

Final KC Water Report

Identifying Factors Associated with Increased Numbers of Water Cutoffs in Kansas City

UMKC MATH 206 EUREKA PROJECT (SPRING 2017)

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1. Background Objectives and Project Teams

Background: Since 2008, the average water rate bill in Kansas City, Missouri has risen by 242% (see Figure 1). As these bills have gone up, we would like to find out what the impact has been on customers in the city. To that end, KC Water has sent us data showing the number of cutoffs per zip code for 2008 to 2016. We also have a break down showing the increase in average bills, the population level for each zip code for 2008 and 2016 and the average household income for each zip code for each of those years.

Objective: What we would like to find out is which zip codes are struggling to pay their water rates and whether the increase in water rates has disproportionately impacted the poorer zip codes in terms of water cutoffs.

Project teams: The Math 206 EUREKA (Experiences in Undergraduate Research), class was divided into 9 groups according to the zip code income levels (see Table A).

Outcomes: By dividing the zip codes among Math 206 students and providing them training on curve fitting and data analysis, the students were able to put together the pieces of the puzzle and get the main picture. They found that, over the past 9 years, there have been four zip codes that have always been low-income with high rates of water cutoffs. These zip codes are **64130, 64132, 64127 and 64128**. On the other hand, the high-income zip codes experienced minimum water cutoffs during the same time interval. They also found that last year was the worst year with a spike of 21,637 water cutoffs in Kansas City. In addition to spatio-temporal data analysis, the students proposed interesting solutions to the problem such as adjusting the water bills based on the annual household incomes, using smart meters to calculate water bills based on water consumption, and providing the minimum required water for lower income communities to operate.

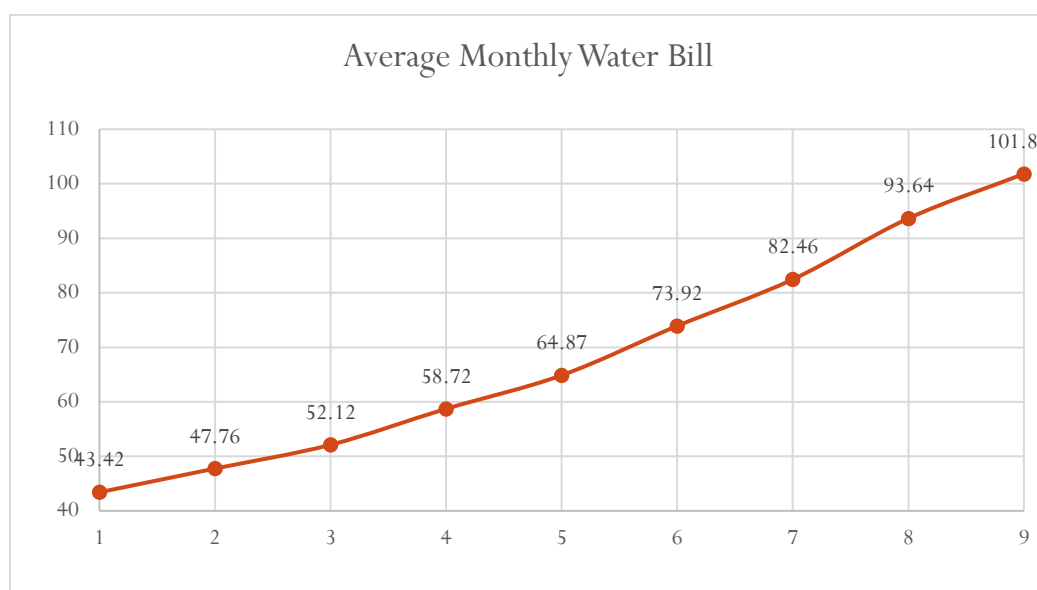


Figure 1. The graph indicates a substantial increase in the average monthly KC water bills

Table A. List of zip codes assigned to each group and the 2016 median income

Low Income		Middle Income		Middle Income		High Income		High Income	
zip code	Income below \$29k	zip code	Income 29k-42k	zip code	Income 42k-55k	zip code	Income 55k-76k	zip code	Income above 76k
Group 1		Group 2		Group 3		Group 6		Group 8	
64147	16660	64124	29319	64163	42030	64161	55208	64079	76898
64128	21986	64129	32352	64117	42717	64112	55611	64086	80221
64126	22119	64123	32999	64101	44069	64119	57833	64152	83116
64127	23916	64136	35385	64116	44933	64154	58668	64156	83708
64125	25581	64108	36569	Group 5		64063	59042	64158	85681
64109	25603	64111	37387	64131	45335	64153	61631	66208	85792
64130	25678	64134	37984	64138	46984	Group 7		64165	88289
64106	26287	Group 4		64133	48479	64151	66020	Group 9	
64132	26896	64110	38151	64137	49289	64145	67178	64166	88540
64120	28258	64150	39083	64146	50247	64164	69560	64157	101738
		64030	40468	64118	50384	66205	72953	64149	103574
		64105	41562	64114	54627	64155	75869	64139	106204
		66106	41731					64167	112523
								64113	122571

2. Spatio-temporal Analysis of Water Cutoffs

As shown in Table 1, the average household income in Kansas City, Missouri substantially decreased during 2013 and 2014. Also 80% of the zip codes are the same in all years. The zip codes of years 2008, 2009, 2010, and 2012 are identical. In year 2011 there is one different zip code and in the years 2013-2016 there are two different zip codes. The fourth column (year 2011) replaces 64120 with 64125. The average household income of 64120 has increased during 2008-2011. But 64120 reappears in 2012. In the year 2013 there are two differences compared to the first three years: 64123 and 64125 appear and 64109 and 64106 are removed.

Table 2 represents the zip codes with the highest number of water cutoffs during 2008-2016. By intersecting the zip codes in tables 1 and 2 we can identify the low-income zip codes with highest number of water cutoff. From Table 1 we get that the following zip codes that have always been among

the top 10 low income zip codes: 64124, 64126, 64127, 64128, 64130, 64132, and 64147. From Table 2 we get the following zip codes that have always been among top 10 high cutoffs: 64127, 64128, 64130, 64131, 64132, and 64134. By intersecting these two groups we get that the low-income zip codes 64127, 64128, 64130 and 64132 have always been experiencing high rates of water cutoffs. Table 3 shows the intersection of zip codes with highest numbers of cutoffs and lowest household income.

Table 1. Kansas City's top 10 low-income zip codes during years 2008-2010

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016
Avg. income	37,908	37,322	38,763	35,689	35,875	32,036	31,449	32,123	34,792
Zip codes	64147	64147	64147	64147	64126	64147	64147	64147	64147
	64126	64128	64127	64126	64124	64128	64128	64128	64126
	64128	64127	64128	64127	64106	64127	64126	64120	64128
	64120	64126	64130	64124	64128	64130	64130	64126	64125
	64127	64120	64126	64128	64127	64120	64127	64127	64127
	64130	64130	64109	64130	64130	64125	64120	64130	64130
	64124	64124	64120	64106	64147	64126	64125	64125	64132
	64132	64109	64124	64132	64132	64132	64124	64124	64120
	64109	64132	64132	64109	64120	64124	64132	64132	64124
	64106	64106	64106	64125	64109	64123	64123	64123	64123

Table2. Zip codes sorted with the highest number of cutoffs during 2008-2016

year	2008	2009	2010	2011	2012	2013	2014	2015	2016
Zip codes	64130	64130	64127	64130	64130	64130	64130	64130	64134
	64127	64127	64128	64134	64134	64134	64134	64134	64130
	64128	64128	64130	64132	64132	64132	64127	64127	64132
	64132	64132	64134	64127	64127	64127	64128	64132	64127
	64134	64134	64132	64128	64128	64128	64132	64128	64128
	64110	64131	64131	64110	64131	64131	64123	64110	64131
	64109	64109	64109	64131	64119	64119	64124	64131	64110
	64131	64124	64114	64119	64110	64110	64119	64124	64119
	64124	64123	64123	64133	64138	64138	64110	64123	64138
	64129	64110	64138	64138	64133	64123	64131	64119	64123

Table 3: Intersection of zip codes with highest numbers of cutoff and lowest household income

year	2008	2009	2010	2011	2012	2013	2014	2015	2016
ratio	6/10	6/10	5/10	4/10	4/10	5/10	6/10	6/10	5/10
zip codes	64109	64109	64109	64127	64127	64123	64123	64123	64123
	64124	64124	64127	64128	64128	64127	64124	64124	64127
	64127	64127	64128	64130	64130	64128	64127	64127	64128
	64128	64128	64130	64132	64132	64130	64128	64128	64130
	64130	64130	64132			64132	64130	64130	64132
	64132	64132					64132	64132	

Table 4. Comparisons of the top ten zip codes with all zip codes. The numbers inside the parentheses are related to the top 10 zip codes. The average cutoffs in top ten zip codes are about 3 times higher than the overall average.

year	2008	2009	2010	2011	2012	2013	2014	2015	2016
Total	3341	19,705	19,534	16,561	17,610	11,566	11,713	15,874	21,637
Top 10	(2631)	(12,875)	(12,205)	(10,413)	(11,019)	(7,427)	(7,849)	(10,984)	(14,829)
percent	78.7 %	65.3 %	62.4 %	62.8 %	62.6 %	64.2 %	67.0 %	69.1 %	68.5 %
avg. cutoffs	83.5 (263.1)	402.1 (1,288)	398.6 (1,220)	345.0 (1,041)	382.8 (1,102)	282.1 (742.7)	254.6 (784.9)	358.7 (1,098)	470.4 (1,483)
ratio	3.15	3.20	3.06	3.02	2.89	2.64	3.08	3.06	3.15
min	1 (101)	1 (677)	1 (604)	1 (505)	1 (585)	1 (391)	1 (406)	1 (533)	1 (767)
max	666	2,216	1,976	2,427	2,083	1,394	1,488	2,273	2,793

Table 4 shows that 62.4 % to 78.7% of all KC water cutoffs are from 10 zip codes including 64127, 64128, 64130 and 64132. The ratio of water cutoffs in those ten zip codes (see Table 2), was 2.64 to 3.15 times more than the other KC zip codes. Also the first row of Table 4 shows that the water cutoffs decreased in 2013 and 2014, but reached to a maximum of 21,637 in 2016. Apparently the decrease in 2013 and 2014 was due to KC local funding to pay the delinquent water bills.

Table 5 shows that 9 out of 10 zip codes with the highest number of water cutoffs have annual household incomes of \$50k or less. In all years, the highest number of cutoffs (2,793) belong to zip code 64134, and second highest (2,616) to zip code 64130. More than 50 % of all cutoffs belong to the following zip codes: 64109, 64110, 64114, 64119, 64127, 64128, 64130, 64131, 64132, 64134, and 64138.

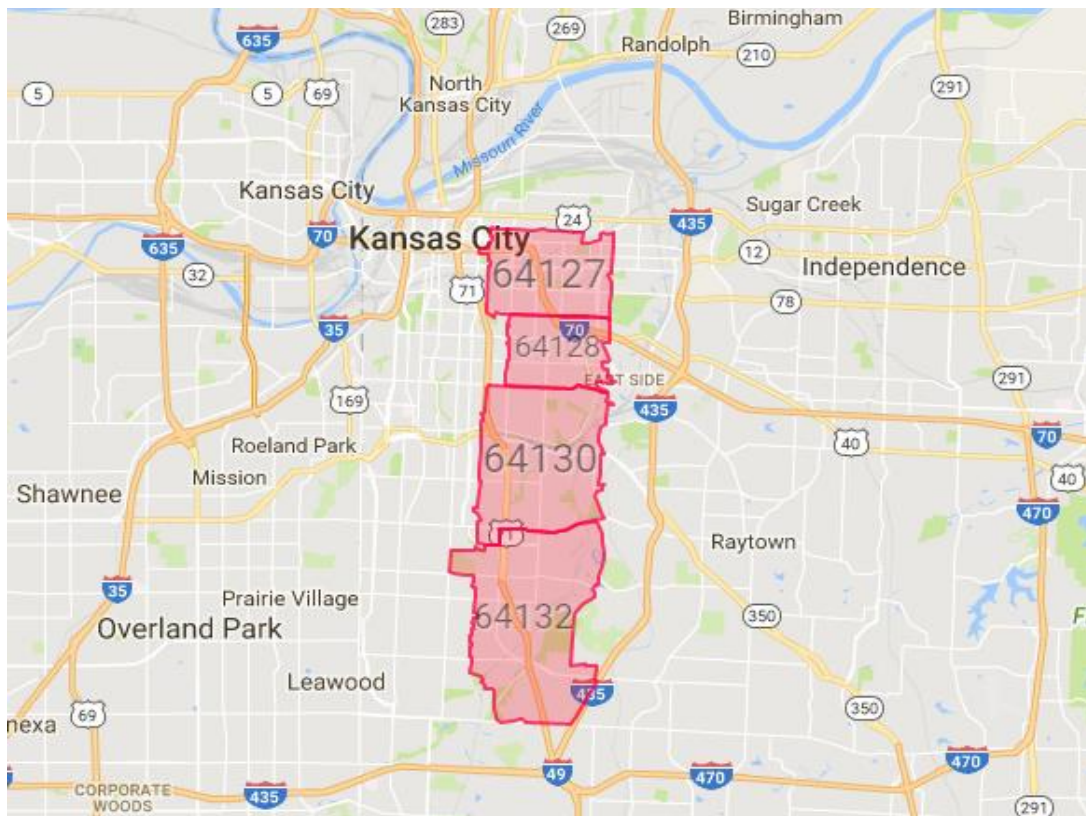
Table 5. KC zip codes with highest numbers of cutoff and median household income below \$50k

year	2008	2009	2010	2011	2012	2013	2014	2015	2016
ratio	9/10	10/10	8/10	9/10	9/10	9/10	9/10	9/10	9/10
zip codes	64109	64109	64109	64110	64110	64110	64110	64110	64110
	64110	64110	64123	64127	64127	64123	64123	64123	64123
	64124	64123	64127	64128	64128	64127	64124	64124	64127
	64127	64124	64128	64130	64130	64128	64127	64127	64128
	64128	64127	64130	64131	64131	64130	64128	64128	64130
	64129	64128	64131	64132	64132	64131	64130	64130	64131
	64130	64130	64132	64133	64133	64132	64131	64131	64132
	64131	64131	64134	64134	64134	64134	64132	64132	64134
	64132	64132	64138	64138	64138	64138	64134	64134	64138
	64134	64134	64138	64119	64119	64119	64119	64119	64119

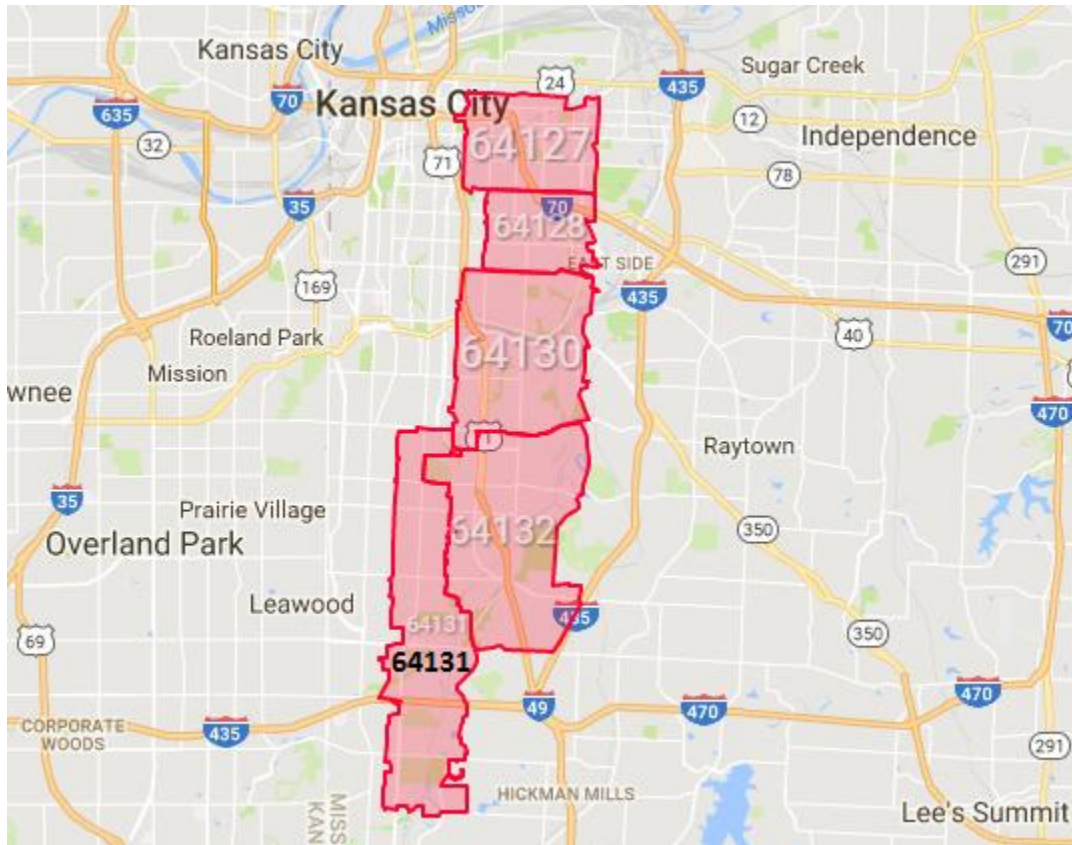
The numbers in red are indicating the missing zip codes

3. Main Results of the Spatio-Temporal Analysis

1. The average monthly bill in Kansas City Missouri has significantly increased during 2008-2016. See figure 1 and Table 6.
2. In the past 9 years (2008-2016), the following four zip codes have always been among the top 10 high cutoffs and top 10 low income zip codes: 64127, 64128, 64130, 64132 (see the explanations below table 2)
3. The following zip codes have always been among top 10 high cutoffs: 64127, 64128, 64130, 64131, 64132, 64134
4. Comparison of items 2 and 3: zip codes 64134 (\$37,984) and 64131 (\$45,335) are not among the top ten low income zip codes, but the incomes in these zip codes could be very diverse. For instance, zip code 64131 is a narrow strip from 63rd street all the way to 119th street. Also these zip codes are neighboring low income zip codes. Further data is needed to determine if the water cutoffs in these zip codes occurred to low income families.
5. The average numbers of cutoffs in top ten zip codes are about 3 times higher than the overall average (see Table 4).
6. At least 62% of all cutoffs occur in the top 10 zip codes (see Table 4)
7. In the past 9 years (2008-2016), the following four zip codes have always been among the top 10 high cutoffs and top 10 low income zip codes: 64127, 64128, 64130, 64132 (see the following map; the map was generated using <https://www.zeemaps.com/>)



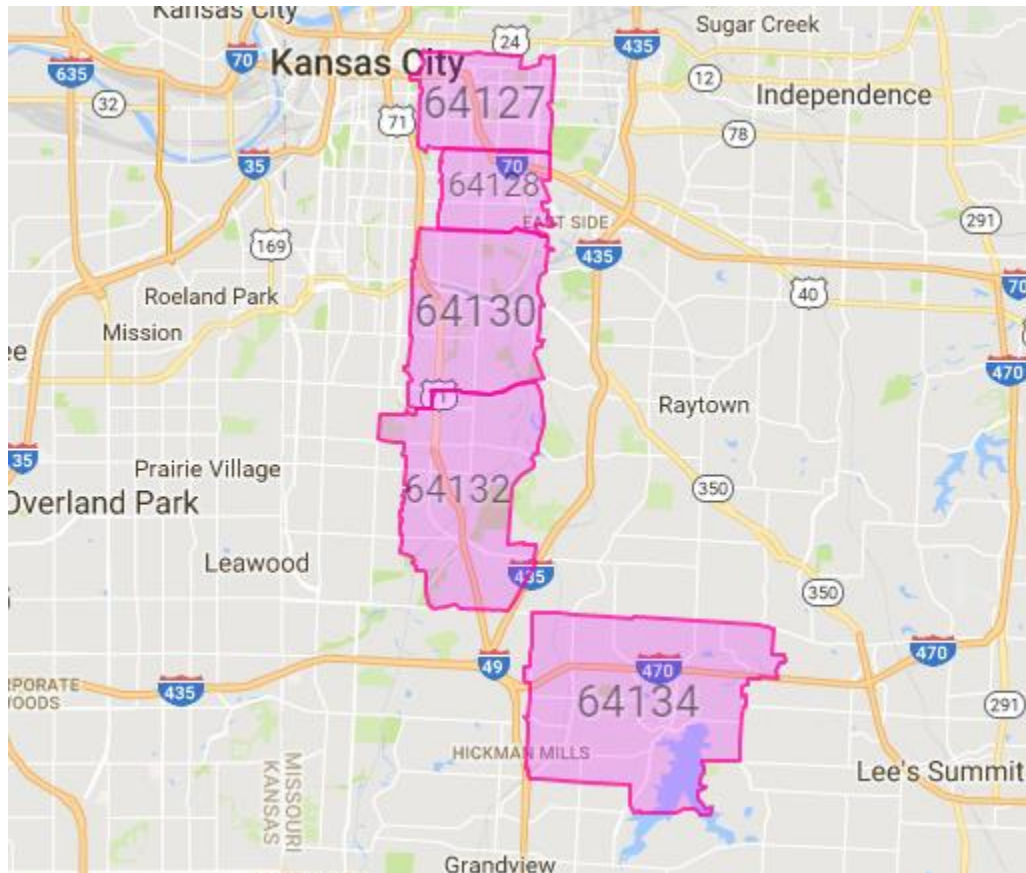
8. The following zip codes have always been among the top 10 highest for cutoffs: 64127, 64128, 64130, 64131, 64132, 64134
9. Comparison of items 1 and 2: zip codes 64134 (\$37,984) and 64131 (\$45,335) are not among the top ten low income zip codes, but they have been among the top 10 for high water cutoffs. We may wonder why zip codes 64131 and 64134 are among the top 10 zip codes with the highest number of water cutoffs. In the following we attempt to explain this phenomenon.



