Inference

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```r
rm(list = ls())

setwd('/Users/jasonluo/Documents/R_crime_analysis')
library(tidyverse)

# Importing cleaned data
df <- read.csv('RMS_Crime_Incidents_Cleaned.csv')

unique(df$year)
```

```
## [1] 2021 2022 2023 2024
```

χ^2 test

We run a χ^2 test for Homogeneity, testing if there is a difference in the amount of crimes that occur in each zipcode per year

```r
get_num_crimes_by_zip_year <- function(data, yr) {


  print(paste0("Year: ", yr))
  crimes <- data %>%
    select(year, zip_code) %>%
    filter(year == yr) %>%
    group_by(zip_code) %>%
    summarise(num_crimes = n())

  return(crimes)
}



num_crimes_by_zip_year <- list()
years = c(2021,2022,2023)

for (i in seq_along(years)) {
  crimes <- get_num_crimes_by_zip_year(df, years[i])
  num_crimes_by_zip_year[[i]] <- crimes$num_crimes
}
```

```
## [1] "Year: 2021"
## [1] "Year: 2022"
## [1] "Year: 2023"
```

```r
zip_codes <- crimes$zip_code # all 3 years have the same zip codes
contingency_table <- rbind(num_crimes_by_zip_year[[1]], num_crimes_by_zip_year[[2]], num_crimes_by_zip_
dimnames(contingency_table) <- list(Year = years, Zipcode = zip_codes)

contingency_table
```

```
##      Zipcode
## Year   48201 48202 48203 48204 48205 48206 48207 48208 48209 48210 48211 48212
##   2021  1682  1592  1986  2547  4795  1732  2583  1172  1884  1914   475  1267
##   2022  2323  1764  2375  2576  4744  1685  2904  1180  1893  1917   495  1286
##   2023  2895  2119  2630  2997  5264  1912  3199  1242  1987  2048   492  1317
##      Zipcode
## Year   48213 48214 48215 48216 48217 48219 48221 48223 48224 48226 48227 48228
##   2021  2513  1758  1342   664   615  4822  3204  2420  4633  1766  5038  6010
##   2022  2700  1989  1472   771   517  4964  3584  2418  4866  2469  5142  5985
##   2023  2768  2010  1603   835   540  5140  3626  2610  5142  2835  5655  6091
##      Zipcode
## Year   48234 48235 48236 48238 48239 48243
##   2021  3823  4689   262  3315   410    53
##   2022  4092  5031   280  3443   400    50
##   2023  4078  5231   326  3839   408    52
```

Displaying the χ^2 test results

```r
Xsq <- chisq.test(contingency_table)
Xsq
```

```
##
##  Pearson's Chi-squared test
##
## data:  contingency_table
## X-squared = 564.47, df = 58, p-value < 2.2e-16
```

Other related quantities:

```r
Xsq$observed   # observed counts
```

```
##      Zipcode
## Year   48201 48202 48203 48204 48205 48206 48207 48208 48209 48210 48211 48212
##   2021  1682  1592  1986  2547  4795  1732  2583  1172  1884  1914   475  1267
##   2022  2323  1764  2375  2576  4744  1685  2904  1180  1893  1917   495  1286
##   2023  2895  2119  2630  2997  5264  1912  3199  1242  1987  2048   492  1317
##      Zipcode
## Year   48213 48214 48215 48216 48217 48219 48221 48223 48224 48226 48227 48228
##   2021  2513  1758  1342   664   615  4822  3204  2420  4633  1766  5038  6010
##   2022  2700  1989  1472   771   517  4964  3584  2418  4866  2469  5142  5985
##   2023  2768  2010  1603   835   540  5140  3626  2610  5142  2835  5655  6091
##      Zipcode
## Year   48234 48235 48236 48238 48239 48243
##   2021  3823  4689   262  3315   410    53
##   2022  4092  5031   280  3443   400    50
##   2023  4078  5231   326  3839   408    52
```

```r
Xsq$expected   # expected counts under the null
```

```
##      Zipcode
## Year      48201    48202    48203    48204    48205    48206    48207    48208
```

