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Vacant Opportunities

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Introduction

Baltimore City (BC) is a unique and beautiful city with historical charm, interesting architecture, green spaces, and water ways in a structurally appealing urban setting. Driving through Baltimore, popularly known as “Charm City,” one is struck by both its appeal and its decay.

There are over 15,000 vacant and abandoned residential properties in BC. These properties are a major problem, economic drain, and impediment to urban population growth, yet they also represent an opportunity. The idea is to revitalize and repopulate BC by rehabilitating and developing vacant properties to help families rediscover this hidden gem. The theme for the redevelopment effort will be “*Charm City... fall in love again.*”



Targeted CSAs

The largest city in the state of Maryland, BC has 55 distinct Community Statistical Areas (CSAs) made up of various neighborhoods. Midtown, a CSA located in the center of BC, experienced economic and population growth last year. Three CSAs immediately surrounding and directly bordering Midtown did not experience growth:

- Greater Charles Village/Barclay (north);
- Greenmount East (east);
- and Upton/Druid Heights (west).

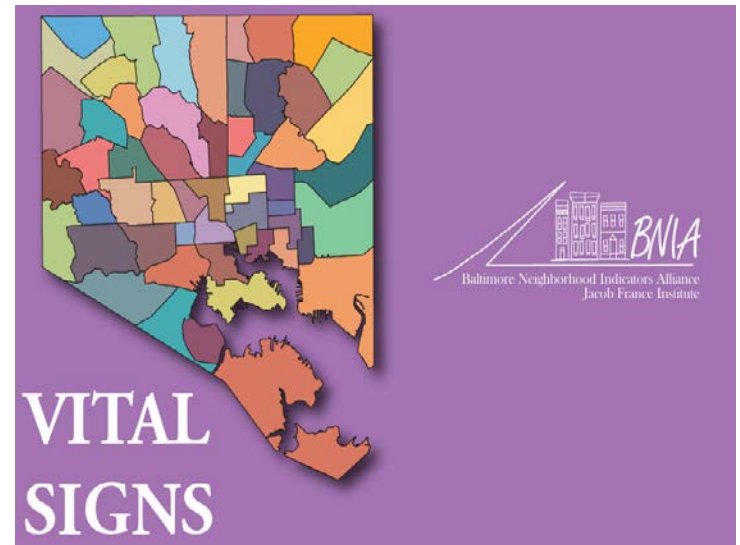
The proposition is to positively influence CSAs surrounding Midtown and affect population growth and future property values in those CSAs, measured by Sales Price and Percent of Residential Properties that are Vacant, by developing vacant properties.



Data Source and Tests

The sample data used for this report is from Vital Signs 2011, provided by the Baltimore Neighborhood Indicators Alliance-Jacob France Institute (BNIA-JFI). Vital Signs data is compiled from various public and private information silos. BNIA-JFI is an organization which promotes helping people make better decisions through the use of and access to reliable indicators and data in an effort to improve the quality of life in BC neighborhoods.

First, the median Sales Price for CSAs were compared to see if % Vacant affected median Sales Price. Then % Vacant properties were compared between targeted CSAs. Finally, a predictive linear regression model was developed to determine if % Vacant had an effect on Sales Price. A statistical significance level of 5% was used for all testing.



Sales Price affected by Vacant Properties

Compared mean of median Sales Prices for all CSAs in BC, grouped by Percent of Vacant Properties, to determine if there is a statistically significant difference in the mean of median Sales Prices between CSA groups. Median Sales Price was used because it is less affected by extremes.