Additional remarks: The people living in Zip code 64131 are primarily white. **The number of people in their late 20s to early 40s is extremely large while the number of middle aged adults is large. There are also an extremely small number of families and an extremely large number of single adults.** The percentage of children under 18 living in the 64131 ZIP code is slightly less than average compared to other areas of the country.

Husband Wife Family Households	2,886	30%
Single Guardian	2,219	23%
Singles	3,741	39%
Singles With Roommate	844	9%
Average Household Size:	2	
Households without Kids	7,132	74%
Households with Kids	2,558	26%

We don't think the demography of the zip codes is much of a factor. Instead, as shown in the map half of zip code 64132 is next to the zip code 64132, which has been among the top 10 zip codes with the highest number of water cutoffs during 2008-2016. Maybe the majority of water cutoffs come from the northern part of zip code 64131



The people living in ZIP code 64134 are primarily black or African American. **The number of people in their late 20s to early 40s is extremely large** while the number of middle aged adults is large. **There are also an extremely large number of single parents and an extremely small number of families.** The percentage of children under 18 living in the 64134 ZIP code is large compared to other areas of the county.

Demography can be a factor here: high percentage of single parents and singles

Husband Wife Family Households	2,740	33%
Single Guardian	2,767	34%
Singles	2,258	27%
Singles with Roommate	494	6%

Average Household Size: 3

Households without Kids	5,078	61%
Households with Kids	3,181	39%

Table 6. KC Water Inside City Residential Rates in dollars from 2000 to 2017

<u>Fiscal Year</u>	<u>Water Service Charge (Fixed)</u>	<u>Water Usage Charge (Variable) 1st Tier</u>	<u>Water Usage Charge (Variable) 2nd Tier</u>	<u>Sewer Service Charge (Fixed)</u>	<u>Sewer Usage Charge (Variable)</u>	<u>Storm water Charge (Variable)</u>	<u>Average Monthly Bill</u>
FY2000	9.60	1.47	1.63	4.80	1.10	0.35	\$ 33.20
FY2001	9.60	1.54	1.70	5.15	1.18	0.38	\$ 34.67
FY2002	9.60	1.54	1.70	5.46	1.25	0.38	\$ 35.40
FY2003	9.60	1.54	1.70	5.79	1.33	0.38	\$ 36.21
FY2004	9.60	1.54	1.70	6.14	1.41	0.50	\$ 37.64
FY2005	9.79	1.57	1.73	6.51	1.49	0.50	\$ 38.89
FY2006	9.00	1.60	1.82	6.90	1.58	0.50	\$ 39.30
FY2007	9.00	1.70	1.89	7.31	1.67	0.50	\$ 40.92
FY2008	9.00	1.86	2.07	7.89	1.80	0.50	\$ 43.42
FY2009	9.00	2.16	2.40	8.60	2.05	0.50	\$ 47.76
FY2010	10.35	2.39	2.65	8.60	2.28	0.50	\$ 52.12
FY2011	11.40	2.70	3.00	9.90	2.62	0.50	\$ 58.72
FY2012	10.85	3.18	3.58	9.90	3.16	0.50	\$ 64.87
FY2013	10.85	3.67	4.08	11.55	3.82	0.50	\$ 73.92
FY2014	11.90	4.02	4.50	12.20	4.54	0.50	\$ 82.46
FY2015	13.09	4.45	4.75	15.10	5.25	0.50	\$ 93.64
FY2016	13.50	4.60	4.85	17.05	6.05	0.50	\$ 101.80
FY2017	13.90	4.60	5.09	18.05	7.18	0.50	\$ 110.22

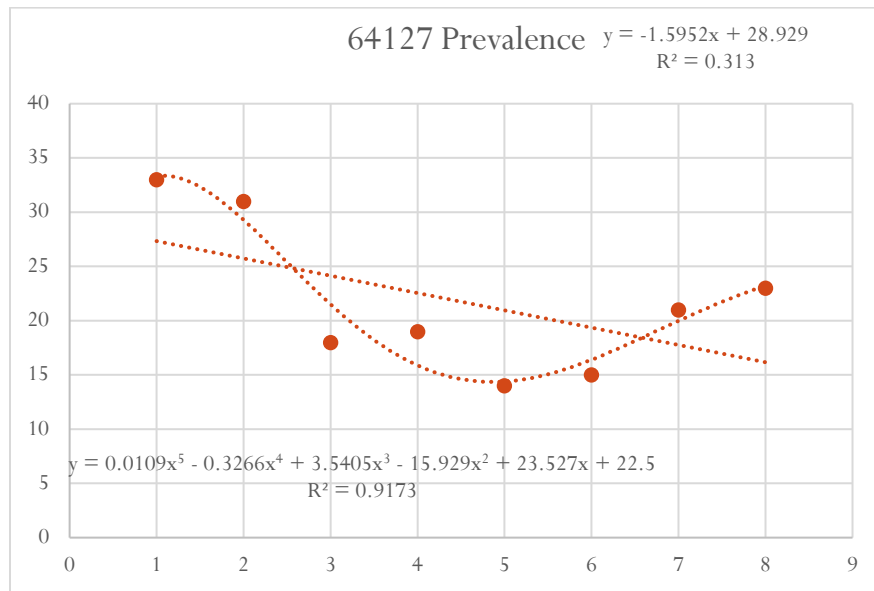
Notes:

- 1) Fiscal Year runs from May 1st to April 30th.
- 2) 1st Tier Water Usage charge is per 100 cubic feet (approximately 748 gallons) for the first 600 cubic feet.
- 3) 2nd Tier Water Usage charge is per 100 cubic feet (approximately 748 gallons) for the next 4,400 cubic feet.
- 4) Sewer Usage charge is per 100 cubic feet (approximately 748 gallons).
- 5) Storm water charge is the charge per 500 square feet of impervious surface area.
- 6) For average monthly bill examples, we assume average usage of 700 cubic feet for water, 600 cubic feet for sewer, and 2,500 square feet for storm water.
- 7) KC Water switched from bi-monthly billing to billing every month in Fiscal Year 2012.

4. Analysis of Zip Codes with Income below \$29k

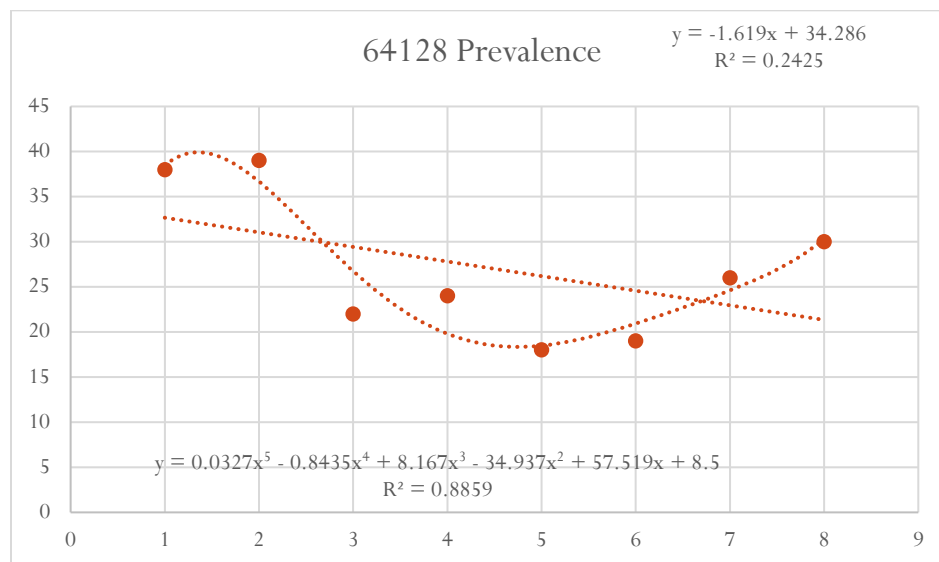
Zip Code 64127

1. Unemployment rate, young adults and Vacant for Other Reasons (housing units) are in greatest numbers among all types of the data that we have for four of these zip codes:
2. No Earnings 5,491 46%
3. Singles 2,282 36%
4. Vacant For Other Reasons 1,003 48.8%



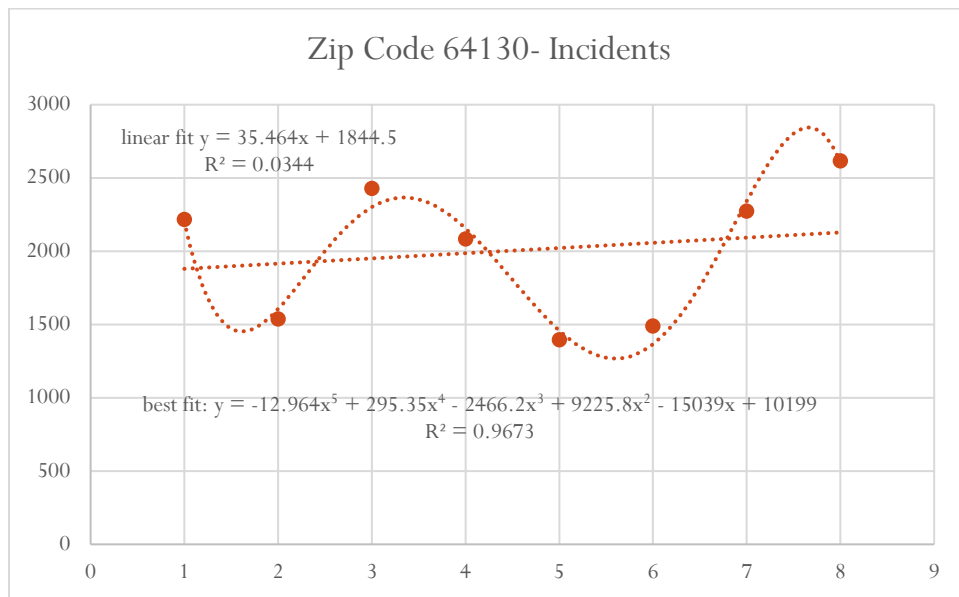
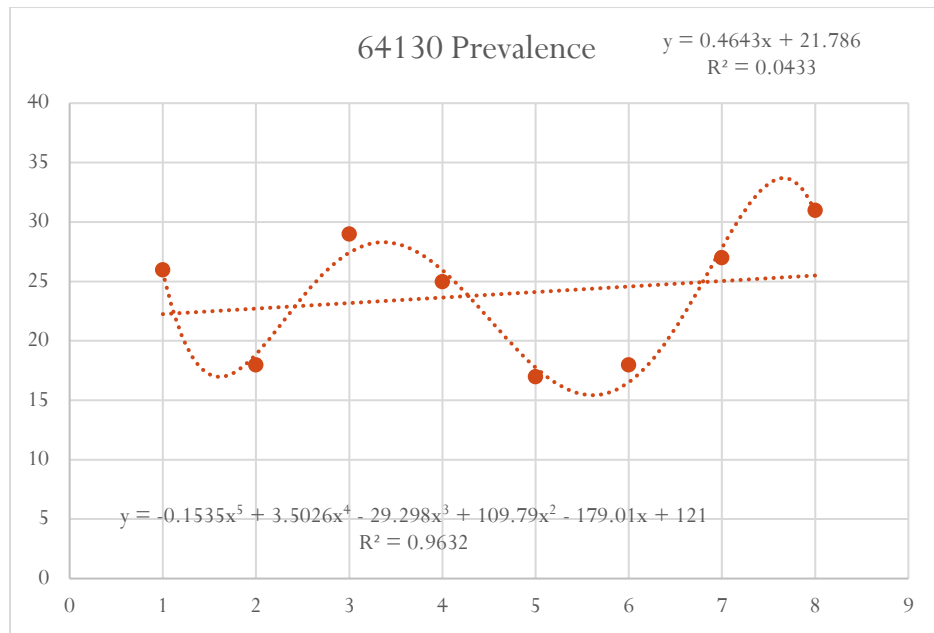
Zip Code 64128

1. No Earnings 4,179 45%
2. Singles 1,739 37%
3. Vacant for Other Reasons 948 56.2%



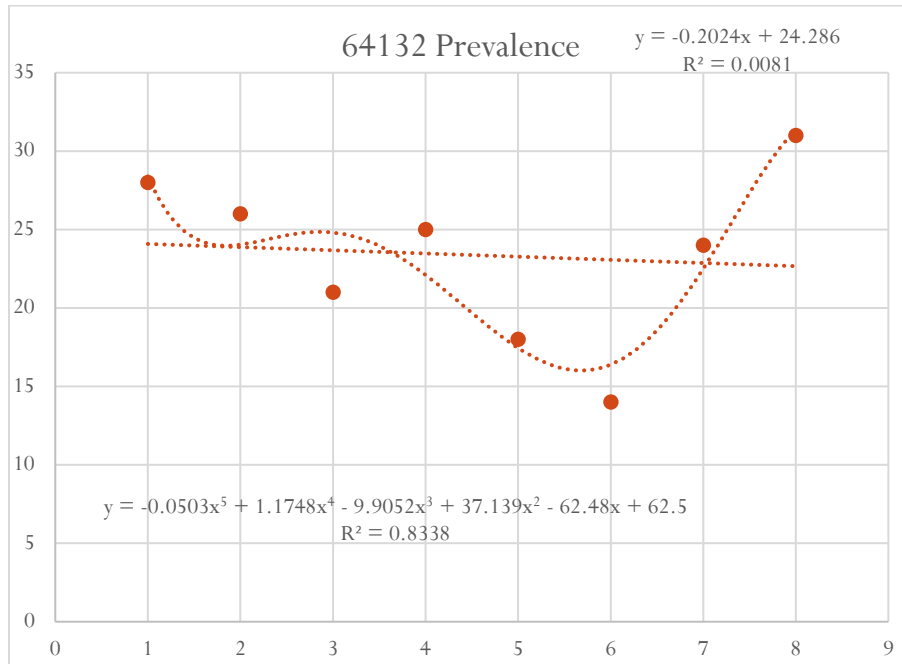
Zip Code 64130

1. No Earnings 7,395 46%
2. Single Guardian 3,271 39%
3. Black Or African American 18,654 91.0%
4. Vacant For Other Reasons 1,328 54.3%



Zip Code 64132

1. No Earnings 4,125 42%
2. Single Guardian 2,281 42%
3. Black Or African American 11,396 82.5%
4. Vacant For Other Reasons 521 39.4%



5. Analysis of Zip Codes with Income between \$29k and \$42k

1. The key factors seem to be income level and possibly whether or not households have kids.
2. As income increases, the prevalence of water cutoffs decreases. Zip codes 64123 and 64134 are outliers, however, which may be due to their high numbers of households with kids.

Zipcode	Average Prevalence	Median Household Income	Yes Kids
64124	12.9	\$29,319	1705 (40%)
64129	10.48	\$32,352	1234 (32%)
64123	17.33	\$32,999	1423 (42%)
64136	3.2	\$35,385	335 (36%)
64108	3.4	\$36,569	674 (18%)
64111	1.87	\$37,387	982 (10%)
64134	20.19	\$37,984	3181 (39%)

Fluctuations in Prevalence

1. There seems to be a trend in fluctuations of the graphs. Years 2014 and/or 2015 are minimums in all of our graphs for prevalence.
2. One possible explanation is the 25% increase in funds in Spring of 2014 from the KC Water Services to the Mid America Assistance Coalition, which assists those who are unable to pay their water bills.
3. Information on whether this increase in funds continued after 2014 was not found. But since overall water cutoffs prevalence increased after 2015, it is possible there may have been a cut in funding.

Conclusion: After taking a closer look at our own work along with other groups' work, we came to the solution we guessed from the beginning: Income seems to be the biggest factor. The lower the income yields, the greater the number of water cutoffs. This seems fairly obvious because it is hard to pay your water bill if you don't make enough to cover it.

Key Factors Associated with Number of Cutoffs in Zip Codes 64110, 64150, 64030, 64105, and 66106

Similarities:

1. The majority of zip codes showed spikes in the years of 2009 and 2016
2. All the groups' zip codes have relatively the same median household income.
3. The median age of all the zip codes ranges between 30 and 40 (working class)
4. The zip codes with houses built before 1940 had significantly more cutoffs than those built afterwards. The age of the home could have an effect on the number of cutoffs.

Differences:

1. 64110 has 2 colleges within the boundaries, which suggests there is a large number of students living in the zip code, which may explain the lower median income and the high number of cutoffs
2. 64105 has, by far, the largest median home value and the least number of cutoffs. So in this case, there's a direct link between high income and low cut-offs.
3. 64150, 64030, 64105 and 66106 (which all have low cut-offs) are predominantly white neighborhoods. They can be assumed to be the white neighborhood, while 64110, which has a mixed-race population, has the most cut-offs.

Fluctuations:

- In general, cutoffs decreased, or were zero, from 2011 until 2013 where they began to increase with the largest spikes occurring in 2016. This is most likely due to the increased water bills within the last year. This stays fairly consistent within the group as well as throughout the other groups. According to KCTV 5, Missouri residents are paying twice their normal water bill as of 2016.