```
##    2021 2155.483 1710.329 2183.910 2536.597 4624.292 1664.720 2713.410 1122.726
##    2022 2287.577 1815.143 2317.747 2692.047 4907.682 1766.739 2879.695 1191.529
##    2023 2456.940 1949.528 2489.343 2891.355 5271.026 1897.541 3092.895 1279.745
##        Zipcode
## Year      48209    48210    48211    48212    48213    48214    48215    48216
##    2021 1800.609 1836.534 456.7125 1208.945 2493.175 1798.423 1379.822 709.1227
##    2022 1910.956 1949.082 484.7012 1283.032 2645.964 1908.635 1464.381 752.5798
##    2023 2052.435 2093.384 520.5863 1378.023 2841.860 2049.942 1572.797 808.2975
##        Zipcode
## Year      48217    48219    48221    48223    48224    48226    48227    48228
##    2021 522.3142 4662.716 3253.217 2326.672 4573.685 2208.589 4946.677 5649.865
##    2022 554.3231 4948.461 3452.584 2469.257 4853.974 2343.938 5249.824 5996.105
##    2023 595.3628 5314.823 3708.199 2652.071 5213.341 2517.473 5638.499 6440.031
##        Zipcode
## Year      48234    48235    48236    48238    48239    48243
##    2021 3746.479 4670.526 271.1535 3310.385 380.4896 48.42027
##    2022 3976.074 4956.749 287.7706 3513.255 403.8071 51.38760
##    2023 4270.446 5323.725 309.0759 3773.361 433.7033 55.19212
```

Xsq$residuals # Pearson residuals

```
##        Zipcode
## Year         48201      48202      48203       48204       48205       48206
##    2021 -10.1984025 -2.861220 -4.234980   0.2065443  2.51033015  1.6489753
##    2022   0.7406181 -1.200409  1.189234  -2.2366302 -2.33648409 -1.9446578
##    2023   8.8376475  3.838244  2.819159   1.9647072 -0.09677166  0.3319316
##        Zipcode
## Year         48207      48208      48209       48210      48211       48212
##    2021 -2.5035239  1.4705682  1.9652042  1.8076375  0.8557224  1.66969631
##    2022  0.4529195 -0.3340052 -0.4107527 -0.7266882  0.4677908  0.08284719
##    2023  1.9078830 -1.0551127 -1.4443560 -0.9919199 -1.2528881 -1.64385364
##        Zipcode
## Year        48213      48214      48215      48216      48217      48219
##    2021  0.3970339 -0.9531879 -1.0181878 -1.6944716  4.055529  2.3326668
##    2022  1.0504813  1.8395217  0.1991005  0.6714581 -1.585243  0.2209019
##    2023 -1.3855087 -0.8821897  0.7615649  0.9392162 -2.268961 -2.3980332
##        Zipcode
## Year        48221      48223      48224      48226      48227      48228
##    2021 -0.8629049  1.9348336  0.8770618 -9.417667  1.2984380  4.7912254
##    2022  2.2365373 -1.0315079  0.1726168  2.583169 -1.4881380 -0.1434072
##    2023 -1.3498407 -0.8169313 -0.9880568  6.328464  0.2197563 -4.3493014
##        Zipcode
## Year        48234      48235      48236       48238      48239      48243
##    2021  1.250162  0.2703242 -0.5558795  0.08021679  1.5128762  0.6581518
##    2022  1.838450  1.0546402 -0.4580688 -1.18527587 -0.1894563 -0.1935694
##    2023 -2.944912 -1.2708397  0.9626608  1.06855996 -1.2342182 -0.4296760
```

Xsq$stdres   # standardized residual

```
##        Zipcode
## Year         48201     48202     48203      48204      48205      48206
##    2021 -12.4898852 -3.492828 -5.187610  0.2536563  3.1310588  2.0123209
##    2022   0.9199243 -1.486233  1.477456 -2.7858516 -2.9556613 -2.4068982
##    2023  11.1845333  4.841875  3.568540  2.4933604 -0.1247279  0.4185879
##        Zipcode
```

