployment, education, divorce, and race. Currently, the Eau Claire County board issues liquor licenses according to the number available, not based on the effect on the surrounding areas. This study is meant to address the geographic implications on crime in order to affect change in liquor license distribution at the city level.

Objectives

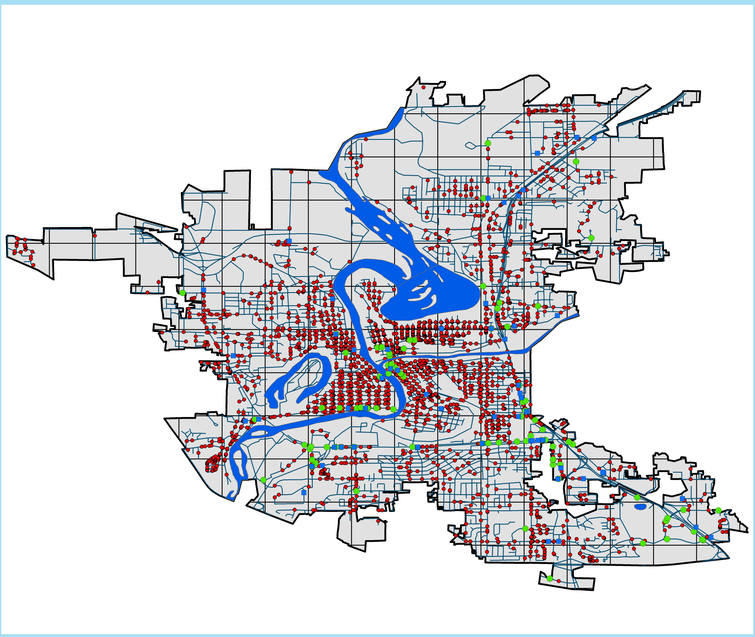
1. Collect and Geocode Crime Data
2. Identify other independent variables and collect census data
3. Spatially join all independent variables to a common grid
4. Run regression analysis on all variables
5. Analyze results

Data Flow Model



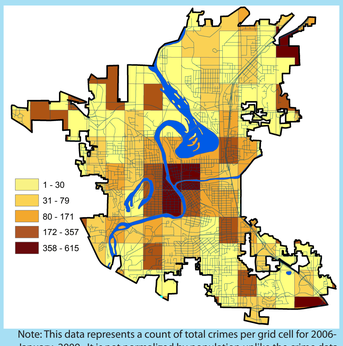
Crime Analysis

Crime and Liquor License Locations



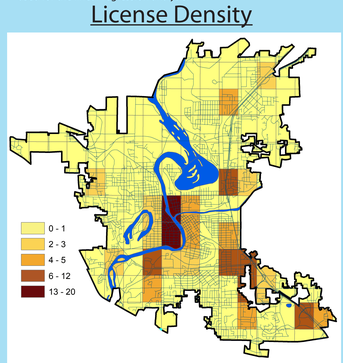
Most of the crimes in Eau Claire occur near the high density liquor license areas. The points of each crime in Eau Claire were used to make a surface of crime density which was then analyzed against liquor license density and other economic and cultural variables in order to explain crime patterns. The results will be presented to the City of Eau Claire to provide the information necessary to make an informed decision regarding liquor license distribution.

Crime Density



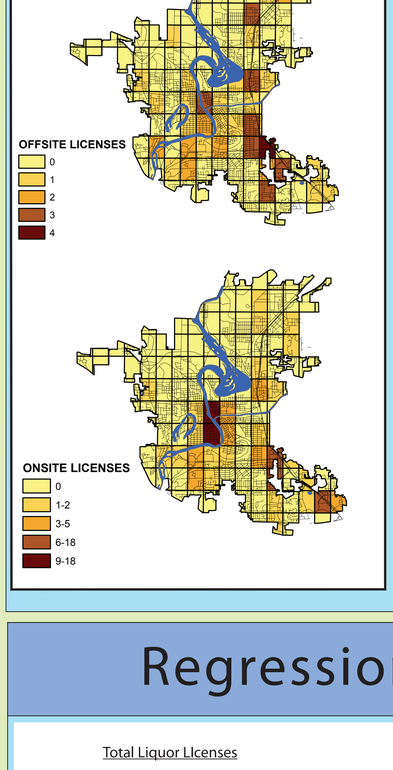
Note: This data represents a count of total crimes per grid cell for 2006-January 2009. It is not normalized by population unlike the crime data used for the linear regression analysis.