Income Effects within Group

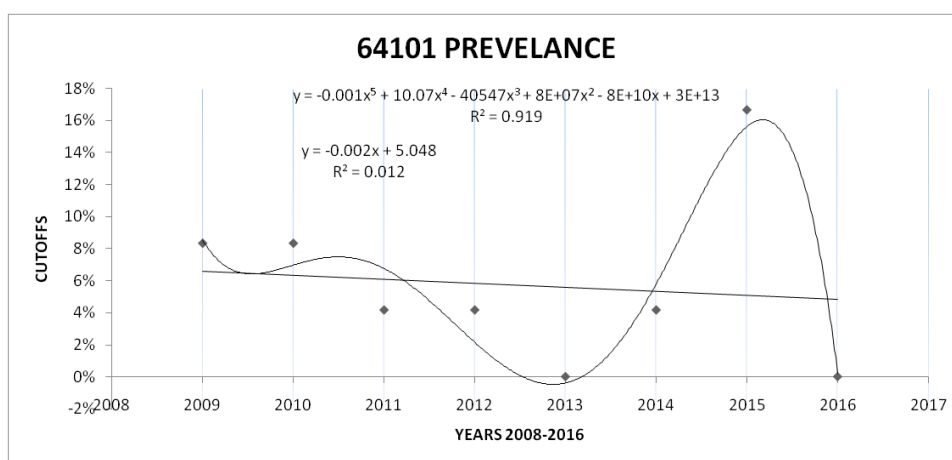
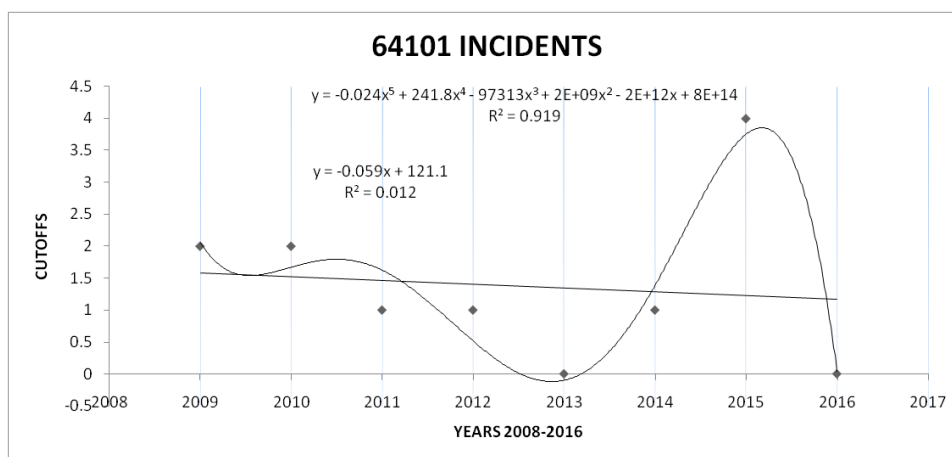
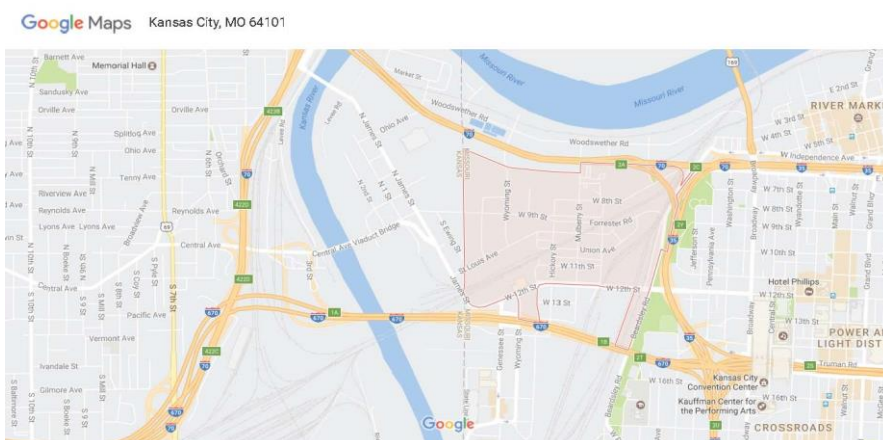
- Within our group, median income does not seem to be a main factor in affecting the number of water cutoffs. Only 2 zip codes had cutoffs for all 8 years, with the other three having a very minimal number of cutoffs, if any, for the 8 years. Furthermore, the zip code with the most cut-offs (64110) had a median income similar to that of our other zip codes with far less cut-offs.

Income Effects Compared to Other Groups

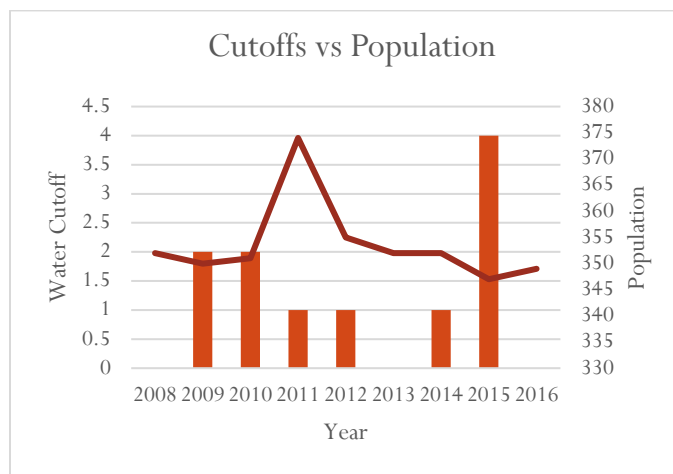
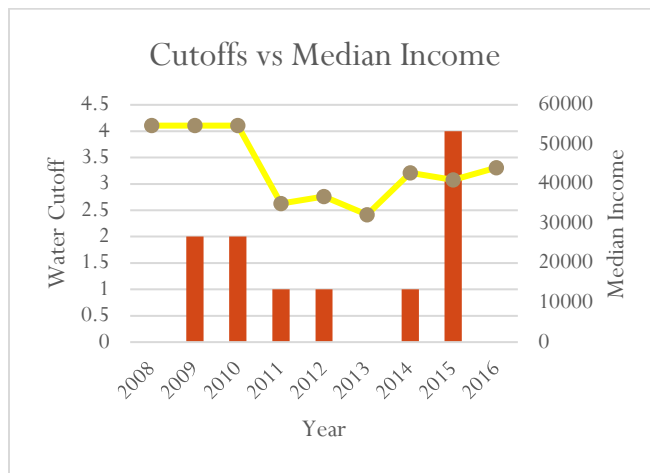
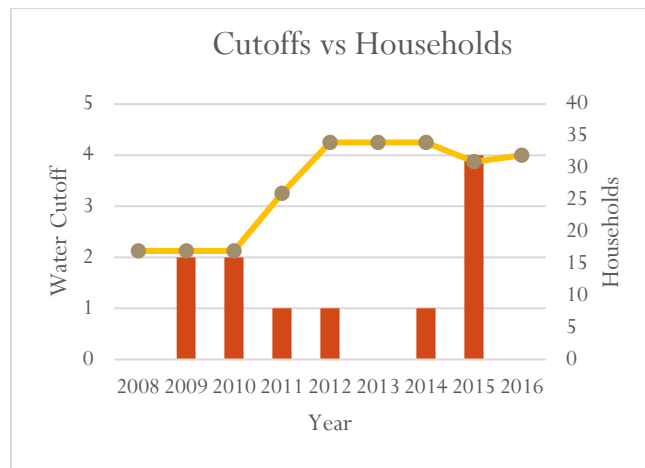
1. Income had little effect on the number of cutoffs... for example, 64113 had a median income of \$122,571 with its highest prevalence being 2.4% whereas 64150 had a median income of \$39,390 with its highest prevalence being 0.15%
2. Overall, the prevalence did not drop as the income increased
3. In general, the zip codes with houses built before 1940 had significantly more cutoffs than those built afterwards- The age of the home could have an effect on the number of cutoffs.
4. The zip codes with a higher population with no income generally had a higher prevalence when it comes to the number of cutoffs. This is to say the higher the population with no earnings in a zip code affects the number of cutoffs.

6. Analysis of Zip Codes with Income between \$42k and \$55k

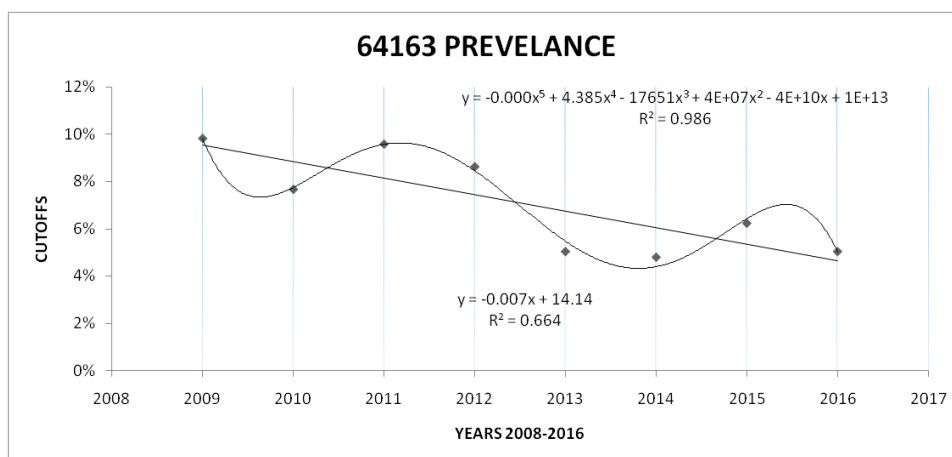
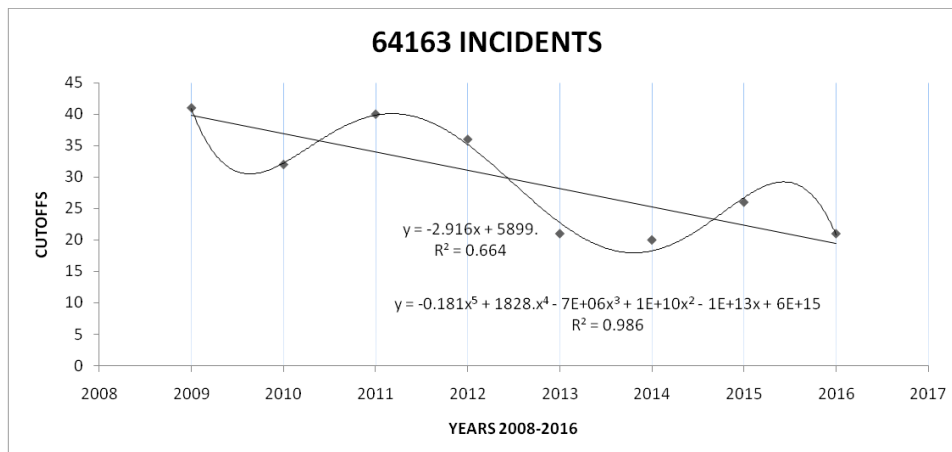
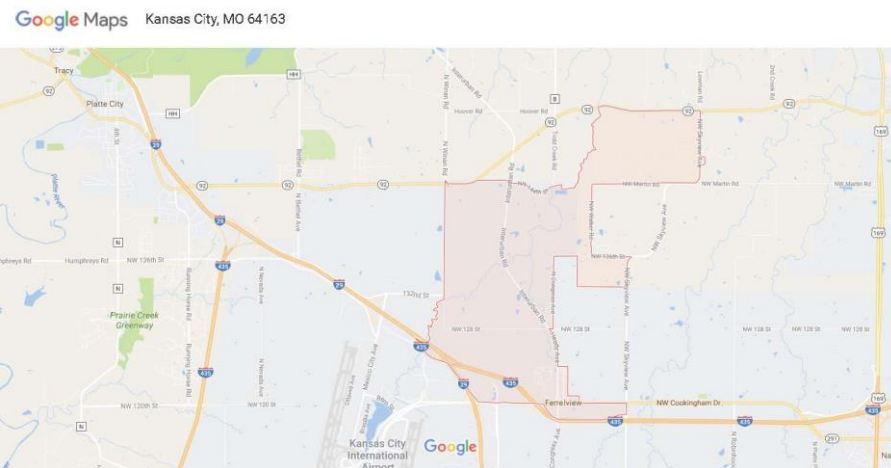
64101 This zip code contains the north side of the West Bottoms, which doesn't include Kemper arena. From 2008 to 2016, the population ranged from 347 to 374 people, and the total households ranged from 17 to 32 and the cut-offs ranged from 0 to 2. The area is all commercial and industrial which provides no significant, comparable data.



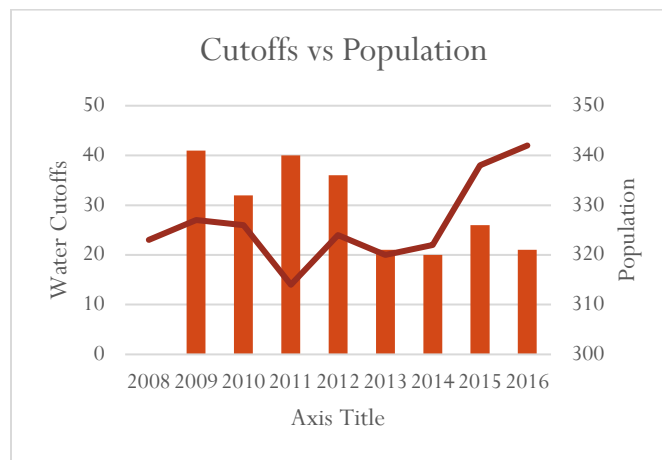
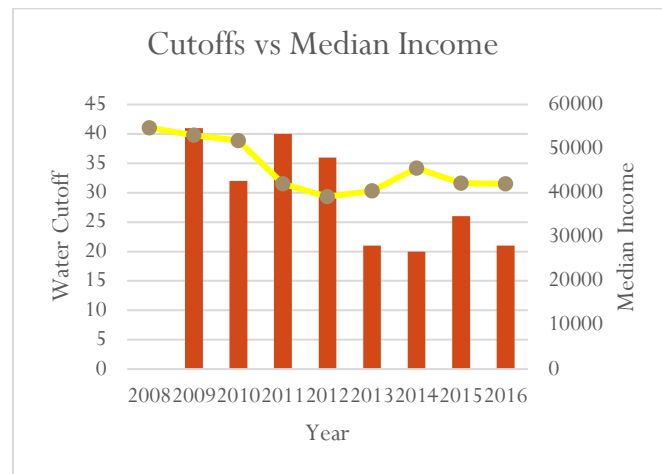
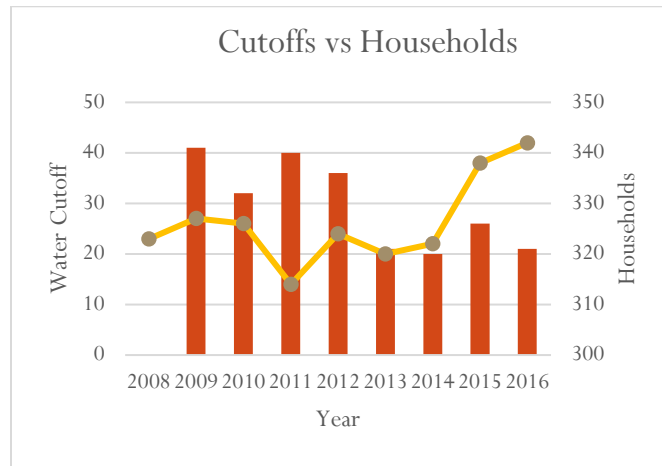
Additional Data for 64101



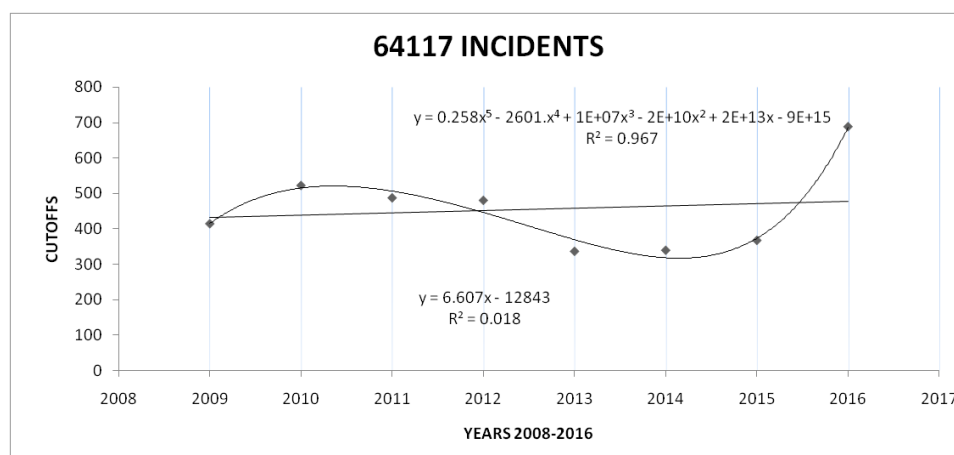
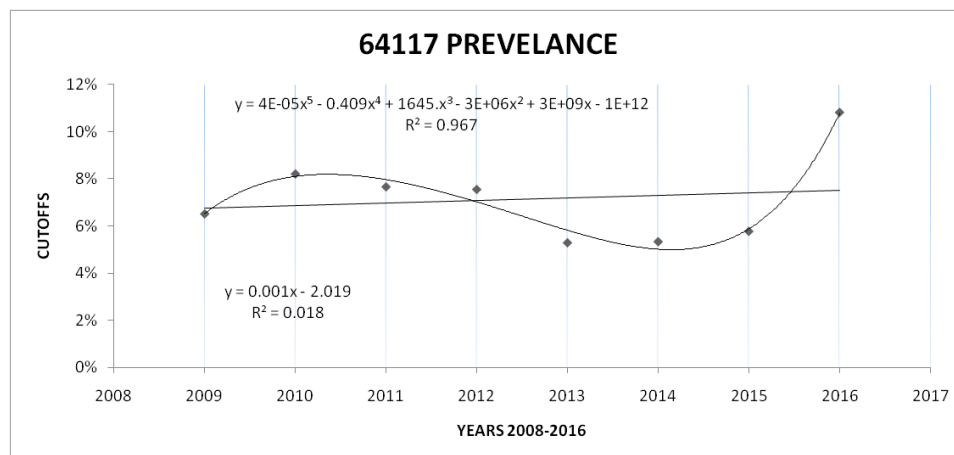
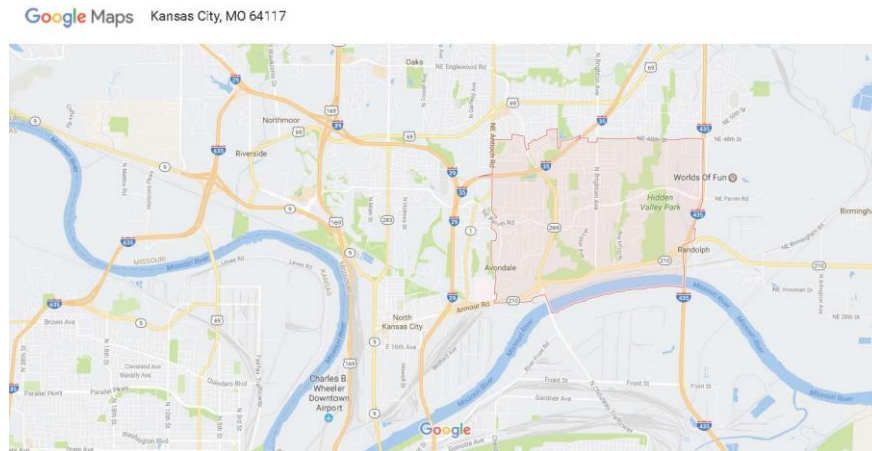
64163 This zip code is located just northeast of KCI. The village of Ferrelview is located on the southern edge. Ferrelview has a population of 451 as of 2010, which makes up the bulk of the populace in 64163. The rest of the land in the zip code is mostly rural with a few rural housing developments mostly on the north end of the zip code. From 2008-2016, the population ranged from 599 to 698. Total households ranged from 323 to 342, and cut-offs ranged from 21 to 41.