```
## Year          48207      48208      48209      48210      48211      48212
##    2021 -3.0785477  1.7876257  2.4005844  2.2086833  1.0352934  2.0309402
##    2022  0.5648675 -0.4117902 -0.5088867 -0.9005372  0.5740023  0.1022042
##    2023  2.4243805 -1.3253945 -1.8232173 -1.2524304 -1.5663822 -2.0662253
##       Zipcode
## Year          48213      48214      48215      48216      48217      48219
##    2021  0.4874412 -1.164343 -1.2399955 -2.0537311  4.908855  2.9103076
##    2022  1.3080199  2.278971  0.2459212  0.8253909 -1.946077  0.2795226
##    2023 -1.7577567 -1.113575  0.9584159  1.1763315 -2.838014 -3.0916924
##       Zipcode
## Year          48221      48223      48224      48226      48227      48228      48234
##    2021 -1.065323  2.372525  1.0935157 -11.538179  1.623452  6.0226839  1.549074
##    2022  2.800438 -1.282836  0.2182777   3.209802 -1.887091 -0.1828294  2.310411
##    2023 -1.722090 -1.035160 -1.2730094   8.012114  0.283932 -5.6496023 -3.770798
##       Zipcode
## Year          48235      48236      48238      48239      48243
##    2021  0.3372847 -0.6716460  0.09907568  1.8293606  0.7939677
##    2022  1.3345890 -0.5613348 -1.48474774 -0.2323467 -0.2368344
##    2023 -1.6385415  1.2019545  1.36381536 -1.5422073 -0.5356397
```

Poisson Regression

Using poisson regression to model number (count) of crime incidents based off of neighborhood, council district, year of occurence, and zip code

```
df_agg <- df %>%
  group_by(zip_code, year, council_district, neighborhood) %>%
  summarise(num_crimes = n())
```

```
## `summarise()` has grouped output by 'zip_code', 'year', 'council_district'. You
## can override using the `.groups` argument.
```

```
model1 <- glm(formula = num_crimes ~ neighborhood + council_district + year + zip_code,
           data = df_agg, family = poisson(link = 'log'))

summary(model1)
```

```
##
## Call:
## glm(formula = num_crimes ~ neighborhood + council_district +
##     year + zip_code, family = poisson(link = "log"), data = df_agg)
##
## Coefficients:
##                                  Estimate Std. Error z value Pr(>|z|)
## (Intercept)                     6.570e+02  1.427e+01  46.041  < 2e-16
## neighborhoodArden Park         -2.126e+00  1.441e-01 -14.751  < 2e-16
## neighborhoodAviation Sub        3.765e-01  4.235e-02   8.890  < 2e-16
## neighborhoodBagley              2.265e+00  2.564e-02  88.321  < 2e-16
## neighborhoodBarton-McFarland    1.357e+00  2.577e-02  52.659  < 2e-16
## neighborhoodBelle Isle         -2.666e+00  2.140e-01 -12.456  < 2e-16
## neighborhoodBelmont             3.249e-01  3.790e-02   8.573  < 2e-16
## neighborhoodBerg-Lahser         8.271e-01  3.894e-02  21.238  < 2e-16
## neighborhoodBethune Community   6.588e-01  2.404e-02  27.404  < 2e-16
## neighborhoodBlackstone Park     5.919e-01  4.632e-02  12.779  < 2e-16
## neighborhoodBoston Edison      -2.013e-01  4.740e-02  -4.248 2.16e-05
## neighborhoodBoynton             1.927e+00  3.045e-02  63.269  < 2e-16
```