Sorted CSAs based on Percent of Vacant Properties into 3 groups:

- **Group 1: < 5% Vacant**
- **Group 2: 6-20% Vacant**
- **Group 3: > 20% Vacant**

Conducted ANOVA test to determine if there was sufficient evidence that the mean of the median Sales Prices is affected by Percent of Vacant Properties for the 3 groups of CSAs. Hypothesis:

$H_0: \mu_1 = \mu_2 = \mu_3$ (all means are equal)

H_1 : not all μ_i are equal (at least one mean is different)

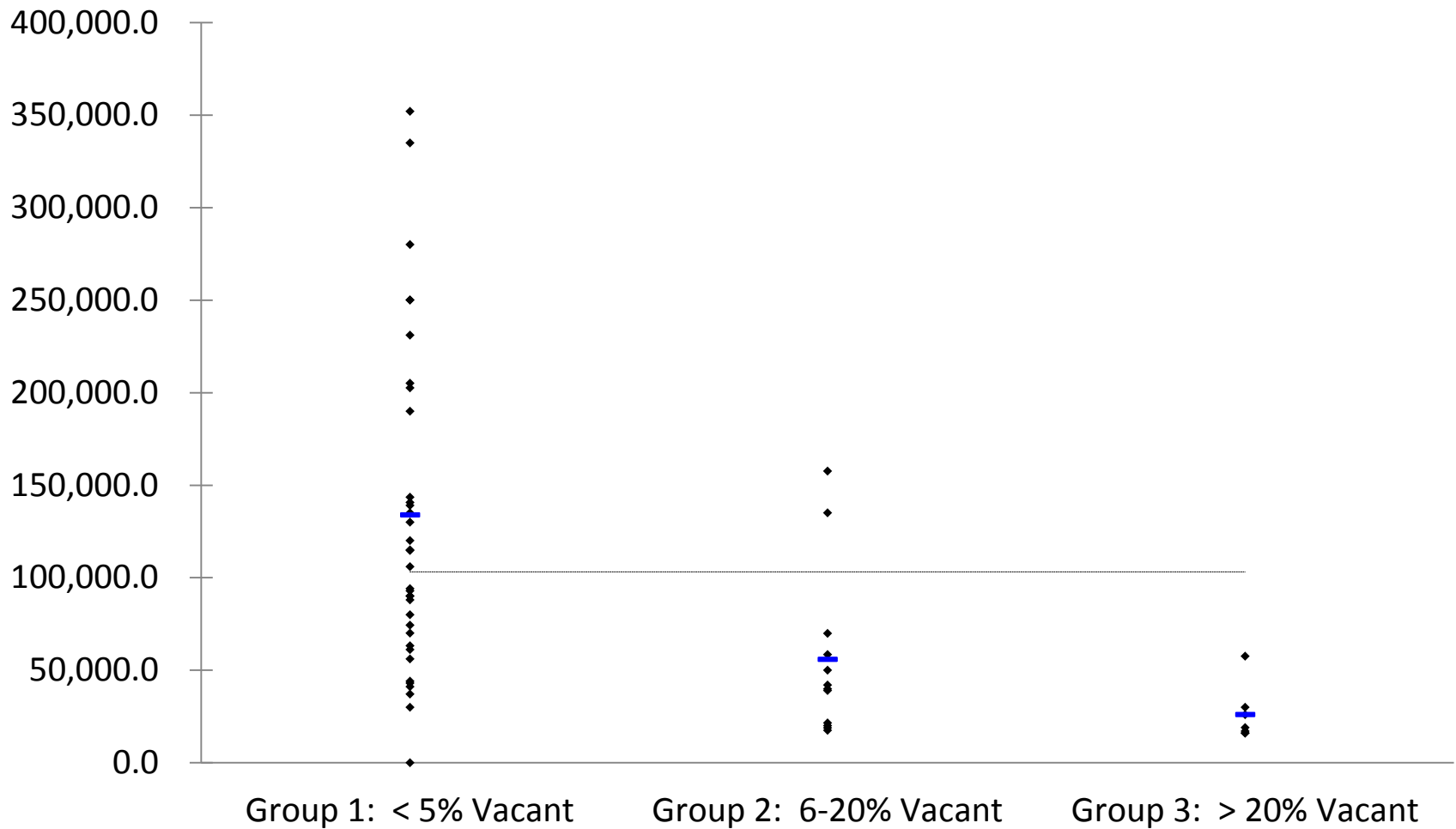
ANOVA Summary Table

<i>Mean</i>	<i>n</i>	<i>Std. Dev</i>	
133,884.7	36	83,690.83	Group 1: < 5% Vacant
55,804.2	12	45,621.62	Group 2: 6-20% Vacant
25,935.7	7	14,928.85	Group 3: > 20% Vacant
103,110.0	55	83,001.28	Total