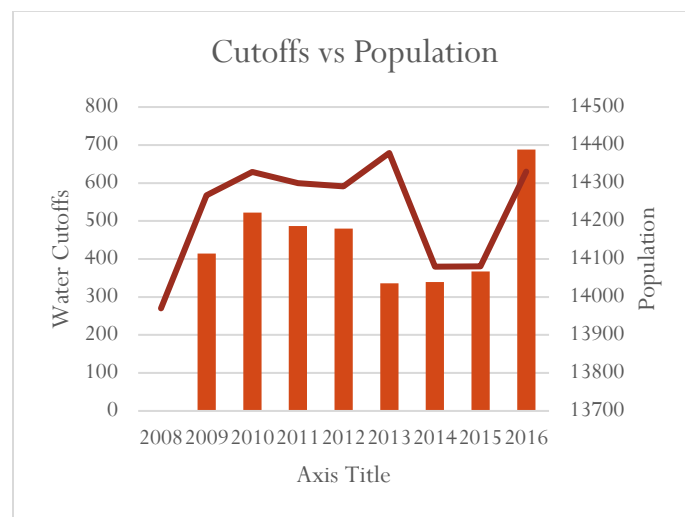
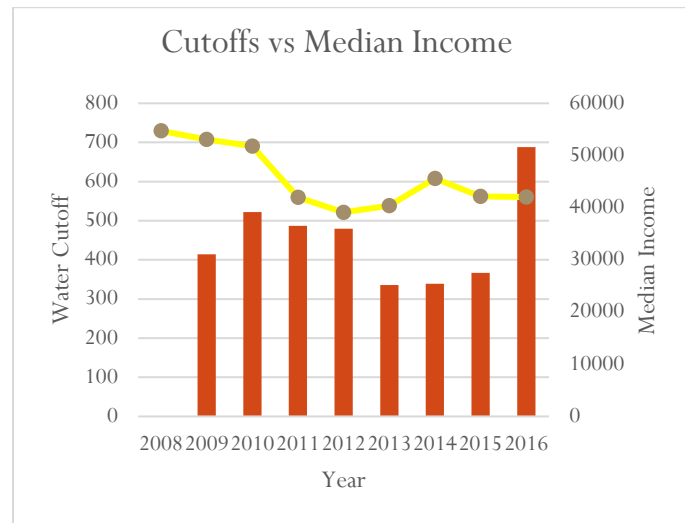
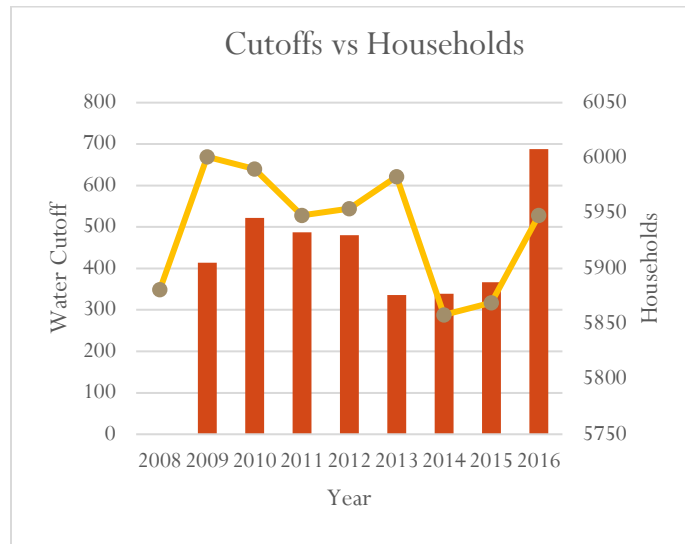
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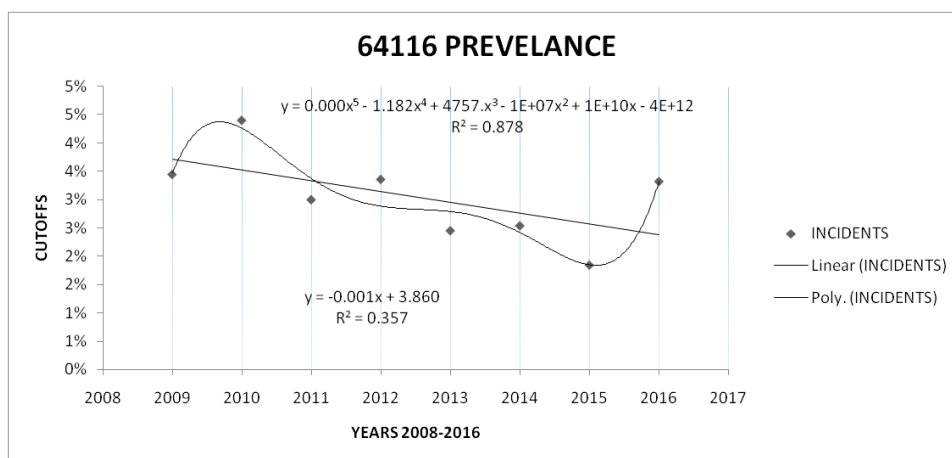
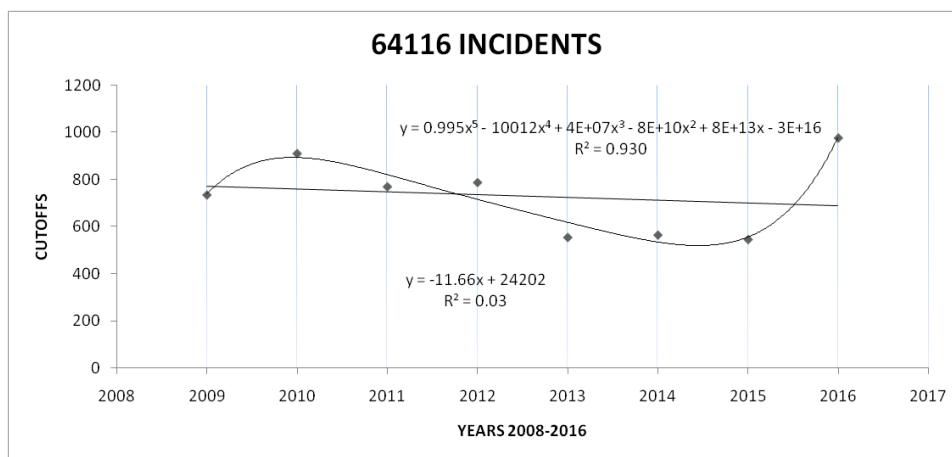
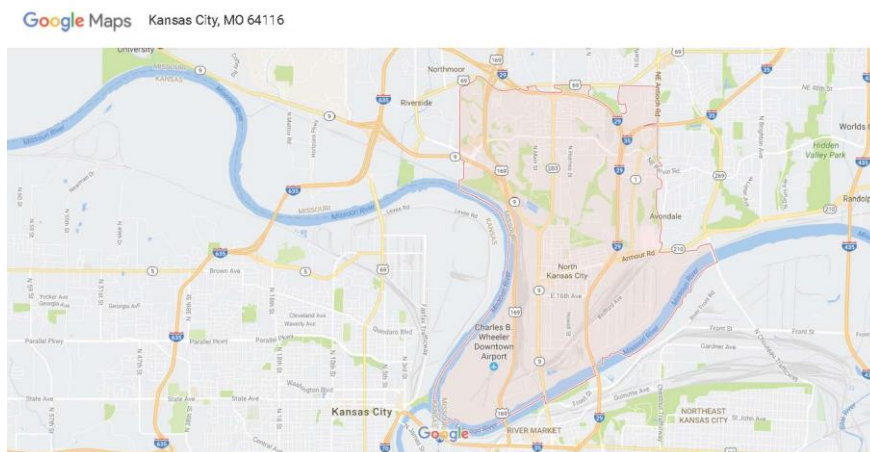
64117. This zip-code is located just north of the Missouri River, up to NE 48th Street. It's western edge is Antioch and extends easterly to 435. From 2008 to 2016, the population ranged from 13,970 to 14,330. The total households ranged from 5,881 in 2008, to 5,948 in 2016. There were 414 cut-offs in 2009 then went up to 522 in 2010. The number of cut-offs dropped from between 2010 to 2016, with the low of 336 cut-offs in 2013, but in 2016 there was a steep increase to 688.



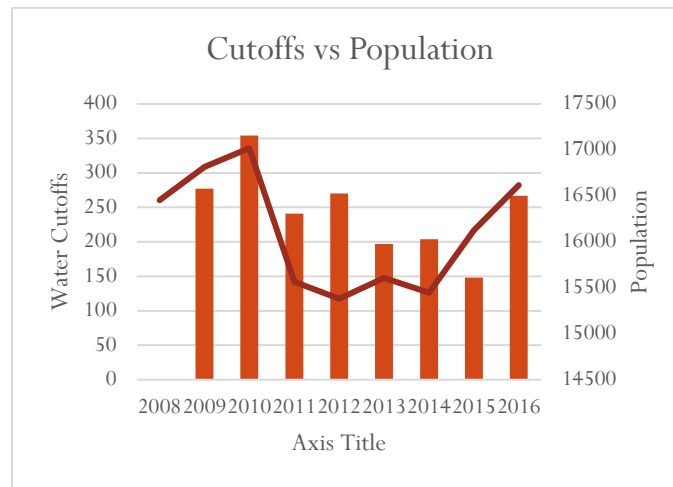
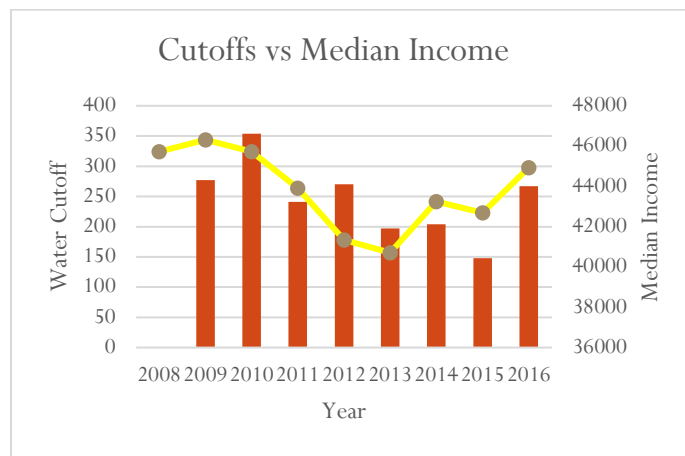
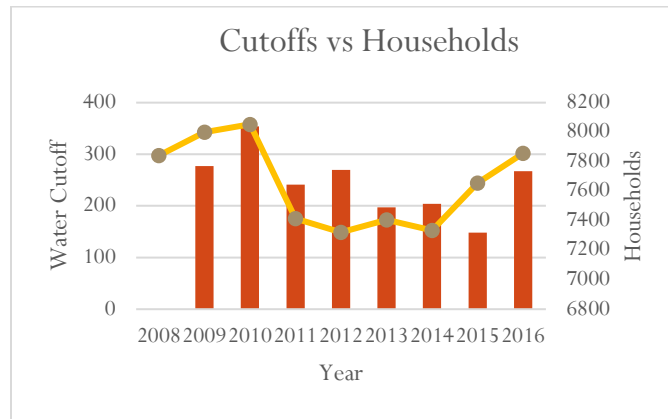
Additional Data for 64117



64116. This zip-code is also located just north of the Missouri River and it shares its eastern border with 64117. Besides Kansas City, the zip-code also includes the cities of North Kansas City and Avondale. From 2008 to 2016, the population of the entire zip-code ranged from 15,381 as its low in 2012 and had its high in 2010 with 17,019 residents. The cut-offs ranged from its low in 2015 of 148 to its high in 354 in 2010.

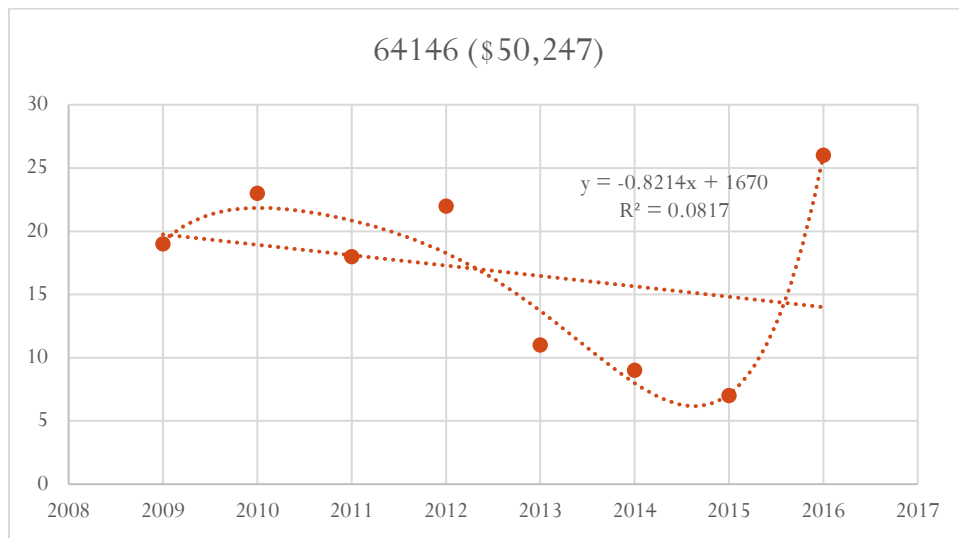
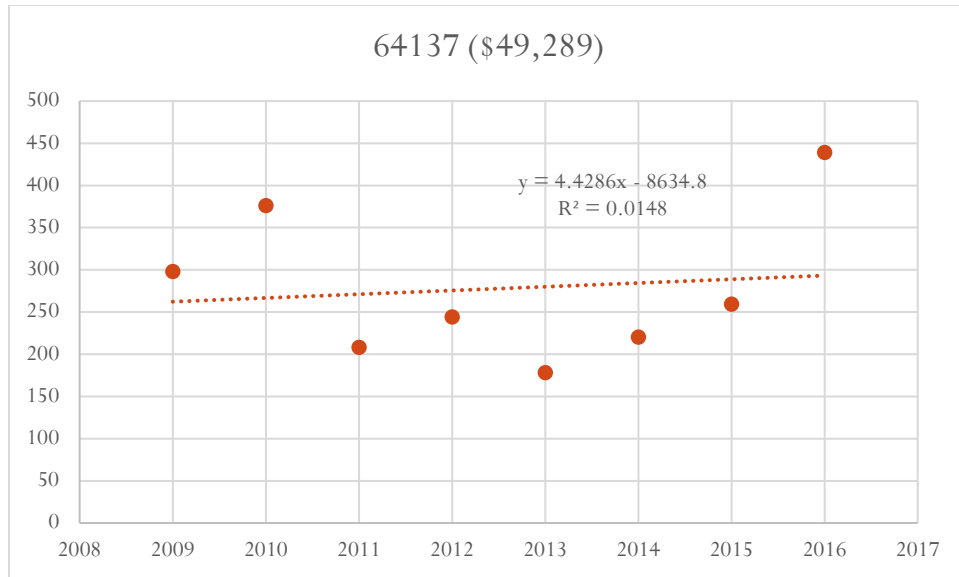


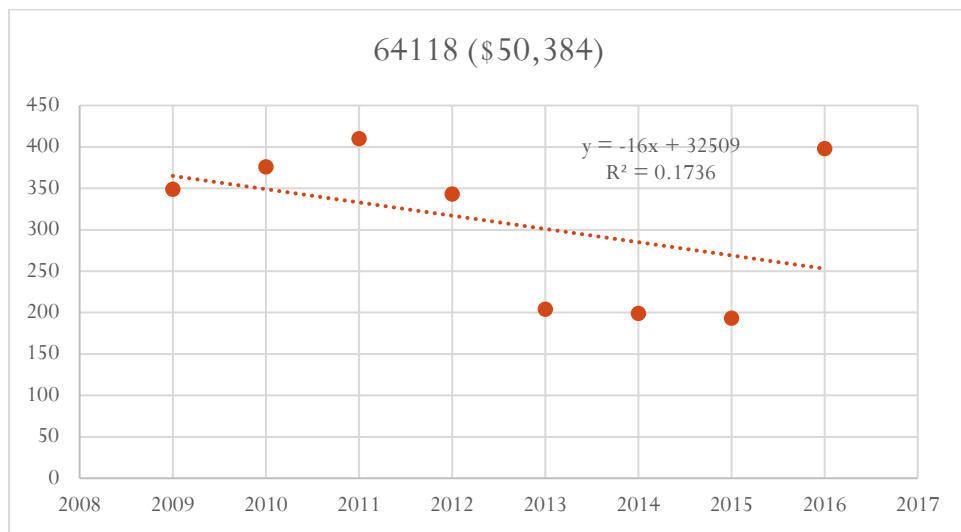
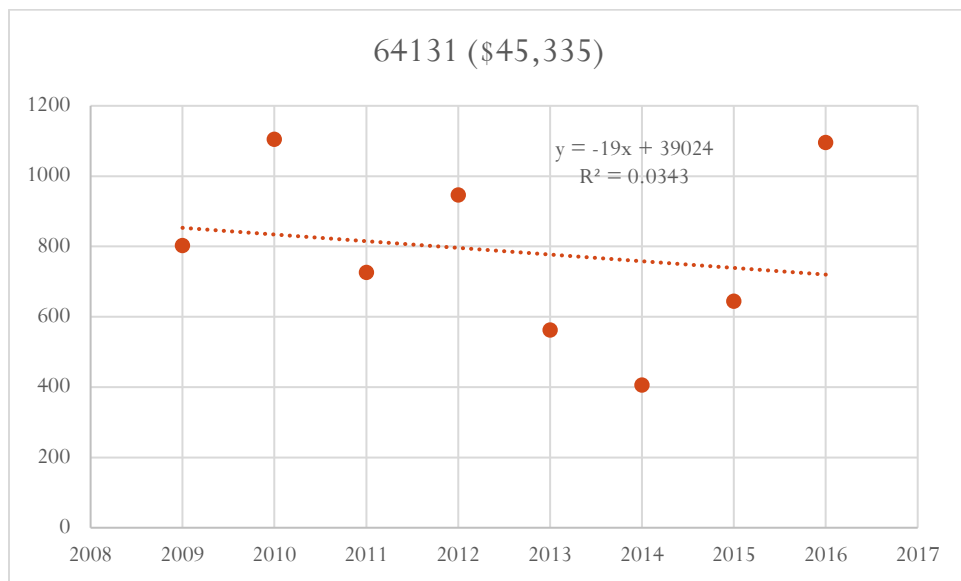
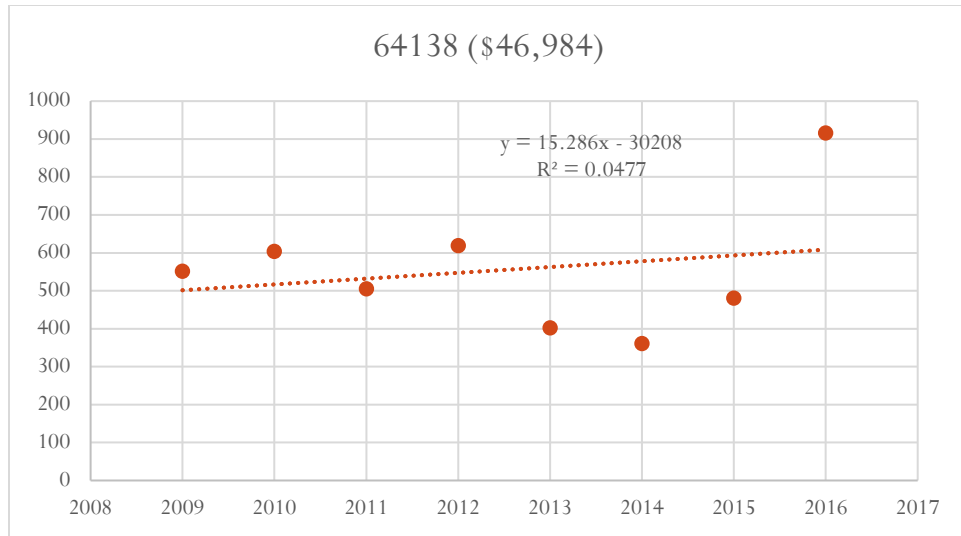
Additional Data for 64116



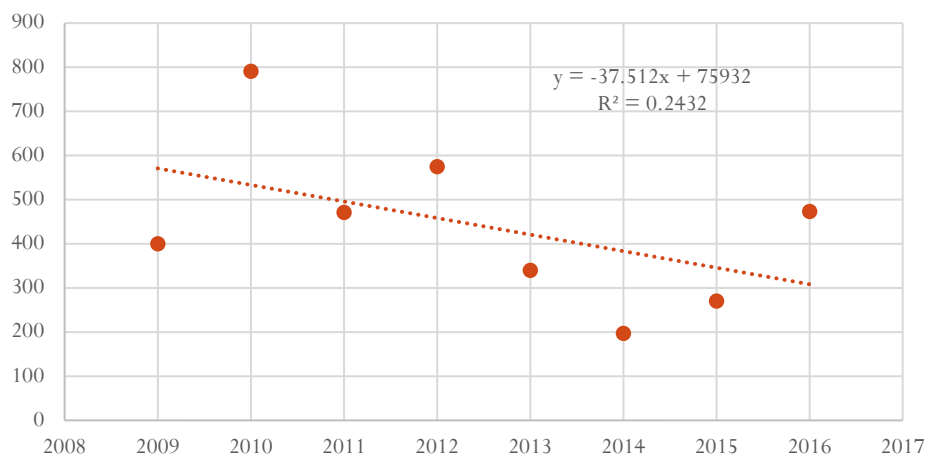
Overview of data analysis for zip codes: 64131, 64138, 64133, 64137, 64146, 64118, and 64114

1. Average Income was \$47k
2. Min Income was \$45k
3. Max Income was \$50.3k
4. Medium income zip codes had a wide variety of cutoff %'s
5. The biggest outlier was 64146 (over 50k a year) with 8% cutoff
6. 64137 (third highest zip code income) = lowest cutoff %
7. Key Factors: income, location, # of households, population, and education.