```
## neighborhoodBrewster Homes                 -9.311e-01  6.534e-02 -14.250   < 2e-16
## neighborhoodBrightmoor                       1.151e+00  2.437e-02  47.241   < 2e-16
## neighborhoodBrush Park                        1.664e-01  4.124e-02   4.034  5.49e-05
## neighborhoodBuffalo Charles                   1.253e+00  3.391e-02  36.955   < 2e-16
## neighborhoodButler                            1.098e+00  3.882e-02  28.279   < 2e-16
## neighborhoodCadillac Community                1.650e-01  5.222e-02   3.159  0.001582
## neighborhoodCadillac Heights                  3.300e-01  3.639e-02   9.068   < 2e-16
## neighborhoodCampau/Banglatown                 5.031e-01  4.527e-02  11.113   < 2e-16
## neighborhoodCarbon Works                     -1.436e+00  9.374e-02 -15.317   < 2e-16
## neighborhoodCastle Rouge                      5.055e-01  4.468e-02  11.314   < 2e-16
## neighborhoodCentral Southwest                 1.348e+00  2.631e-02  51.229   < 2e-16
## neighborhoodChadsey Condon                    6.840e-01  3.132e-02  21.844   < 2e-16
## neighborhoodChalfonte                         6.764e-01  3.705e-02  18.254   < 2e-16
## neighborhoodChandler Park                     5.091e-01  3.569e-02  14.266   < 2e-16
## neighborhoodChandler Park-Chalmers           -6.423e-01  4.860e-02 -13.216   < 2e-16
## neighborhoodClaytown                          2.014e+00  2.567e-02  78.468   < 2e-16
## neighborhoodCollege Park                      1.399e+00  2.797e-02  50.033   < 2e-16
## neighborhoodConant Gardens                   -4.939e-01  5.360e-02  -9.214   < 2e-16
## neighborhoodConner Creek                      1.098e+00  2.901e-02  37.857   < 2e-16
## neighborhoodConner Creek Industrial          -6.848e-01  4.019e-02 -17.039   < 2e-16
## neighborhoodCore City                         4.042e-01  4.252e-02   9.506   < 2e-16
## neighborhoodCorktown                          4.907e-01  3.352e-02  14.638   < 2e-16
## neighborhoodCornerstone Village               1.911e+00  2.494e-02  76.639   < 2e-16
## neighborhoodCrary/St Marys                    5.744e-01  2.836e-02  20.253   < 2e-16
## neighborhoodCultural Center                  -1.580e-01  4.250e-02  -3.716  0.000202
## neighborhoodDavison                           7.154e-01  3.318e-02  21.559   < 2e-16
## neighborhoodDavison-Schoolcraft               1.075e+00  4.107e-02  26.175   < 2e-16
## neighborhoodDelray                            7.638e-01  4.479e-02  17.053   < 2e-16
## neighborhoodDenby                             1.507e+00  3.311e-02  45.516   < 2e-16
## neighborhoodDetroit Golf                     -1.827e+00  9.182e-02 -19.894   < 2e-16
## neighborhoodDexter-Fenkell                    8.620e-03  4.808e-02   0.179  0.857715
## neighborhoodDexter-Linwood                    1.232e+00  2.427e-02  50.744   < 2e-16
## neighborhoodDouglass                         -2.253e+00  1.701e-01 -13.245   < 2e-16
## neighborhoodDowntown                          1.429e+00  2.242e-02  63.755   < 2e-16
## neighborhoodEast Canfield                    -6.461e-01  7.911e-02  -8.166  3.18e-16
## neighborhoodEast English Village              1.657e+00  3.150e-02  52.603   < 2e-16
## neighborhoodEast Village                      1.111e+00  2.960e-02  37.542   < 2e-16
## neighborhoodEastern Market                    1.007e+00  3.890e-02  25.880   < 2e-16
## neighborhoodEden Gardens                      6.215e-01  3.379e-02  18.393   < 2e-16
## neighborhoodElijah McCoy                     -4.725e-02  4.265e-02  -1.108  0.267947
## neighborhoodEliza Howell                      6.793e-01  4.174e-02  16.275   < 2e-16
## neighborhoodElmwood Park                      2.019e+00  2.790e-02  72.347   < 2e-16
## neighborhoodEvergreen Lahser 7/8              1.786e+00  2.877e-02  62.084   < 2e-16
## neighborhoodEvergreen-Outer Drive             8.372e-01  2.800e-02  29.904   < 2e-16
## neighborhoodFar West Detroit                  1.237e+00  4.358e-02  28.395   < 2e-16
## neighborhoodFarwell                           2.204e+00  2.733e-02  80.629   < 2e-16
## neighborhoodFiskhorn                          1.233e+00  4.170e-02  29.580   < 2e-16
## neighborhoodFitzgerald/Marygrove              1.242e+00  2.599e-02  47.768   < 2e-16
## neighborhoodFive Points                       1.099e+00  3.536e-02  31.088   < 2e-16
## neighborhoodForest Park                       3.976e-01  4.263e-02   9.326   < 2e-16
## neighborhoodFox Creek                         4.804e-01  3.480e-02  13.805   < 2e-16
## neighborhoodFranklin                          8.484e-01  3.066e-02  27.667   < 2e-16
## neighborhoodFranklin Park                     3.102e+00  2.545e-02 121.882   < 2e-16
## neighborhoodGarden Homes                      8.971e-01  3.889e-02  23.070   < 2e-16
```