ANOVA table

<i>Source</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>p-value</i>
Treatment	102,640,202,039.68	2	51,320,101,019.841	9.91	.0002
Error	269,377,306,210.32	52	5,180,332,811.737		
Total	372,017,508,250.00	54			

Comparison of Groups



Pair Comparisons and Assumptions

There was sufficient evidence that there is a significant difference between at least one of the means of the median Sales Prices for the 3 Groups.

Tukey-Kramer Procedure was conducted to construct multiple Pair Comparisons for all possible pairs. From the comparisons it was determined that the mean of median Sales Prices from Group 1 is different than the means of Groups 2 and 3.

Assumptions were also confirmed:

- Randomness and independence
- Normality (Normal Probability Plot)
- Homogeneity of Variance (Levene test, P-value: 0.053201)

Post Hoc Analysis

p-values for pairwise t-tests				
		Group 3: > 20% Vacant	Group 2: 6-20% Vacant	Group 1: < 5% Vacant
		25,935.7	55,804.2	133,884.7
Group 3: > 20% Vacant	25,935.7			
Group 2: 6-20% Vacant	55,804.2	.3869		
Group 1: < 5% Vacant	133,884.7	.0006	.0020	
Tukey simultaneous comparison t-values (d.f. = 52)				
		Group 3: > 20% Vacant	Group 2: 6-20% Vacant	Group 1: < 5% Vacant
		25,935.7	55,804.2	133,884.7
Group 3: > 20% Vacant	25,935.7			
Group 2: 6-20% Vacant	55,804.2	0.87		
Group 1: < 5% Vacant	133,884.7	3.63	3.25	
critical values for experimentwise error rate:				
		0.05	2.41	
		0.01	3.05	

Compare Proportion of Vacant Properties

Compared Percent of residential properties that are Vacant between the four CSAs. Conducted Chi-Square test to compare Percent of Vacant Properties.

Hypothesis:

$H_0: \pi_1 = \pi_2 = \pi_3 = \pi_4$ (all proportions are equal)

H_1 : not all π_j are equal (at least one Vacant Properties proportion is different)

Contingency Table with frequency observed values for Vacant and Occupied Properties for each CSA:

	<u>Midtown</u>	<u>Charles Villg</u>	<u>Greenmount</u>	<u>Upton/Druid</u>	Total
<i>Vacant</i>	154	331	1418	734	2637
<i>Occupied</i>	3129	3344	2669	1425	10567
Total	3283	3675	4087	2159	13204

1575.56 chi-square 3 df **0.00E+00 p-value**

Conduct Pair Tests

The null hypothesis was rejected and there was sufficient evidence to conclude that the CSAs are different with respect to the proportion of residential Properties that are Vacant and Abandoned.

The Proportions were compared and a Z test conducted for each relevant pair of CSAs to determine if the Proportion of Vacant in Midtown is less than each of the other CSAs: Charles Village, Greenmount East, and Upton/Druid Heights. Hypothesis:

$$H_0: \pi_1 \geq \pi_{(2,3,4)}$$

$$H_1: \pi_1 < \pi_{(2,3,4)}$$

The null hypothesis was rejected and there was sufficient evidence to conclude that Midtown had a statistically significant lower Proportion of Vacant Properties than each of the other 3 CSAs.