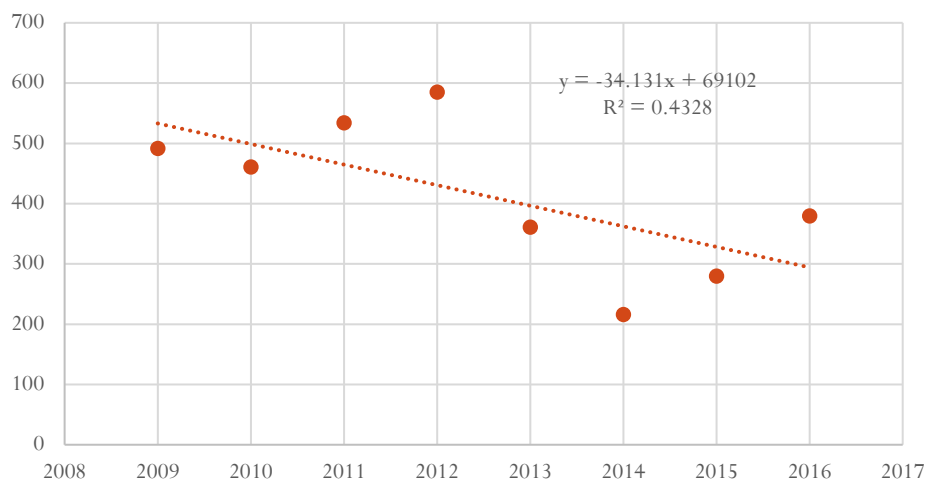




64114 (\$54,627)



64133 (\$48,479)



7. Analysis of Zip Codes with Income between \$55k and \$76k

Key factors

1. Occupied Housing Units: Minimum: 156 (64161) Maximum: 11,104 (64119)
2. Income: Min: \$53,586 Max: \$63,065
3. Households with kids: 64063: 39% 64153: 29% 64119: 31% 64112: 8% 64161: 34%
4. All of our zip codes were in predominately white neighborhoods

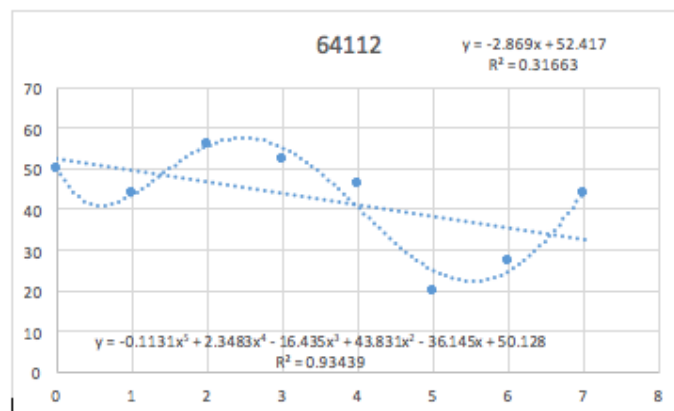
Fluctuations

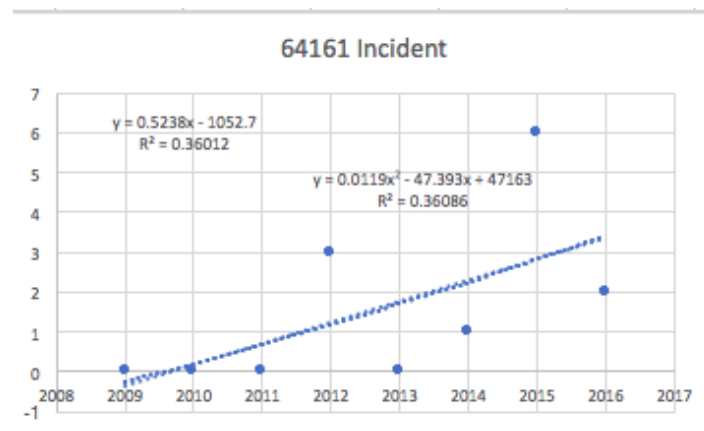
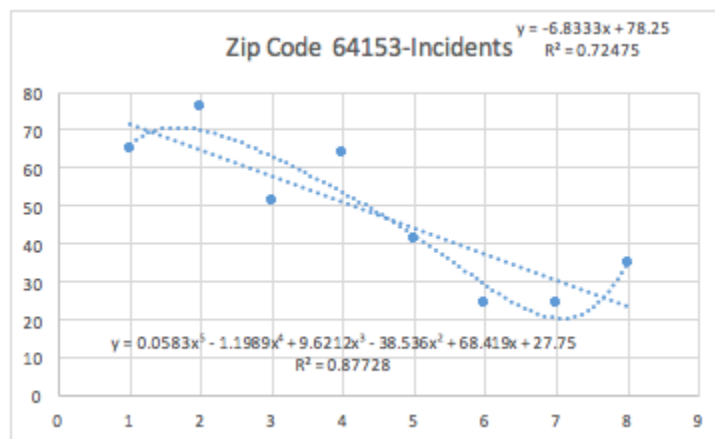
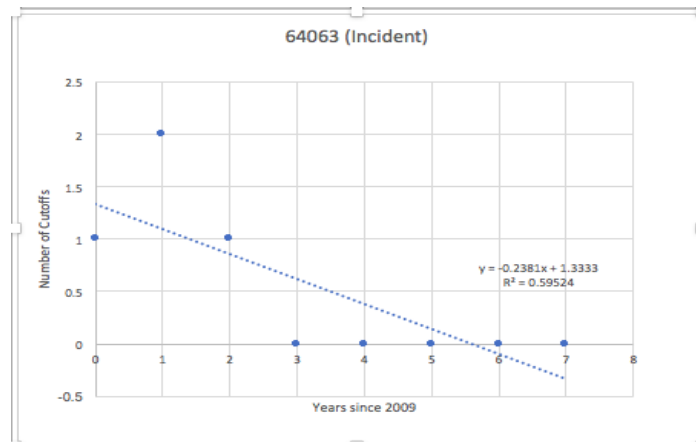
1. 64119, big spike in 2016
2. 64112, spike in 2011 and gradually decreased. Increase in 2016
3. 64154, decrease in 2011-2014
4. 64063, almost no cutoffs
5. 64153, high in 2009 and gradually decreased

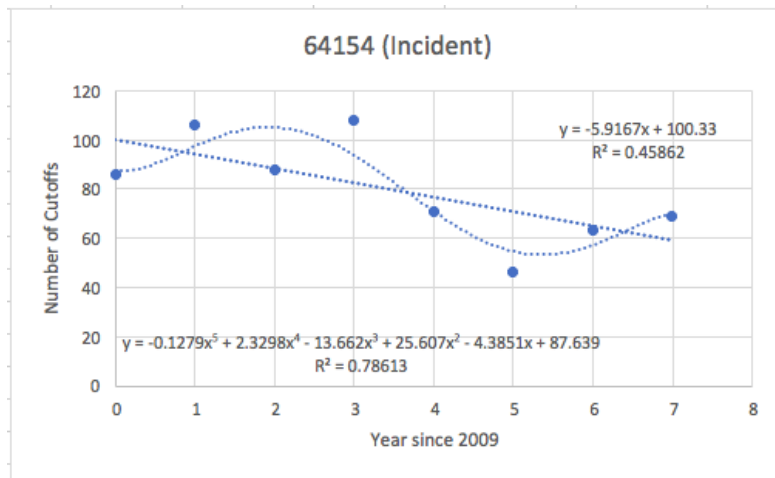
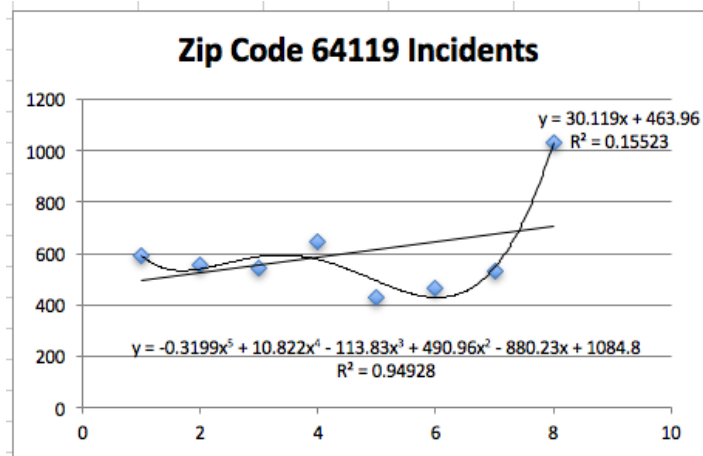
Occupied Housing

- 64119 had 11,104 occupied housing units compared to 64161 which had 156. While there's an assumption that higher incomes have less cutoffs, that turned out to be false according to our information. 64119 had a medium income of \$60k with a max of 1032 cutoffs. 64154 had a medium income of \$53k with a max of 106 cutoffs. 64119 has 11,104 occupied housing units which has a significantly greater amount than 64154 which has 4,032 occupied housing units.

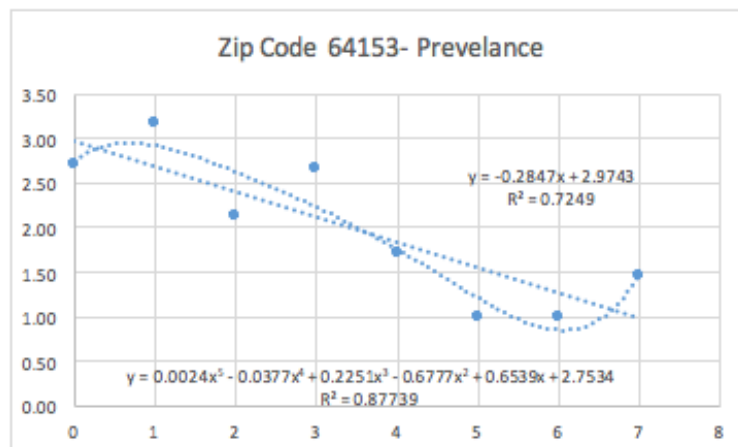
Incident Graphs

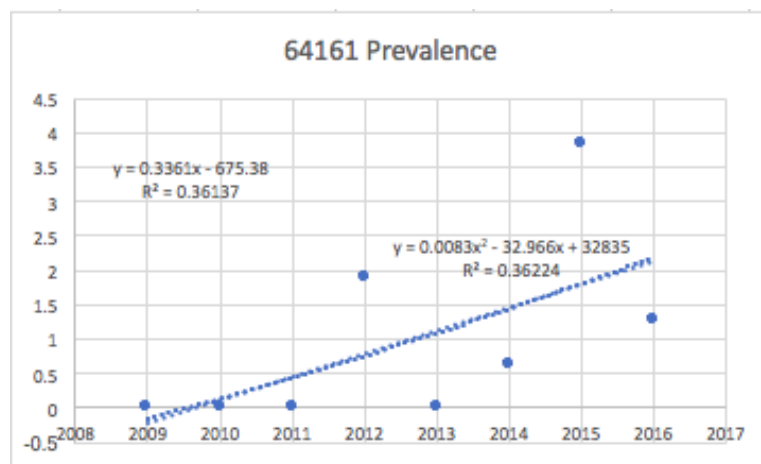
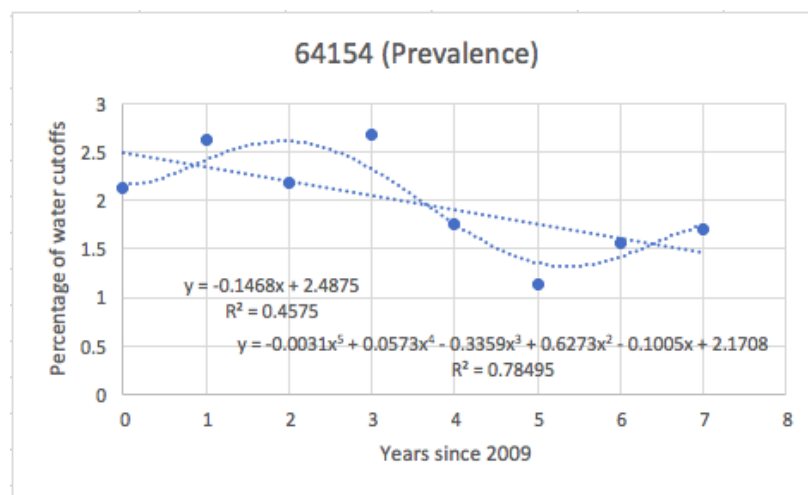
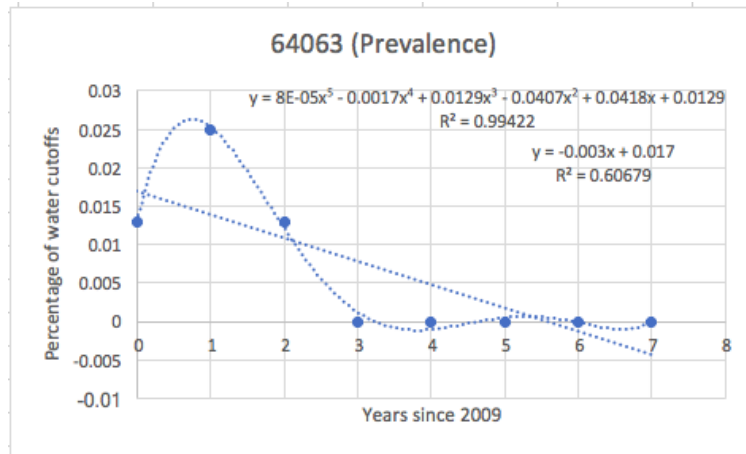


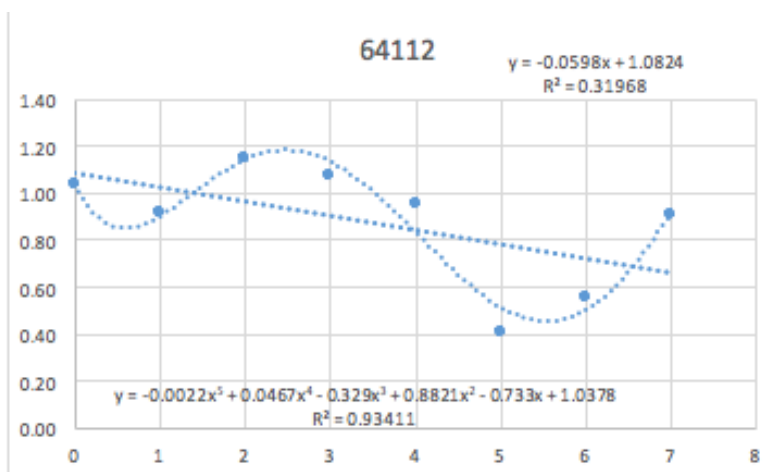
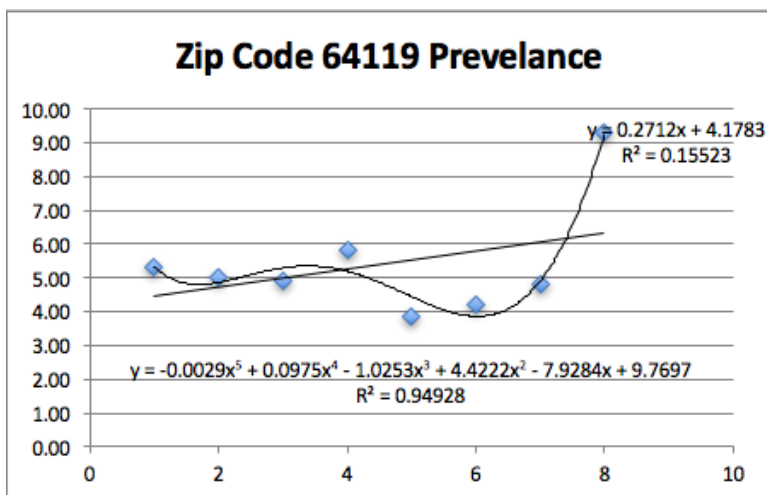




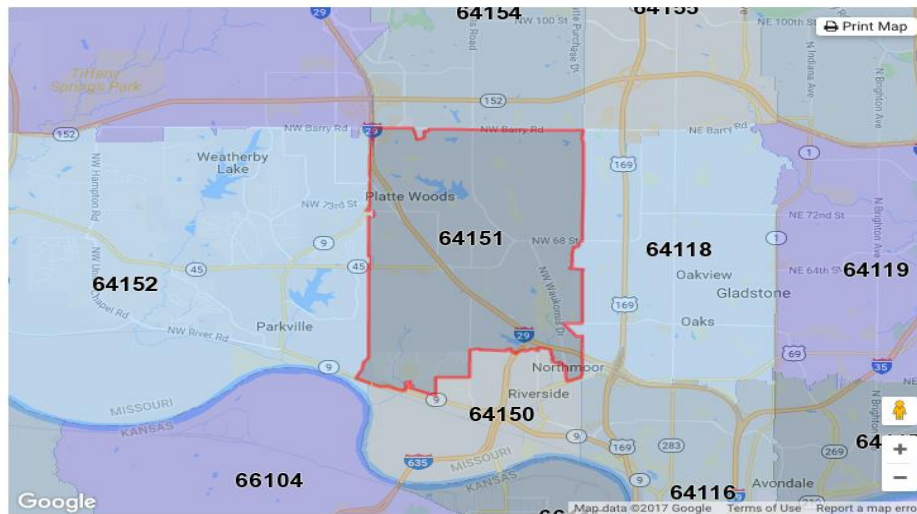
Prevalence graphs



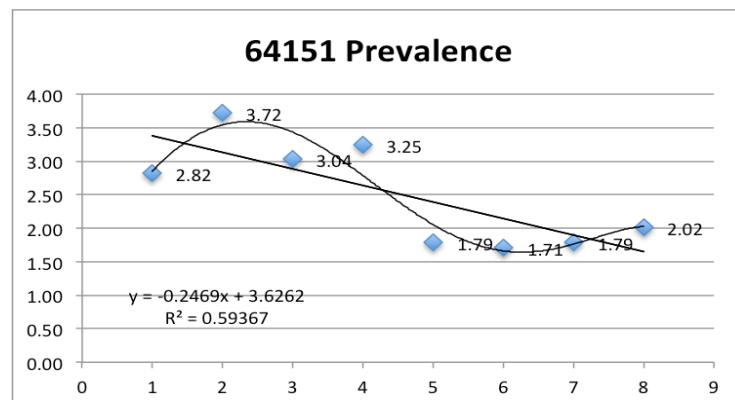
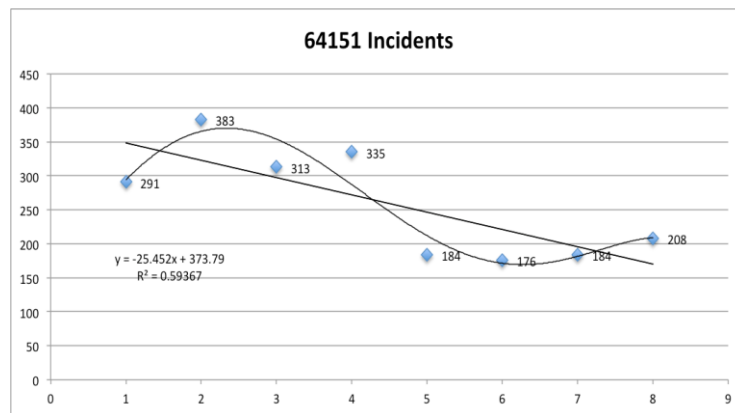




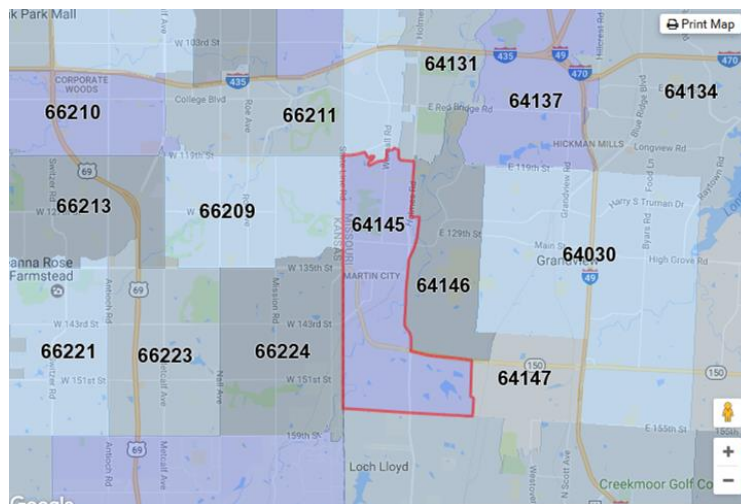
64151. ZIP code 64151 is located in northwest Kansas City and is less than the average land area compared to other zip codes in KC. It also has a higher than average population. There are more singles than families in this area and the average household income is \$63,957.