```
## neighborhoodGarden View                   1.091e+00  4.401e-02  24.789  < 2e-16
## neighborhoodGateway Community           -5.351e-01  4.330e-02 -12.358  < 2e-16
## neighborhoodGold Coast                   2.763e-01  3.988e-02   6.930  4.21e-12
## neighborhoodGrand River-I96              4.194e-01  2.984e-02  14.055  < 2e-16
## neighborhoodGrand River-St Marys         1.044e+00  3.701e-02  28.204  < 2e-16
## neighborhoodGrandmont                   -1.269e-01  4.394e-02  -2.889  0.003864
## neighborhoodGrandmont #1                 1.559e-01  5.161e-02   3.020  0.002526
## neighborhoodGrant                        4.926e-01  3.590e-02  13.721  < 2e-16
## neighborhoodGratiot Town/Ketterring     -4.900e-01  3.786e-02 -12.941  < 2e-16
## neighborhoodGratiot Woods               -2.005e-01  4.258e-02  -4.709  2.49e-06
## neighborhoodGratiot-Findlay              6.191e-01  3.382e-02  18.307  < 2e-16
## neighborhoodGratiot-Grand                1.584e-01  3.589e-02   4.413  1.02e-05
## neighborhoodGreektown                    8.988e-01  3.414e-02  26.329  < 2e-16
## neighborhoodGreen Acres                 -5.399e-01  5.092e-02 -10.603  < 2e-16
## neighborhoodGreenfield                   1.601e+00  2.661e-02  60.175  < 2e-16
## neighborhoodGreenfield Park              4.053e-01  4.580e-02   8.849  < 2e-16
## neighborhoodGreenfield-Grand River       1.073e+00  3.663e-02  29.299  < 2e-16
## neighborhoodGreenwich                    5.635e-01  4.687e-02  12.023  < 2e-16
## neighborhoodGrixdale Farms               1.581e-01  3.790e-02   4.171  3.03e-05
## neighborhoodHappy Homes                  1.593e-01  6.474e-02   2.461  0.013867
## neighborhoodHarmony Village              8.439e-01  3.060e-02  27.583  < 2e-16
## neighborhoodHawthorne Park               4.411e-01  4.512e-02   9.777  < 2e-16
## neighborhoodHenry Ford                   8.741e-04  3.739e-02   0.023  0.981350
## neighborhoodHerman Kiefer               -8.814e-01  6.388e-02 -13.798  < 2e-16
## neighborhoodHistoric Atkinson           -1.640e+00  9.110e-02 -18.000  < 2e-16
## neighborhoodHolcomb Community            1.897e+00  2.797e-02  67.830  < 2e-16
## neighborhoodHubbard Farms               -2.289e-01  5.134e-02  -4.458  8.29e-06
## neighborhoodHubbard Richard             -4.594e-01  7.894e-02  -5.820  5.90e-09
## neighborhoodHubbell-Lyndon               1.631e+00  3.069e-02  53.159  < 2e-16
## neighborhoodHubbell-Puritan              1.123e+00  3.712e-02  30.256  < 2e-16
## neighborhoodIndian Village              -3.452e-01  7.137e-02  -4.837  1.32e-06
## neighborhoodIslandview                   1.189e+00  2.918e-02  40.738  < 2e-16
## neighborhoodJamison                      3.656e-01  5.034e-02   7.262  3.81e-13
## neighborhoodJefferson Chalmers           1.662e+00  3.058e-02  54.333  < 2e-16
## neighborhoodJeffries                    -2.885e-01  5.121e-02  -5.633  1.77e-08
## neighborhoodJoseph Berry Sub            -1.303e+00  1.127e-01 -11.559  < 2e-16
## neighborhoodJoy Community                1.669e+00  2.937e-02  56.831  < 2e-16
## neighborhoodJoy-Schaefer                 9.333e-01  4.681e-02  19.939  < 2e-16
## neighborhoodKrainz Woods                 1.484e+00  3.380e-02  43.915  < 2e-16
## neighborhoodLafayette Park               1.073e+00  3.064e-02  35.005  < 2e-16
## neighborhoodLaSalle College Park         5.076e-01  3.623e-02  14.011  < 2e-16
## neighborhoodLaSalle Gardens             -4.005e-01  5.213e-02  -7.684  1.54e-14
## neighborhoodLittlefield Community        3.242e-01  4.387e-02   7.390  1.47e-13
## neighborhoodMapleridge                   1.150e+00  2.554e-02  45.031  < 2e-16
## neighborhoodMarina District             -2.248e-01  6.750e-02  -3.331  0.000866
## neighborhoodMartin Park                 -1.085e-01  3.739e-02  -2.901  0.003724
## neighborhoodMcDougall-Hunt               6.655e-01  3.573e-02  18.625  < 2e-16
## neighborhoodMcDowell                    -1.036e-02  4.335e-02  -0.239  0.811087
## neighborhoodMcNichols Evergreen          1.550e-01  5.087e-02   3.047  0.002314
## neighborhoodMedbury Park                -1.654e+00  9.808e-02 -16.864  < 2e-16
## neighborhoodMedical Center               6.736e-01  3.388e-02  19.881  < 2e-16
## neighborhoodMelvern Hill                -1.765e+00  1.238e-01 -14.258  < 2e-16
## neighborhoodMexicantown                 -4.478e-01  7.851e-02  -5.703  1.17e-08
## neighborhoodMichigan-Martin              3.806e-01  5.275e-02   7.215  5.41e-13
```