License Density

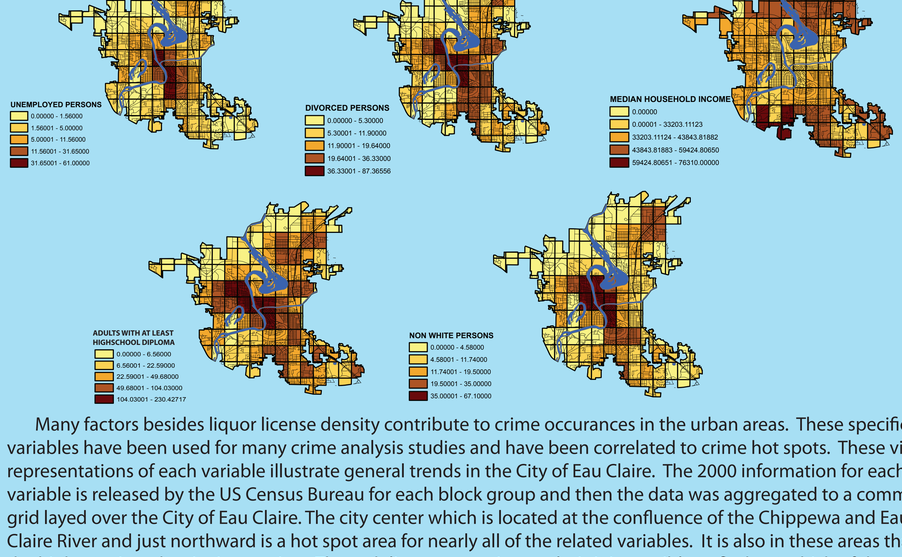


Independent Variables

Liquor License Data



Census Data



Many factors besides liquor license density contribute to crime occurances in the urban areas. These specific variables have been used for many crime analysis studies and have been correlated to crime hot spots. These visual representations of each variable illustrate general trends in the City of Eau Claire. The 2000 information for each variable is released by the US Census Bureau for each block group and then the data was aggregated to a common grid layed over the City of Eau Claire. The city center which is located at the confluence of the Chippewa and Eau Claire River and just northward is a hot spot area for nearly all of the related variables. It is also in these areas that the highest crime density is occuring. Through linear regression analysis it is possible to find out which of these cultural, economic, and racial variables are the strongest in comparison to the license distribution density.

Regression Analysis: Ordinary Least Squares

Total Liquor LIcenses

Sample(adjusted): 1 124
Included observations: 124 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CONSTANT	17.23263	13.21248	1.304270	0.1947
DIVORCE	7.983729	2.203979	3.622416	0.0004
EDUCATION	-1.519643	0.577928	-2.629466	0.0097
EMPLOYMENT	-2.382883	1.216819	-1.958289	0.0526
INCOME	-0.575712	0.308753	-1.864634	0.0647
LICENSES	17.17110	1.834659	9.359289	0.0000
RACE	1.594593	0.808948	1.971194	0.0511
R-squared	0.745580	Mean dependent var		56.09677
Adjusted R-squared	0.732533	S.D. dependent var		104.3598
S.E. of regression	53.97196	Akaike info criterion		10.86960
Sum squared resid	340817.8	Schwarz criterion		11.02881
Log likelihood	-666.9153	F-statistic		57.14501
Durbin-Watson stat	1.490406	Prob(F-statistic)		0.000000