Population: 24,134
Housing Units: 11,197
Family Households: 4,885
Owned Households: 6,599
Median Household Income: \$63,957



64145. ZIP code 64145 is located in the southern region of Kansas City west of Grandview. This area has a low population density and a large elderly population.



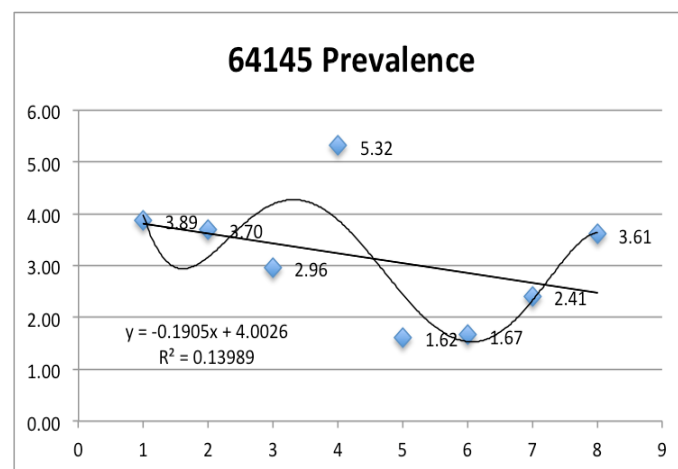
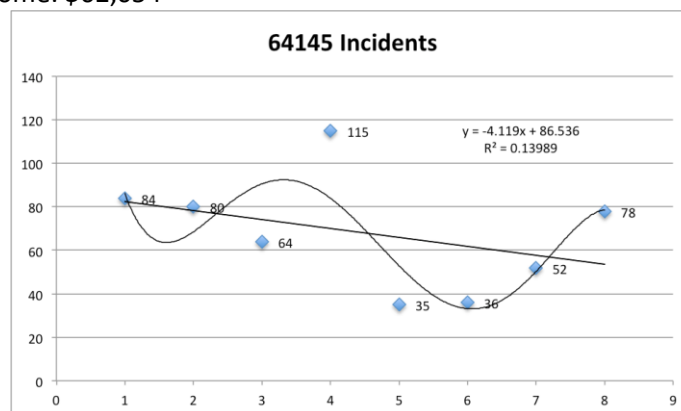
Population: 5,389

Housing Units: 2,303

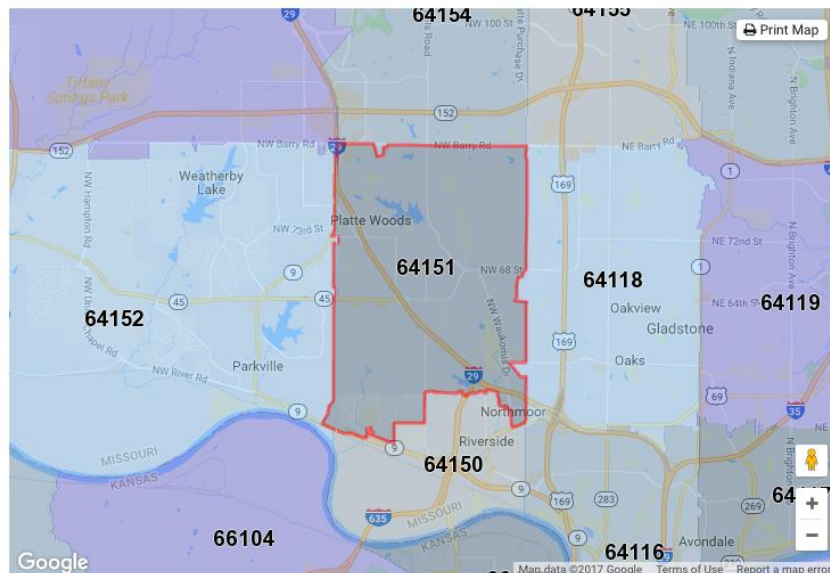
Family Households: 1,141

Owned Households: 1,749

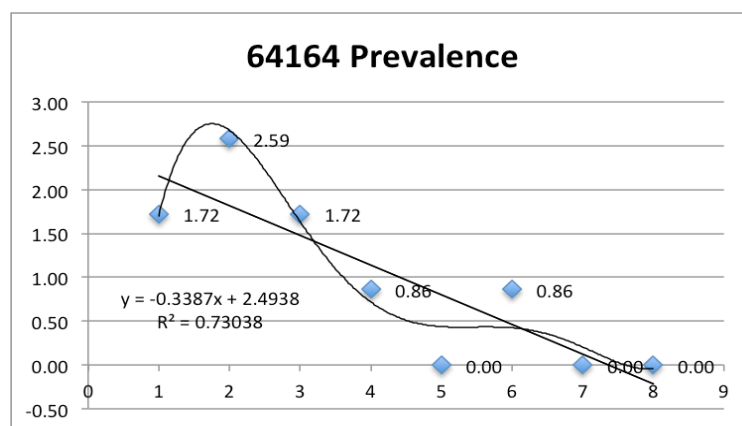
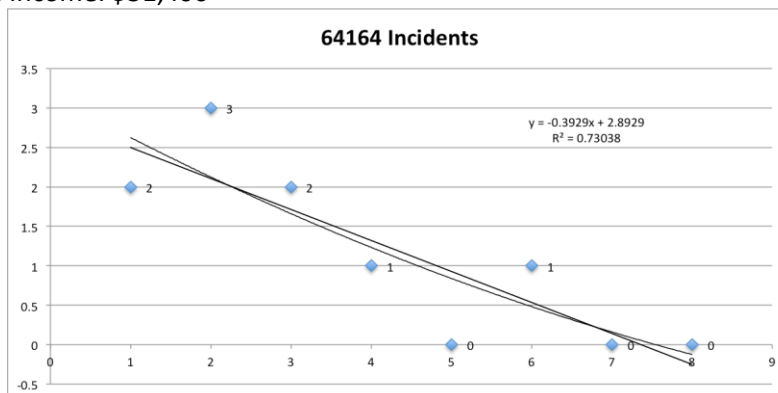
Median Household Income: \$62,054



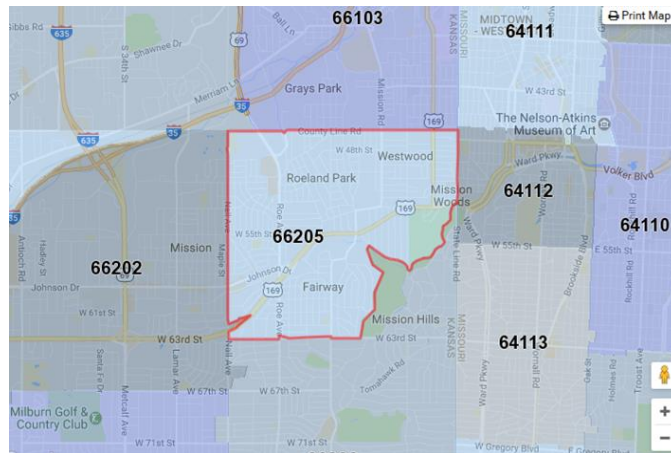
64164. This zip code is located in northwest Kansas City and is only 10 Sq. mi. in area. The population in this area is very low with only 300 people.



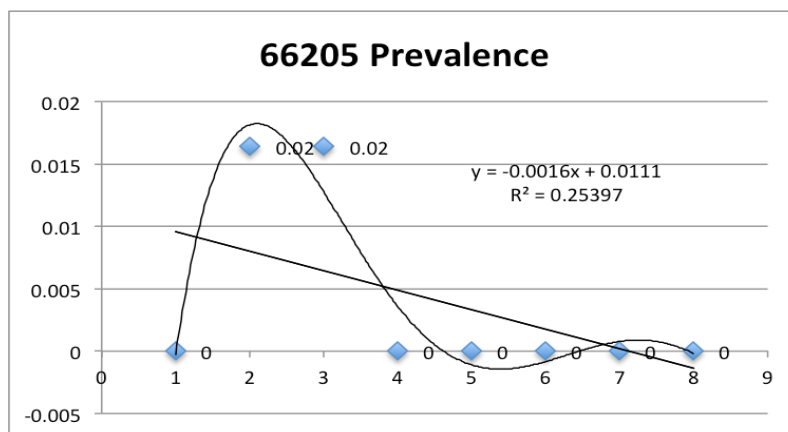
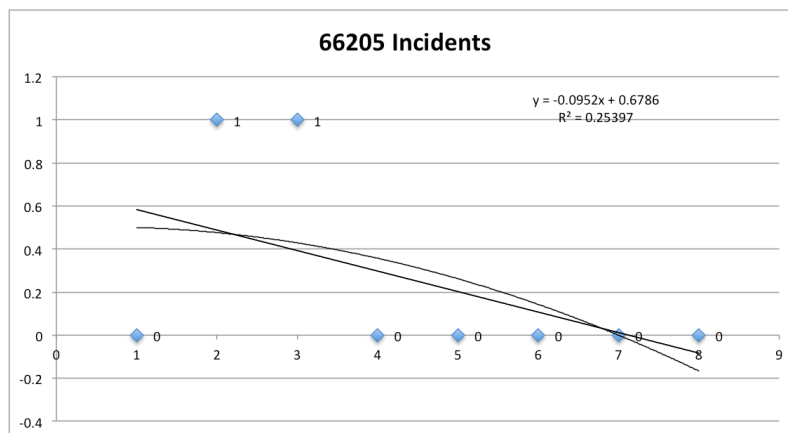
Population: 302
Housing Units: 128
Family Households: 79
Owned Households: 100
Median Household Income: \$31,406



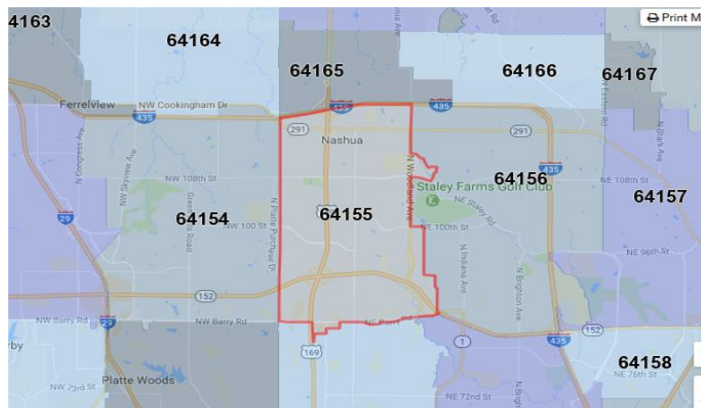
66205. This zip code in Mission, **Kansas** is southwest of Kansas City. It has the highest population density out of all of our zip codes.



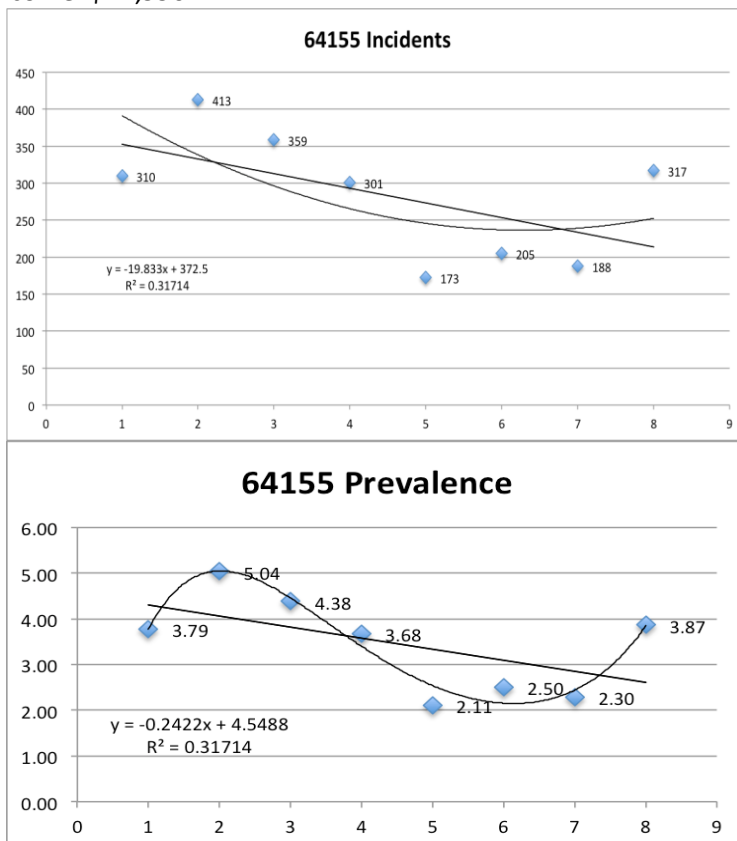
Population: 13,216
Housing Units: 6,484
Family Households: 2,759
Owned Households: 4,946
Median Household Income: \$78,648



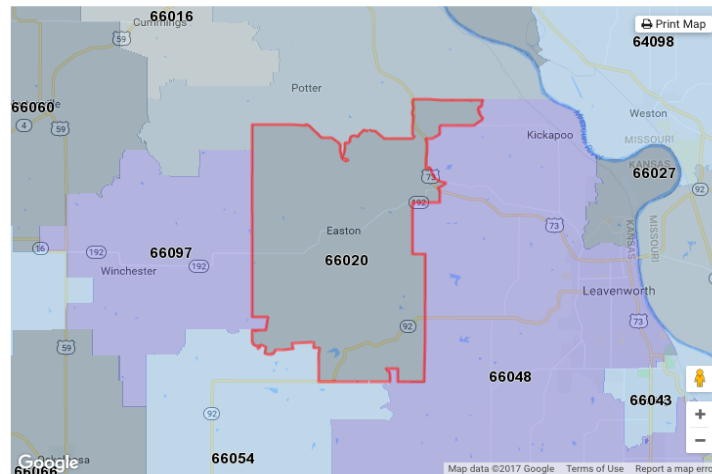
64155. ZIP code 64155 is located in northwest Missouri and covers a slightly less than average land area compared to other ZIP codes in the United States. It also has a slightly higher than average population density. The people living in ZIP code 64155 are primarily white. The number of people in their late 20s to early 40s is extremely large while the number of middle aged adults is large. There are also a slightly less than average number of single adults and a slightly higher than average number of families. The percentage of children under 18 living in the 64155 ZIP code is large compared to other areas.



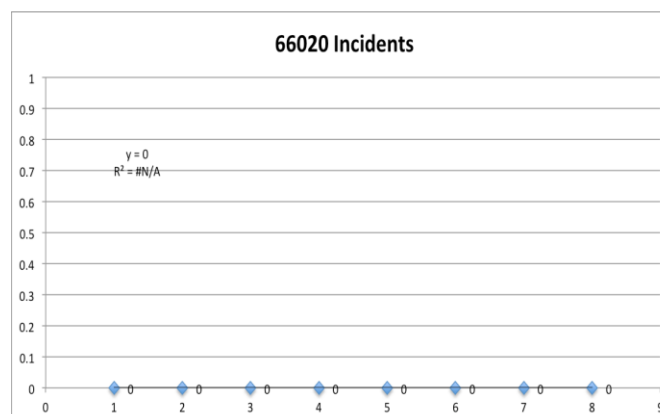
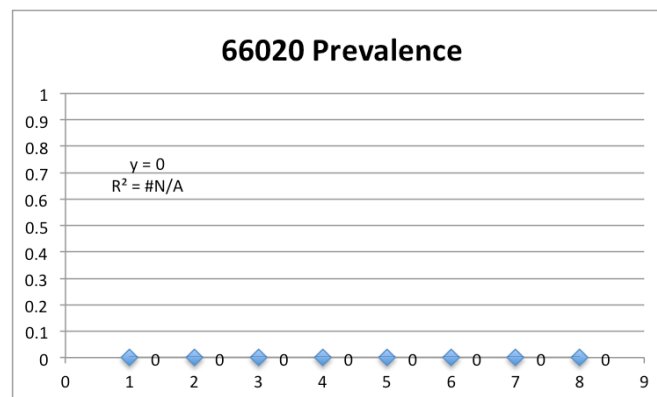
Population: 21,901
Housing Units: 8,670
Family Households: 4,752
Owned Households: 6,289
Median Household Income: \$72,990



66020. This zip code is located in Leavenworth County, or northwest of KC. This area has less than the average population, however it is predominantly seniors. This zip code also has a large amount of families compared to singles.



Population: 1,442
Housing Units: 578
Family Households: 360
Owned Households: 441
Median Household Income: \$74,609



Trends

It is a general trend across most zip codes that the highest number of cutoffs occur in the first few years of data, 2009-2012. Following those years, most zip codes see a decline in both the number of incidents and the prevalence in cutoffs.