```
## neighborhoodMidtown                        2.323e+00  2.374e-02  97.862   < 2e-16
## neighborhoodMidwest                         8.020e-01  2.544e-02  31.530   < 2e-16
## neighborhoodMiller Grove                   -2.229e-01  4.700e-02   -4.743 2.10e-06
## neighborhoodMilwaukee Junction              2.171e-02  4.357e-02    0.498 0.618331
## neighborhoodMinock Park                    -1.145e+00  6.695e-02  -17.097   < 2e-16
## neighborhoodMohican Regent                  1.275e+00  3.310e-02   38.527   < 2e-16
## neighborhoodMorningside                     1.815e+00  2.465e-02   73.618   < 2e-16
## neighborhoodMoross-Morang                   2.207e+00  2.683e-02   82.289   < 2e-16
## neighborhoodMount Olivet                    9.163e-01  3.540e-02   25.882   < 2e-16
## neighborhoodNardin Park                     3.888e-01  3.089e-02   12.586   < 2e-16
## neighborhoodNew Center                      8.360e-01  4.098e-02   20.402   < 2e-16
## neighborhoodNew Center Commons              9.845e-01  3.870e-02   25.438   < 2e-16
## neighborhoodNolan                           1.704e+00  2.476e-02   68.822   < 2e-16
## neighborhoodNorth Campau                   -2.927e-01  4.653e-02   -6.290 3.17e-10
## neighborhoodNorth Corktown                 -2.186e-01  4.265e-02   -5.125 2.97e-07
## neighborhoodNorth End                       7.210e-01  3.353e-02   21.505   < 2e-16
## neighborhoodNorth LaSalle                   7.826e-01  4.234e-02   18.483   < 2e-16
## neighborhoodNorth Rosedale Park             3.164e-01  3.670e-02    8.620   < 2e-16
## neighborhoodNortheast Central District     -1.967e-01  3.904e-02   -5.038 4.70e-07
## neighborhoodNorthwest Community             2.828e-01  4.684e-02    6.037 1.57e-09
## neighborhoodNortown                         1.856e+00  3.005e-02   61.762   < 2e-16
## neighborhoodNW Goldberg                     2.534e-01  3.787e-02    6.691 2.22e-11
## neighborhoodO'Hair Park                     1.078e+00  2.949e-02   36.558   < 2e-16
## neighborhoodOak Grove                       5.260e-01  3.424e-02   15.365   < 2e-16
## neighborhoodOakman Blvd Community           1.050e+00  2.510e-02   41.834   < 2e-16
## neighborhoodOakwood Heights                -1.028e+00  1.039e-01   -9.893   < 2e-16
## neighborhoodOld Redford                    -7.548e-01  7.638e-02   -9.882   < 2e-16
## neighborhoodOuter Drive-Hayes               1.548e+00  2.368e-02   65.377   < 2e-16
## neighborhoodPalmer Park                     1.006e+00  3.550e-02   28.351   < 2e-16
## neighborhoodPalmer Woods                   -9.573e-01  6.896e-02  -13.883   < 2e-16
## neighborhoodPaveway                         4.883e-01  5.605e-02    8.711   < 2e-16
## neighborhoodPembroke                       -1.560e-01  4.600e-02   -3.392 0.000694
## neighborhoodPenrose                         4.737e-02  5.175e-02    0.915 0.359958
## neighborhoodPershing                        1.173e+00  3.774e-02   31.084   < 2e-16
## neighborhoodPetoskey-Otsego                -3.006e-02  3.690e-02   -0.814 0.415369