Off Site Liquor Licenses

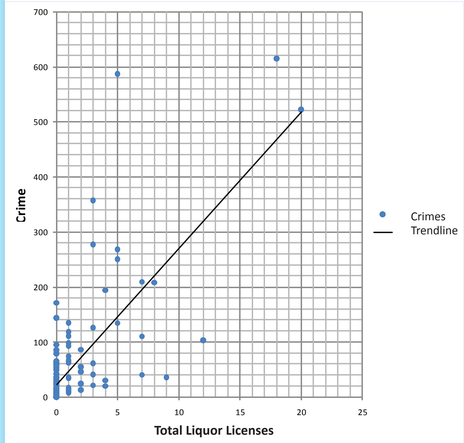
Sample(adjusted): 1 124
Included observations: 124 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CONSTANT	26.16349	16.27823	1.607268	0.1107
DIVORCE	9.456524	2.710804	3.488457	0.0007
EDUCATION	-1.662569	0.711788	-2.335765	0.0212
EMPLOYMENT	-1.331201	1.497280	-0.889080	0.3758
INCOME	-0.795567	0.378893	-2.099711	0.0379
OFFSITE	31.07280	7.374674	4.213448	0.0000
RACE	0.794980	0.988804	0.803981	0.4230
R-squared	0.613713	Mean dependent var		56.09677
Adjusted R-squared	0.593904	S.D. dependent var		104.3598
S.E. of regression	66.50398	Akaike info criterion		11.28720
Sum squared resid	517465.1	Schwarz criterion		11.44641
Log likelihood	-692.8062	F-statistic		30.98066
Durbin-Watson stat	1.474755	Prob(F-statistic)		0.000000

On Site LIquor LIcenses

Sample(adjusted): 1 124
Included observations: 124 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CONSTANT	19.67054	12.92750	1.521605	0.1308
DIVORCE	8.247089	2.159246	3.819430	0.0002
EDUCATION	-1.523295	0.567379	-2.684794	0.0083
EMPLOYMENT	-2.778721	1.197954	-2.319556	0.0221
INCOME	-0.573034	0.303071	-1.890756	0.0611
ON SITE	21.68502	2.221978	9.759331	0.0000
RACE	1.678815	0.795120	2.111397	0.0369
R-squared	0.754748	Mean dependent var		56.09677
Adjusted R-squared	0.742171	S.D. dependent var		104.3598
S.E. of regression	52.99060	Akaike info criterion		10.83290
Sum squared resid	328536.4	Schwarz criterion		10.99211
Log likelihood	-664.6399	F-statistic		60.01017
Durbin-Watson stat	1.631556	Prob(F-statistic)		0.000000



The US Census data were aggregated to the grid cell. Weighted percentages for each of the independent variables were calculated based on the total people at each block centroid within each of the 124 grid cells. For the analysis, three separate regressions were run, each using one of the following liquor license variables: total licenses, licenses for off site consumption, and licenses for on site consumption. The results of the three regressions follow the same basic pattern. Crime occurences increase in each grid cell as divorce rate, liquor licenses, and non-white popultation increases. Crime occurences also decrease for each grid cell as higher education, unemployment, and median household income increase. All of the six independent variables except unemployment follow the pattern of other crime analysis studies.

It should be noted that many of these variables have a high likelihood of being correlated with each other, such as median household income and the number of highschool diplomas. This is called multicollinearity. There are several different ways to deal with this problem: 1)Do nothing 2)Drop a redundant variable 3)Transform the multicollinear variables. The first action was taken.

The F-statistic is high which shows that all the variables coefficients as a whole most likely do not equal 0, which is good because if they equaled zero then the variables do not contribute to the model.

The T-statistics are relatively high, which suggests that the chance of each individual coefficient being equal to a number that is not the same as the expected sign is low. For example, there is a 6.47% chance that the income coefficient is not a negative number, but equals zero or a positive number. Many researchers do not use variables that have coefficients with a probability higher than 5%.

Summary

Linear regression was used to establish a correlation of liquor license density with crime density. After running the linear regression analysis , it was discovered that the liquor license coefficients for all three regressions were far higher than any other independent variable. This indicates that crime patterns in the City of Eau Claire are most explained by the density of liquor licenses in the same geographic area. Furthermore, this study shows that as you add liquor liceses to a grid cell, the crimes for that area increase significantly. It appears that regulating liquor license distribution in the City of Eau Claire would be an effective way of reducing crime.

Sources:

US Census Bureau
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