Fluctuations with Respect to Income

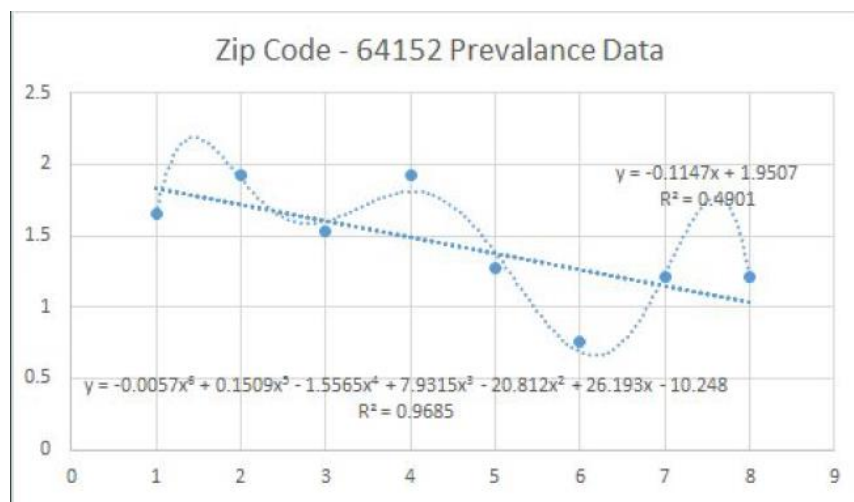
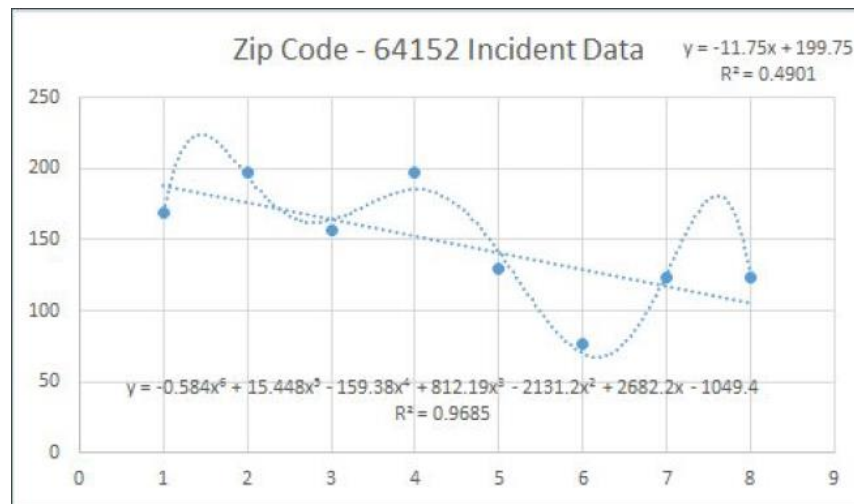
With respect to income, the higher median income zip codes in our data set, 66205 and 66020, saw far fewer cutoffs compared to the lower income zip codes. The maximum number of cutoffs in the higher median income zip codes was 2, where the maximum number of cutoffs in the lower median income zip codes was 383, in zip code 64151.

In relation to other groups, this trend seems to follow. In general, lower income zip codes saw more incidents of cutoffs while higher income zip codes saw less. Specifically, looking at Group 2's data for zip code 64108, the number of cutoffs over the course of 2009-2016 closely follows our zip code 64164, with the highest prevalence of cutoffs being in 2009-2012, and a steady decrease in prevalence in the years following.

8. Analysis of Zip Codes with Income above \$76k

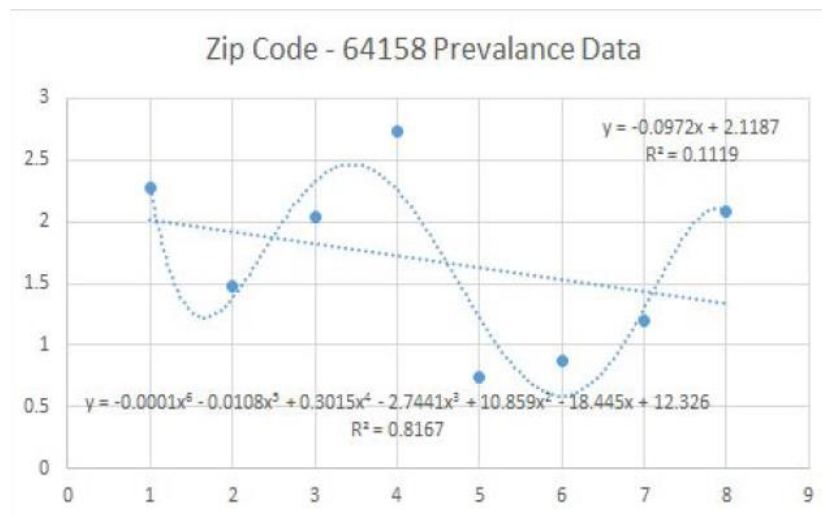
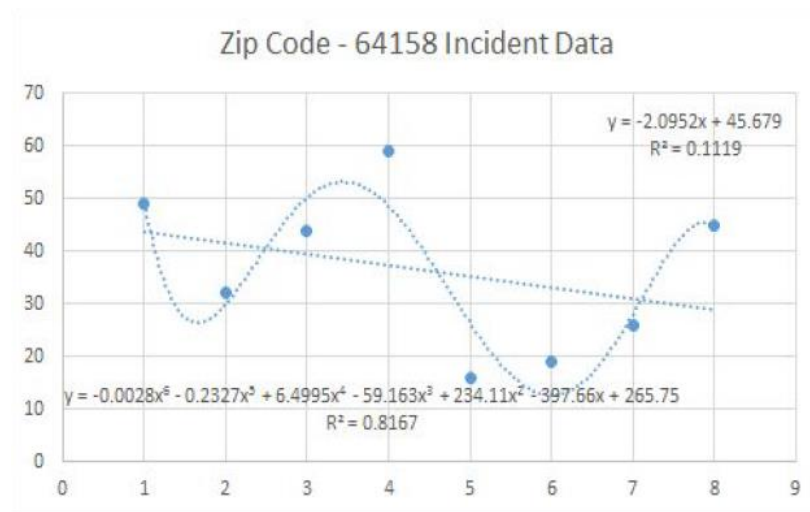
Zip Code 64152

1. Average cutoff prevalence 1.434326171875
2. Population: 26,024
3. Housing Units: 10,240
4. Income: \$83,116
5. Big Community compared to Zip Code 64156 and 64165. 64152 makes up Kansas City, MO.



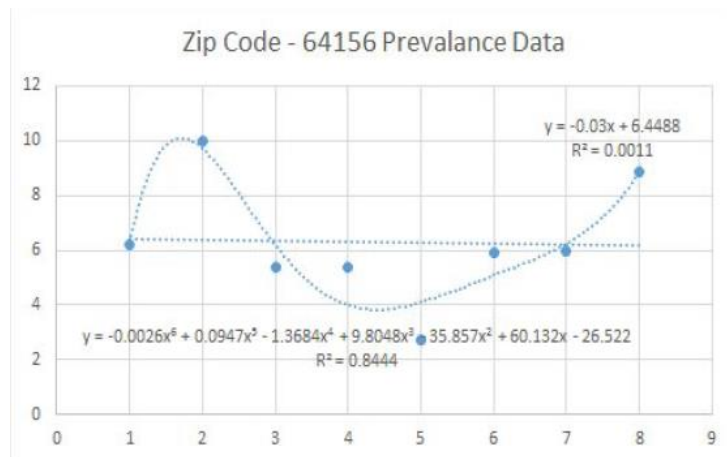
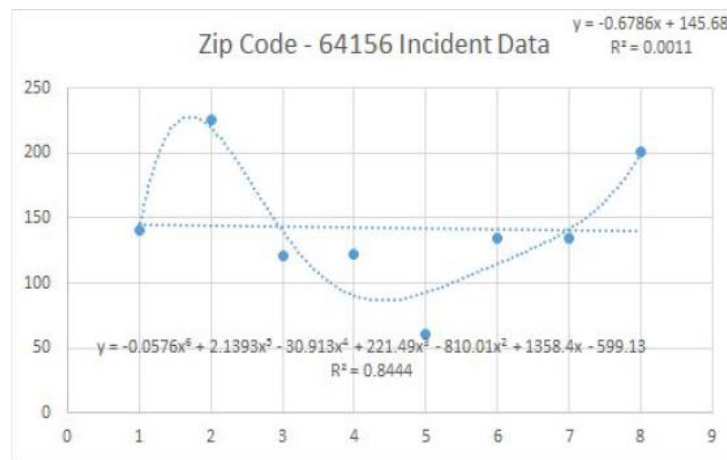
Zip code 64158

1. Average cutoff prevalence 1.681354359725
2. Population: 5,161
3. Housing units: 2,156
4. Average Age: 35-44
5. Income: \$85,681
6. 2012: Highest number of incidents -
7. Population took a small dip meaning cutoffs were affected by vacant housing units



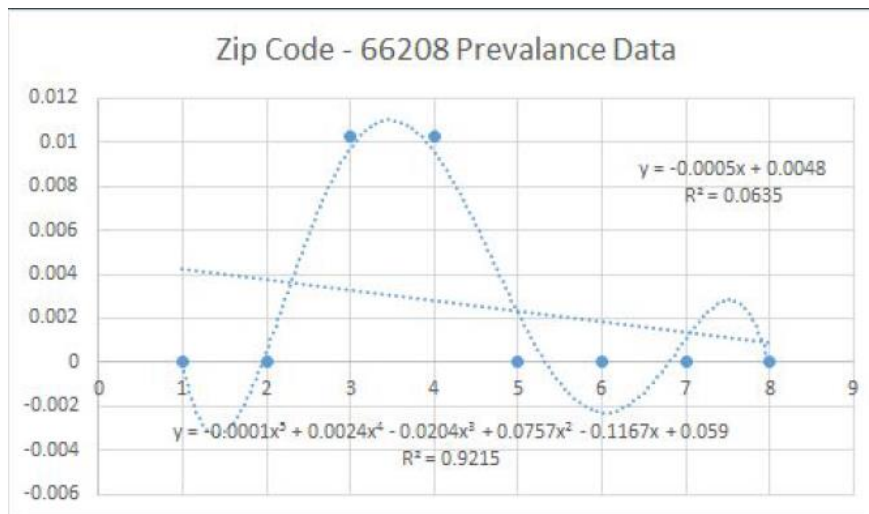
Zip code 64156

1. Average cutoff prevalence 6.31
2. Population: 5,404
3. Housing units: 2,259
4. Average Age: 35-39
5. Income: \$83,708
6. Population has gradually been increasing since 2009. Kansas City, Missouri's population has grown 2,000 over the last 5 years.



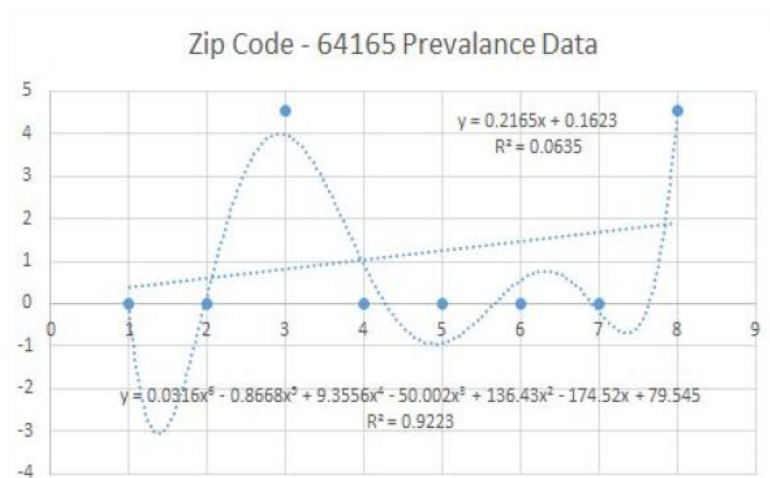
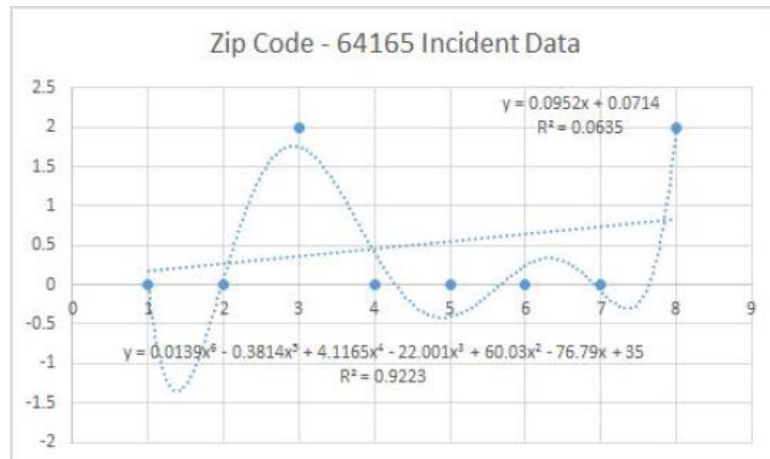
Zip code 66208

1. Average Cutoff Prevalence: 0.003
 2. Population: 20,945
 3. Housing Units: 9,748
 4. Average Age: 39
 5. Income: \$83,860
 6. Big Community compared to the rest of our High Income Zip Codes.
- This Community makes up **Prairie Village, KS**



Zip code 64165

1. Average Cutoff Prevalence: 1.136
2. Population: 112
3. Housing Units: 44
4. Average Age: 37
5. Income: \$88,289
6. Small Community in Jackson County. This zip code makes up the city of Gladstone.

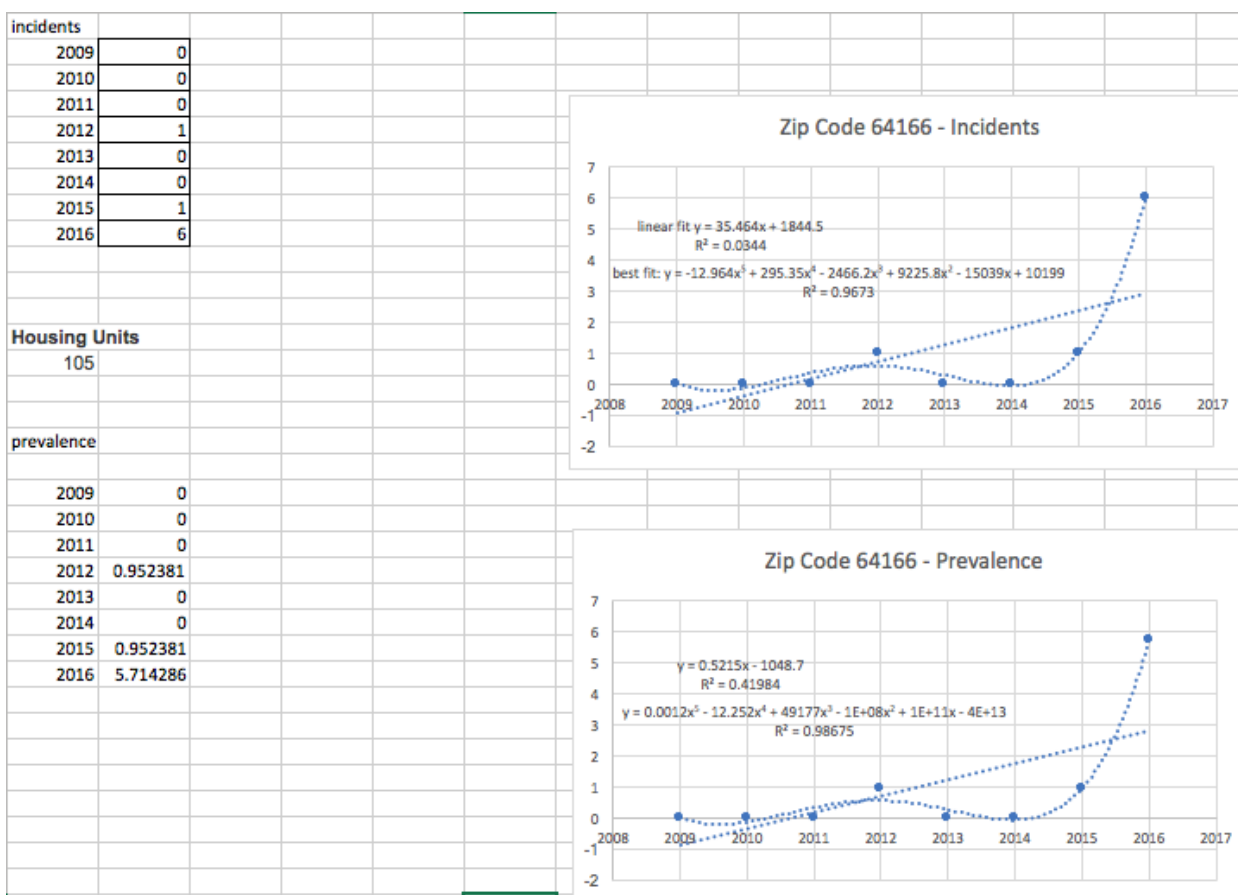


64156: The Outlier

1. Has the lowest number of people living within our data set
2. Has the youngest median population
3. Least number of owned homes
4. Highest number of recently built homes (less than ten years old)
5. Is a recently developed area
6. Considered in the high Income range of zip codes.

Overall

1. Typically see a decrease in cutoffs around the years 2013-2014
2. People not paying bills?
3. Fluctuations in common with other groups: Minimums in 2013 & 2014 most likely due to assistance from grants during this time period with funding from Mid-America Regional Council.
4. Rise in cutoffs are seen after 2014 due to a decrease in funding from Mid-America Regional Council
5. As income increased in our zip codes, prevalence of water cut-offs decreased. This also seemed true when comparing to the other group's zip codes.

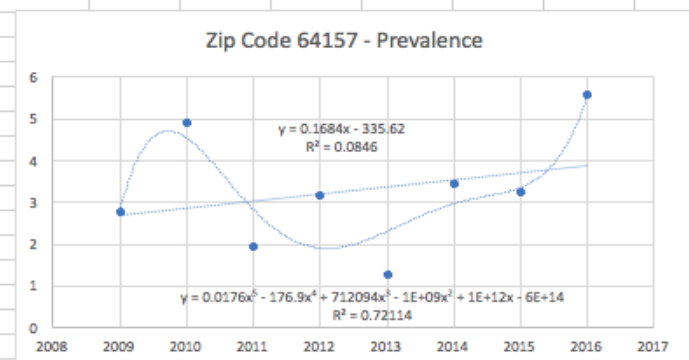
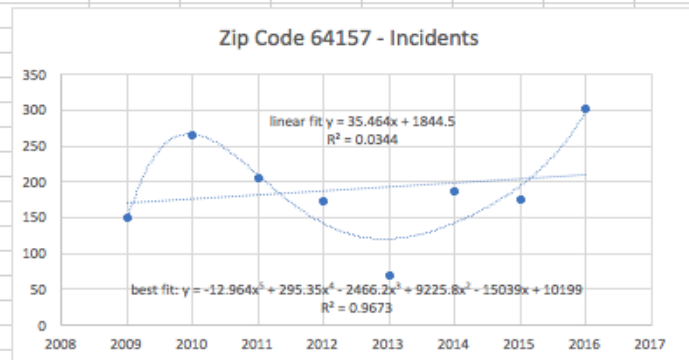


	64166	64157	64149	64139	64167	64113
Population	278	16122	343	1762	353	11328
Population Density	56 PSM	1461 PSM	40 PSM	431	258 PSM	4541 PSM

incidents	
2009	149
2010	264
2011	204
2012	172
2013	68
2014	187
2015	175
2016	301

Housing Units
5,401

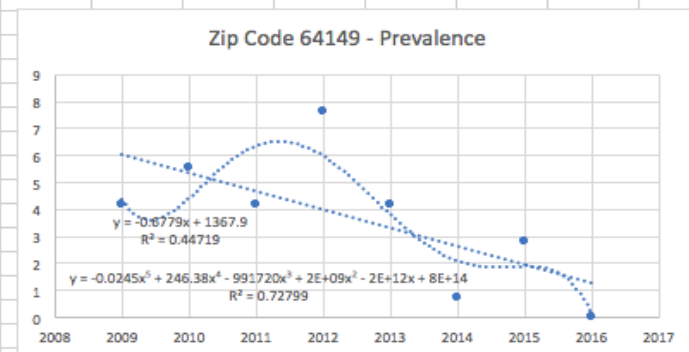
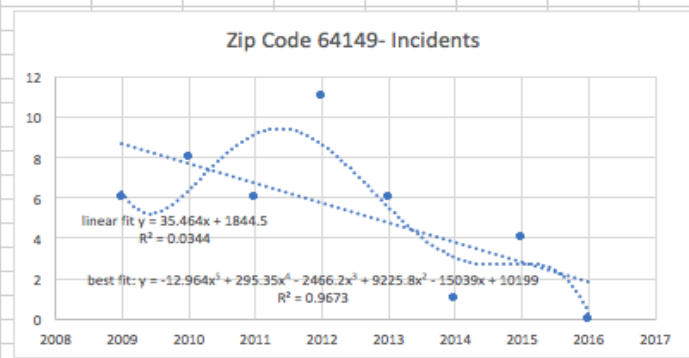
prevalence	
2009	2.75875
2010	4.88798
2011	1.92557
2012	3.1846
2013	1.25903
2014	3.46232
2015	3.24014
2016	5.57304



incidents	
2009	6
2010	8
2011	6
2012	11
2013	6
2014	1
2015	4
2016	0

Housing Units
144

prevalence	
2009	4.166667
2010	5.555556
2011	4.166667
2012	7.638889
2013	4.166667
2014	0.694444
2015	2.777778
2016	0



	64166	64157	64149	64139	64167	64113
Median Household Income	\$132,708	\$100,873	\$54,792	\$82,829	\$138,33	\$113,536
Worked Full-time with Earnings	50%	61%	56%	42%	61%	53%
Worked Part-time with Earnings	26%	23%	19%	30%	34%	24%

1. Most of these higher income zip codes all have one particular thing in common – high college attendance (higher than no high school degree)
2. The question we asked while doing this project was: How is can zip codes like 64157 & 64133 be considered high income but still have a max number of cutoffs that fluctuates from 112 to 301.
3. We deduced that these zip codes are short but wide. 64133, in particular starts right behind the UMKC campus and stretches all the way to Gregory Blvd., which as we know tends to earn a lower income as you approach eastward.
4. 64157 is in the north-east corner of the Kansas City Metro, this area produces higher incomes in the north-west region, but low income in the south east.
5. Half of these zip codes, (64116, 64157, & 64113) have seen a rise in the number of cutoffs post 2014

9. Proposed Solutions to the problem of high KC water cutoffs

The following solutions were proposed by the students of each group.