## neighborhoodPiety Hill                      5.333e-01  4.629e-02   11.521   < 2e-16
## neighborhoodPilgrim Village                 3.020e-01  3.317e-02    9.105   < 2e-16
## neighborhoodPingree Park                   -4.233e-01  5.390e-02   -7.853 4.08e-15
## neighborhoodPlymouth-Hubbell                1.514e+00  3.054e-02   49.561   < 2e-16
## neighborhoodPlymouth-I96                    1.244e-01  4.286e-02    2.903 0.003694
## neighborhoodPoletown East                  -2.678e-01  4.957e-02   -5.403 6.57e-08
## neighborhoodPride Area Community            1.213e+00  4.185e-02   28.989   < 2e-16
## neighborhoodPulaski                         1.247e+00  2.781e-02   44.838   < 2e-16
## neighborhoodRavendale                       4.220e-01  4.856e-02    8.692   < 2e-16
## neighborhoodRegent Park                     1.366e+00  2.434e-02   56.103   < 2e-16
## neighborhoodRiverbend                       1.817e+00  2.915e-02   62.354   < 2e-16
## neighborhoodRiverdale                       6.095e-01  4.229e-02   14.414   < 2e-16
## neighborhoodRivertown                       1.509e+00  3.252e-02   46.404   < 2e-16
## neighborhoodRosedale Park                   1.012e+00  3.692e-02   27.398   < 2e-16
## neighborhoodRouge Park                     -3.694e-01  6.180e-02   -5.977 2.28e-09
## neighborhoodRussell Industrial             -1.166e+00  8.433e-02  -13.832   < 2e-16
## neighborhoodRussell Woods                  -2.657e-02  3.680e-02   -0.722 0.470363
## neighborhoodSan Bernardo                    6.059e-01  4.606e-02   13.154   < 2e-16
## neighborhoodSchaefer 7/8 Lodge              1.572e+00  3.240e-02   48.523   < 2e-16
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## neighborhoodSchoolcraft Southfield      1.027e+00  2.885e-02  35.601  < 2e-16
## neighborhoodSchulze                      1.544e+00  2.630e-02  58.685  < 2e-16
## neighborhoodSeven Mile Lodge            -3.971e-01  7.147e-02  -5.556 2.76e-08
## neighborhoodSeven Mile-Rouge             9.906e-01  3.672e-02  26.981  < 2e-16
## neighborhoodSherwood                     9.137e-01  4.166e-02  21.932  < 2e-16
## neighborhoodSherwood Forest              1.666e-01  5.240e-02   3.178 0.001481
## neighborhoodSouth of Six                -1.743e-01  5.119e-02  -3.404 0.000663
## neighborhoodSouthfield Plymouth         -1.168e-01  5.629e-02  -2.074 0.038051
## neighborhoodSpringwells                  2.417e+00  2.637e-02  91.649  < 2e-16
## neighborhoodState Fair                   3.871e-01  4.490e-02   8.622  < 2e-16
## neighborhoodTech Town                   -7.374e-01  8.183e-02  -9.011  < 2e-16
## neighborhoodThe Eye                      8.868e-01  3.810e-02  23.272  < 2e-16
## neighborhoodTri-Point                   -6.785e-01  8.149e-02  -8.326  < 2e-16
## neighborhoodUniversity District          9.386e-01  3.828e-02  24.520  < 2e-16
## neighborhoodVirginia Park               -1.405e+00  1.127e-01 -12.466  < 2e-16
## neighborhoodVon Steuben                  5.869e-01  2.924e-02  20.071  < 2e-16
## neighborhoodWade                         