Test for Two Independent Proportions

Midtown	Chrls Villg	pc		-0.0497	difference
0.0493	0.099	0.075	p (as decimal)	0.	hypothesized difference
154/3129	331/3344	485/6473	p (as fraction)	0.0066	std. error
154.301	331.	485.301	X	-7.58	z
3129	3344	6473	n	1.69E-14	p-value (one-tailed, lower)
Midtown	Greenmt	pc		-0.482	difference
0.0493	0.5313	0.2712	p (as decimal)	0.	hypothesized difference
154/3129	1418/2669	1572/5798	p (as fraction)	0.0117	std. error
154.301	1418.	1572.301	X	-41.15	z
3129	2669	5798	n	0.00E+00	p-value (one-tailed, lower)
Midtown	Upton	pc		-0.4658	difference
0.0493	0.5151	0.1951	p (as decimal)	0.	hypothesized difference
154/3129	734/1425	888/4554	p (as fraction)	0.0127	std. error
154.301	734.	888.301	X	-36.78	z
3129	1425	4554	n	0.00E+00	p-value (one-tailed, lower)

Variables to Predict Sales Price

Explored independent variables and anticipated relationship to Sales Price:

- **Percent of Vacant Properties** *negative relationship*

Vacant Properties are unsightly, unsafe, and a drain on public resources, all of which bring down the average value of surrounding properties.

- **Percent of Properties with Housing Violations** *negative relationship*

Unkempt properties or those with violations are a reflection of economic distress and reflect poorly on the neighborhood and decrease values.

- **Percent of Properties with Rehab Permits** *positive relationship*

Properties with permits are in the process of being repaired and improved. These upgrades should increase the value of surrounding properties.

- **Percent of Owner-Occupied Properties** *positive relationship*

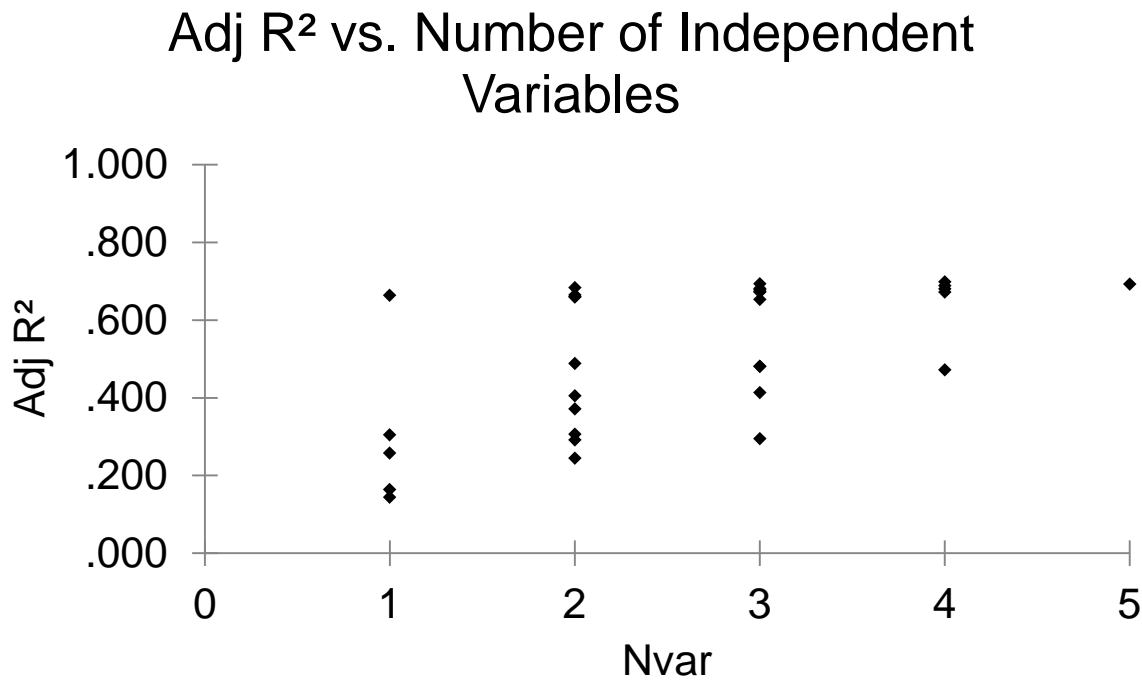
Pride of ownership and concern for investment in the property should be reflected in higher values for surrounding properties.