Water Cutoff Solution

Group 1: Travis Brown, Kristen South, Monica Jimenez, Fathiya Ibrahim, and Phillip

We as a group focused on the following zip codes (64128, 64130, 64132, and 64127). These are lower income and high unemployment areas in Kansas City, Missouri. One possible solution to having the water shut off in these communities would be a system that allows water usage for families that do not pay, but only during designated times per day. This approach seeks to maintain a minimum standard to allow a basic necessity to people who don't pay it on their own. The rationale is that if water is provided every day at a certain time that people with their water cutoff can still meet basic hydration, dietary and hygienic needs. While not a direct solution to water cutoffs themselves this allows water companies to lower quality of service for delinquent payers while still meeting a basic necessity for people in these communities. We believe this solution would allow for better quality of life for these families, and the ability for water companies to potentially save on state and federal taxes through what we would consider a charitable donation of services, while keeping costs to a minimum and deterring people from taking advantage of no cost. The solution in action would allow water usage to homes with their water cut off from 5:00am – 7:00am and from 7:00pm – 9:00pm. Giving these communities the opportunity to perform basic hygiene, and to save water for use throughout the day. It would also allow for companies to offer a tiered payment system giving an even lower price to families that cannot purchase full services.

Water Cutoff Solution

Group 2: Alex Andrews, Rachel Replogle, Rachel Talmadge

With water prices increasing every year and more people unable to pay them, something in Kansas City needs to change. Most groups from class noticed that in 2013 and 2014 the amount of cutoffs lowered substantially. After doing some research we found that there was a temporary government assistance fund that helped out numerous families. Our groups' idea to help the families and businesses in Kansas City would be for another government system. There are a few different directions we can go. One idea would be to add a small tax on families in higher income brackets to help the lower income brackets. If a family in the high income brackets just paid \$50 per year (\$4.17 per month), that money could be pooled together to give assistance to others. Many people would say, "Why should I pay extra to help other people?" Well this is a valid point, but would \$4.17 really be that big of a burden for people who could afford it?

Another idea we came up with was to possibly reallocate a small percentage of sales or even cigarette taxes and help out these families. Even if it were only 1 penny from either of these taxes, plenty of money would be getting pooled together to help out. One group pointed out a law that was passed making sure that if the temperature drops too low then the city cannot turn off the water. If this law was kept and taxes were reallocated then people who need help would get it. We believe that if either of these plans were put into motion, then the lower income brackets would get the help they need to pay for water. If people don't have water then it is pretty much impossible to live, especially for

families with children. Water is a necessity and we as a community should work as hard as we can to help those in need.

Water Cutoff Solution

Group 3: Hunter McDowell, Ricardo Antigueta, Son Doan, Mehak Sood, Deonte Minor, Tom Upman, Jacob Crowder, and James Risalvato

Our proposed solution is two parts. The first would be a regulation for landlords to report when they acquire a new renter or when a renter vacates. This would need to be done within thirty days of structure/unit being occupied or vacated. This would help to provide better data to distinguish cut-offs in owned households, rented households, and commercial. We feel that this data is imperative to any solution. The second part is the creation of a department within the water department where residents could apply for assistance. The assistance would depend on income, employment, and whether or not they are a renter or homeowner. There would need to be an initial investment by the city that would be amortized over 20 years to be used to hire several employees and purchase the operation capital. Once operational, the new department within the water department would be paid for strictly through contributions.

Water Cutoff Solution

Group 4: Mia O'Dirling, Avery Matthews, Fiona Isiavwe, Marcus Johnson, Hannah Belfield.

Based on the results derived from our analysis of the cause of a disparity in water cut-off rates among various zip codes in Kansas City, it can be observed that an inverse relationship exists between the median income of zip codes and the rate of water cut-offs. From this relationship, it can be implied that those who lack adequate income are being stripped of a basic human necessity, clean water.

We have drawn the conclusion that the water billing system is unjust to those with lower incomes. A majority of us know that what makes this economy keep flowing is the idea of debt because debt equals money and money equals debt. For this fact, the rich will remain rich because their money comes from the debt of those with lower incomes. This is known as exploitation. But has this idea on which the monetary system thrives gone too far? Denying basic human necessities due to the lack of a stable income to pay for clean water runs counter to society's morals and values. Focusing on individuality only and not caring about the big picture can lead to worsening conditions. By working together as a community, a solution can be established to benefit everyone.

For the reasons stated above, we want to propose a solution. We have noticed the problem regarding the inverse relationship between income and water-cut-off rates and have tied poverty as the main cause of high water cut-off rates. Therefore, we have come up with a solution to aid in the eradication of this problem. The main idea of our solution is ***“the redistribution of water rates based on income earned.”***

The redistribution of water rates based on income earned involves distributing the water cost in such a way that each economic class will be billed an amount that will not serve as a burden to them. Through weighing out the cost, individuals will find it less cumbersome to pay their water bills and water companies will be able to continue running at a profitable margin.

This could happen by calculating an estimate of each household income and from that drawing out what could be the best fit for their water bills. In other words calculating a set bill monthly until income changes. An important fact to take into consideration is how many people are living in the household. For example, the dependents usually, if under a certain age, cannot contribute to the income to help support the household. Families with some form of Government assistance also need to be taken into consideration when making this calculation. Such solutions keep things relatively fair for all families with low, medium, or high income. All are better off.

So in essence, what we are pushing for is a “fair billing percentage” which will be charged based on the income of the household, and all the factors stated above. For instance, no matter the income of the household, all households will pay a percentage to the water companies. This is to say higher incomes will inherently pay more, while lower incomes will pay less, but it will be fair because the percentages are all the same.

In conclusion, we acknowledge that executing our exact solution may be excessively cumbersome. However, we believe that a solution somewhere along the lines of what we have provided will lead to “fairer” water billings and fewer water cut-offs.

Water Cutoff Solution

Group 5: Mehak Sood, Deonte, Tom, Brady, Jake, Matt

This project started with the assumption that there was a correlation between the increase in water bills and the number of water cutoffs. Through careful analysis of the number of water cutoffs in the various zip codes, which were divided into high income, middle income, and low income, the data suggests there is some relationship between increase in water bills and the number of water cutoffs. However, further research suggests that factors such as rental properties and foreclosures also might play a part in the amount of water cutoffs reported. Unfortunately, the information for rental property and foreclosures throughout those years is not easily accessible. Therefore this study is focusing on the most measureable variable, median income of residents in the zip codes.

The goal for this study is to find the best solution for the Water Company and KC residents. Water is a very basic necessity that everyone should have access to. We aspire to come to a solution that provides equitable treatment to all residents, despite income. Our solution to this problem is that all residents be given a set amount of water to use monthly. The amount of water a resident will be given to use monthly should be set on the basis of residents occupying the household. KC Water

Company should be able to set those standards of how much water is given to a certain size household, however it is important to have an agency overlooking KC water company to ensure fair accommodations are being made. Before standards are set for water limitations based on KC Water Company's interpretation of what is fair, they should be accessible to the public before they are enforced. These credits of water given to each family unable to keep up with water bills, would be funded by organizations that help those whose water gets cut off, or by the state. This way everyone is getting equitable access to water despite income. Any water used over the limit given should be paid by the resident.

This way fair treatment is given to everyone and if someone goes over the limit of water usage, they can be held accountable. The solution we are suggesting would require careful analysis of numbers to determine what a fair standard is for the amount of monthly water credit given to everyone. If someone fails to pay their water overage for the month, they will be given a 2 month grace period. The goal of this study of providing equitable treatment to all residents would be met from this solution.

Water Cutoff Solution

Group 6: Sally Truong, Holly Kramer, Jocelyn Serrate, Taylor Ray, Chrysteene Smith.

Within this whole project our group, (group 6) decided that the most reasonable and logical solution to the water cutoffs in our zip codes is to either tax the city more or fix the utilities in the area where most of the problems are coming from. Most of the zip codes that we had were in the medium and higher income areas and so there weren't that many cutoffs in these areas. But the ones that were cut off we just figured if you tax those people more than the government can put money towards the water cutoffs. They can help people that actually need the help to pay their water bills instead of putting it towards other unnecessary things. For tax payers who make more money and don't really get anything taken out of their checks, I honestly think that they should have more removed from their checks because, it would help a whole bunch in the system. Most of the time it causes issues with the water if the utilities aren't working right, and even if the water is still on it may not be functioning like it should which may result in a water cutoff and eventually will show up as the person was unable to pay their water bill.

Water Cutoff Report and Solution

Group 7: Kyle Lininger, Noemi Aguilera, Caleb Wilfong, Natalie Haushalter

As a class project, we have split among groups and analyzed water cutoffs in specific zip codes across Kansas City. Our research has allowed us to find trends that concur with the data we have based off of the number of cutoffs. After analyzing the vast amount of water cutoffs based off of zip codes in Kansas City, we have ultimately come to a solution to solve the problem of increasing water costs.

One of the trends in our data that we found was that there was a higher number of cutoffs in the zip codes that have the highest home values. This is true for our two highest zip codes of 64155 and 64145. These two zip codes are considered to be in the high income zip code. We have inferred that it is a possibility that some families are stretching themselves financially for houses they don't need, this could be a reason why we see some of the cutoffs happening in our zip codes with high home values.

Another one of the trends that we found in our data was that zip codes with the highest percentage of families with kids have high prevalence data. Our three highest prevalence zip codes follow this trend. The zip code 64155 also follows the trend, but the data falls off after 4 or 5 months. We believe that the more kids that are in a household, there is a chance for more water to be used. This could be the reason why we see high prevalence data for our zip codes with the highest percentage of households with kids. This prevalence data seems to be important because the prevalence data also rises when husband wife family household data rises. Which is basically the same as households with kids, it just separates singles from family units. So the fact that prevalence is also high for this statistic could mean that the two are correlated and have something to do with the number of cutoffs in the area.

Our specific groups of zip codes were in less populated areas and higher income levels. Compared to the other groups and their zip codes, the class had recognized the correlation between the number of cutoffs and the income level. In order to offset the number of cutoffs, we came up with a solution to propose. A solution that group 7 believes would help the water cutoff prevalence would be to completely nix cutting the water of households with more than 1 child. There is high prevalence for this demographic and continuing to cut the water won't help. For all families with kids, each kid should come with a negative multiplier for the water bill. What we mean by this is that for each kid a family has, there should be a discount for that family for each child. The discount should be considerable. Then we believe it is a good idea to move water cutoffs to only 45 days of not paying the bill. If kids are the reason that cutoffs could be happening then discounting the bill for every child should help families that need the help, and moving the deadline for cut off to 45 days should have little to no effect. Three months gives families the feeling like they have too much time.

Water Cutoff Solution

Group 8: Alexandra Foster, Nick Deferraris, Christian Roman, Parker Jones

The number of water cutoffs in the Kansas City area has become an issue for many reasons. Some of these include: income levels, family structure, and age group. After researching the problem, we have determined that cutting out the government, and privatizing water services, will reduce the number of cutoffs. Privatizing water services has never been done before because it involves cutting out the government completely. However, if Missouri were to be the first to implement this solution, water-cutoff prevalence would decrease drastically. Per the class research, income level has the greatest impact on the prevalence of water cutoffs in a neighborhood. Low income neighborhoods will benefit the most from third-party water services. A third-party water service would be able to estimate the amount of water each neighborhood uses on a monthly basis and charge a flat rate accordingly. This would save residents of that neighborhood a lot of money as well as allow them to budget for their water bill each month. The unpredictability of the cost of water services each month can be an issue for people who are living on a tight budget, this will solve that problem for many people. Additionally, a third party service would not be required by the state to turn off a household's water if they have not paid on time. They could charge residents late fees, give them ample warnings, and allow leeway if they cannot pay that month.

Introducing a third-party water service will not only save residents money, but it will save the government money as well. The government would not be responsible for the city's water services and would, therefore, be spending less. According to data collected by the Congressional Budget Office,

federal, state and local governments in the United States spent more than \$2.2 trillion in the last 59 years on operations, maintenance and capital infrastructure of water and wastewater utilities. This is a huge amount of money to be spending on water services, and a third party company will eliminate this expense for the government. If the government no longer has this large expense involved with turning on, maintaining and cutting off water services, they can be putting the money towards other things while people are enjoying much cheaper water.

Water Cutoff Solution

Group 9: Kevin Hansen, Grayson Smith, Xavier Boerger, Mae Bradham

Welfare for Water. Water is a vital necessity for a person to survive. The modern day welfare system works well for low income people who are unable to work for one reason or another. This system provides these persons with an allotted amount of basic income per month which they can use to pay for food, clothing, and other basic necessities. While one of these basic necessities is water, quite often families with two or more children that are on welfare cannot afford all of these things and water with the allotted amount of income they receive. We propose that along with the small amount of income help they receive from the government, they should also receive an allotted usage of cheaper water per month, to meet their needs.

Appendix: Titles and Abstracts

The following abstracts and titles correspond to student poster presentations at 17th Annual Symposium of Undergraduate Research & Creative Scholarship (UMKC)

Incidence and Prevalence of Water Cutoffs in Kansas City during 2008-2016: Low Income versus High Income Zip codes

Math 206 EUREKA (Spring 2017) Groups 1, 8 and 9

Group 1: Travis Brown, Fathiya Ibrahim, Monica Jemenez, Kristen South, Blake McClary, and Philip Best

Group 8: Alexandra Foster, Nick Defarraris, Parker Jones,

Group 9: Kevin Hansen, Grayson Smith, Xavier Boerger, Mae Bradham

The present work investigates the potential correlations between water cutoffs and the income levels in Kansas City during 2008-2016. We focused on the high income (median household income greater than \$76k) and the low income (median household income less than \$29k) zip codes. The low income communities have been historically shown to have their water utilities turned off more frequently than the wealthy communities in neighboring areas.

Analysis of the low income zip codes show that the cutoffs seem to fluctuate greatly based on the aid provided in a given year, this suggests that a large percentage of families experiencing cutoffs are willing to pay for the utilities but are coming up short when less aid is available.

Looking at the temporal data, the following zip codes have always been low income with the highest prevalence and incidence of water cutoffs: 64130, 64132, 64127 and 64128.

In the high income zip codes, the prevalence and incidence of water cutoffs is much smaller than those of low income zip codes showing that wealthier communities are better able to purchase the utilities without being dependent on the aid provided in a given year.

There is a critical need for a sustainable mechanism that helps low income families who are struggling to pay their water bills. This increase in importance given that the average water bills have doubled in recent years. There could be a solution where water companies provide cheaper services to families by creating a niche plan that only provides the basic services for low income communities.

In conclusion these findings point out that there is a strong correlation between the household income and the prevalence of water cutoffs.

Analysis of 2008-2016 Kansas City water cutoffs in zip codes with median household income between \$42k to \$55k

Math 206 EUREKA (Spring 2017) Groups 3 and 5

Hunter McDowell, Ricardo Antigueta, Son Doan, Mehak Sood, Deonte Minor, Tom Upman, Jacob Crowder, and James Risalvato

Problem

There is a growing concern about the number of water cutoffs in Kansas City, Missouri. City wide, the number of delinquent residential water cutoffs has increased from 3,341 in the year 2008 to 21,637 incidents in 2016. During that same time period, the average monthly water bills in Kansas City have increased from \$33.20 to \$110.22, which is approximately a 232% increase.

We hope our study will help answer the following questions.

- Is the increase in the water bills the main cause of increased water cutoffs in Kansas City?
- Is there a viable alternative to simply cutting the water off?

Hypothesis

There is a direct relationship between low income households and water cutoffs. Focusing on middle income zip codes, we analyzed the water cutoff data for zip codes: 64137, 64146, 64138, 64131, 64118, 64163, 64117, 64101, and 64116.

Method

We were provided the data from the Kansas City Water Department from 2009 to 2016, broken down by zip code in excel format. Data regarding income, population, and education was collected from <http://www.unitedstateszipcodes.org/> Data was collected and consolidated into a single excel book. Once the data was consolidated, we created scatter graphs that compared cut-offs to the variables. Bar-

graphs and scatter graphs with trend lines illustrated the results. We also used regression lines and polynomials to determine the fluctuations in the incidence and prevalence of water cutoffs.

Results

The key factors that were found to affect cut-offs since 2008 are (1) Income, (2) Location, (3) Population and (4) Education

Identifying factors associated with Kansas City water cutoffs during 2008-2016: comparing middle income with high income zip codes

Math 206 EUREKA (Spring 2017) Groups 2, 4, 6 and 7

Group 2 Names: Rachel Talmadge, Alex Andrews, Rachel Repogle.

Group 4 Names: Mia O'Dirling, Avery Matthews, Fiona Isiavwe, Marcus Johnson, Hannah Belfield.

Group 6 Names: Sally Truong, Holly Kramer, Jocelyn Serrate, Taylor Ray, Chrysteene Smith.

Group 7 Names: Kyle Lininger, Noemi Aguilera, Caleb Wilfong, Natalie Haushalter.

Since 2008, the average water rate bill in Kansas City, Missouri has risen by over 230%. The main objective of this research was to measure the impacts of increased water bills on customers in the city. Specifically, we wanted to find out which zip codes are struggling to pay their water rates and whether the increase in water rates has disproportionately impacted the poorer zip codes in terms of water cutoffs. To that end, we were provided with the data showing the number of cutoffs per zip code for 2008 to 2016. We also had a break down showing the increase in average bills, the population level for each zip code for 2008 through 2016 and the average household income for each zip code for each of those years.

Our research team focused on middle income zip codes at the two ends. Specifically, the median household income of our zip codes was in the intervals of 29k-42k and 55k-76k.

We noted a big spike in cutoffs in the year 2016 with a record high of 21,637 incidents for that year. For us to study the number of cutoffs, we compared different factors that may correlate with the data results, including number of family households, number of occupied households, income, and whether the zip code had predominantly white neighborhoods.

In our findings, we saw that as the income increased, the number of cutoffs decreased. This implies that household income and the number of water cutoffs are inversely correlated. In summary, it can be concluded from the given data that homes with higher median incomes resulted in lower water cutoffs than those with lower median incomes.