1.178e+00  3.590e-02  32.807  < 2e-16
## neighborhoodWarren Ave Community         2.445e+00  2.886e-02  84.728  < 2e-16
## neighborhoodWarrendale                   3.234e+00  2.445e-02 132.250  < 2e-16
## neighborhoodWaterworks Park             -1.727e+00  1.386e-01 -12.455  < 2e-16
## neighborhoodWayne State                 -5.160e-01  3.806e-02 -13.557  < 2e-16
## neighborhoodWe Care Community            9.428e-01  3.614e-02  26.084  < 2e-16
## neighborhoodWeatherby                    1.089e+00  4.019e-02  27.100  < 2e-16
## neighborhoodWest End                     3.184e-01  3.227e-02   9.867  < 2e-16
## neighborhoodWest Outer Drive             6.588e-01  5.482e-02  12.018  < 2e-16
## neighborhoodWest Side Industrial        -4.013e-01  4.729e-02  -8.487  < 2e-16
## neighborhoodWest Village                 5.175e-01  4.852e-02  10.665  < 2e-16
## neighborhoodWest Virginia Park          -2.132e+00  1.155e-01 -18.455  < 2e-16
## neighborhoodWestwood Park                1.422e-01  5.192e-02   2.739 0.006153
## neighborhoodWildemere Park              -3.104e-01  5.014e-02  -6.191 5.99e-10
## neighborhoodWinship                      1.383e+00  2.808e-02  49.239  < 2e-16
## neighborhoodWoodbridge                   6.694e-02  4.169e-02   1.606 0.108322
## neighborhoodYorkshire Woods              1.947e+00  2.882e-02  67.549  < 2e-16
## council_district                        -7.887e-02  2.852e-03 -27.650  < 2e-16
## year                                    -1.182e-01  1.748e-03 -67.619  < 2e-16
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## neighborhoodSchaefer 7/8 Lodge                   ***
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## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for poisson family taken to be 1)
##
##     Null deviance: 375683  on 1561  degrees of freedom
## Residual deviance: 186590  on 1352  degrees of freedom
## AIC: 196264
##
## Number of Fisher Scoring iterations: 6
```

```r
model2 <- glm(formula = num_crimes ~ council_district + year + zip_code,
              data = df_agg, family = poisson(link = 'log'))

summary(model2)
```

```
##
## Call:
## glm(formula = num_crimes ~ council_district + year + zip_code,
##     family = poisson(link = "log"), data = df_agg)
##
## Coefficients:
##                  Estimate Std. Error z value Pr(>|z|)
## (Intercept)    -3.620e+02  8.704e+00  -41.59   <2e-16 ***
```

```
## council_district -2.166e-02  1.007e-03  -21.52   <2e-16 ***
## year              -1.067e-01  1.739e-03  -61.37   <2e-16 ***
## zip_code           1.209e-02  1.652e-04   73.19   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for poisson family taken to be 1)
##
##     Null deviance: 375683  on 1561  degrees of freedom
## Residual deviance: 365021  on 1558  degrees of freedom
## AIC: 374283
##
## Number of Fisher Scoring iterations: 6
```

We see that comparing models, model 1 has a AIC of 1.9626361×10^5 vs model 2 which has 3.7428271×10^5. The model with the smaller AIC considered better performing in terms of complexity and performance