- **Median Household Income** *positive relationship*

Higher incomes reflect the ability to afford and pay a higher Sales Price.

Build a Linear Regression Model

To identify the model with the highest proportion of variation in Sales Price explained by the set of independent variables, the Best Subsets Approach was used seeking the highest Adjusted Coefficient of Multiple Determination (Adjusted r^2).



Most Appropriate Regression Model

From all possible regressions (55 observations), with Median Sales Price as the dependent variable, the model with the highest Adjusted r^2 included the following four independent variables:

- Percent Vacant
- Percent with Rehab Permits
- Percent Owner-Occupied
- Median Household Income

The independent variable Percent of Properties with Housing Violations was excluded from the model. The four independent variables included in the model, in addition to having the highest proportion of variation, also had the strongest interpretability and relevance.

Regression Analysis was conducted.

Regression Analysis

R ²	0.721		
Adjusted R ²	0.699	n	55
R	0.849	k	4
Std. Error	45570.975	Dep. Var.	Median Sales Price

ANOVA table

<i>Source</i>		<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>p-value</i>
Regression	268,181,818,801.4	4	67,045,454,700.4	32.28	2.65E-13	
Residual	103,835,689,448.6	50	2,076,713,789.0			
Total	372,017,508,250.0	54				

Regression Output

<i>variables</i>	<i>coefficients</i>	<i>std. error</i>	<i>t (df=50)</i>	<i>p-value</i>	<i>95% lower</i>	<i>95% upper</i>	<i>VIF</i>
Intercept	1,569.69	41,594.05	0.038	.9700	-81,974.42	85,113.80	
Percent Vacant	-2,119.50	995.25	-2.130	.0381	-4,118.52	-120.49	2.782
Percent with Rehab Permits	13,687.40	6,016.73	2.275	.0272	1,602.44	25,772.36	1.425
Percent Owner- Occupied	-847.83	611.83	-1.386	.1720	-2,076.73	381.06	2.748
Median Household Income	3.06	0.50	6.146	1.30E-07	2.06	4.05	2.333

2.322
mean
VIF

Multiple Regression Equation

The mean of the median Sales Price (Y_i) can be predicted based on Percent Vacant (X_1), Percent with Rehab Permits (X_2), Percent Owner-Occupied (X_3), and Median Household Income (X_4) by the equation (using Y intercept and X_i net regression coefficients):

$$\text{(est) } Y_i = 1,569.69 - 2,119.50(X_1) + 13,687.40(X_2) - 847.83(X_3) + 3.06(X_4)$$

β_1 : mean Sales Price will drop by \$2,120 for each Percent Vacant

β_2 : mean Sales Price will increase by \$13,687 for each Percent Rehab Permits

β_3 : mean Sales Price will drop by \$848 for each Percent Owner-Occupied

β_4 : mean Sales Price will increase by a factor of 3.06 for every dollar of Median Household Income

Assumptions and Collinearity

The anticipated Linear Regression relationships were correct with the exception of Percent Owner-Occupied, which had a negative relationship yet was not statistically significant.

Assumptions confirmed:

- **Linearity** Residual Plots
- **Independence** same time period
- **Normality** Normal Probability Plot
- **Equal Variance** Residual Plots

All the Variance Inflationary Factors (VIF) were relatively small (below 5.0), so there was little evidence of collinearity.

Summary and Conclusion

The mean of median sales price can be positively affected with the rehabilitation of vacant properties. Interestingly the development could be for prospective renters, instead of only attracting owner residents (owner-occupied), which bodes well for investors. Targeted growth through development of Vacant Opportunities would create an urban revitalization movement, generate a rising tide of increased property values, and attract higher median income households – all of which would increase sales prices and help address the problems of vacant and abandoned properties.

Baltimore City could be a shining example of urban revitalization and population growth through the rehabilitation of Vacant Properties in targeted CSAs such as Charles Village/Barclay, Greenmount East, and Upton/Druid Heights.

Vacant Properties = Vacant Opportunities

“Charm City... fall in love again.”