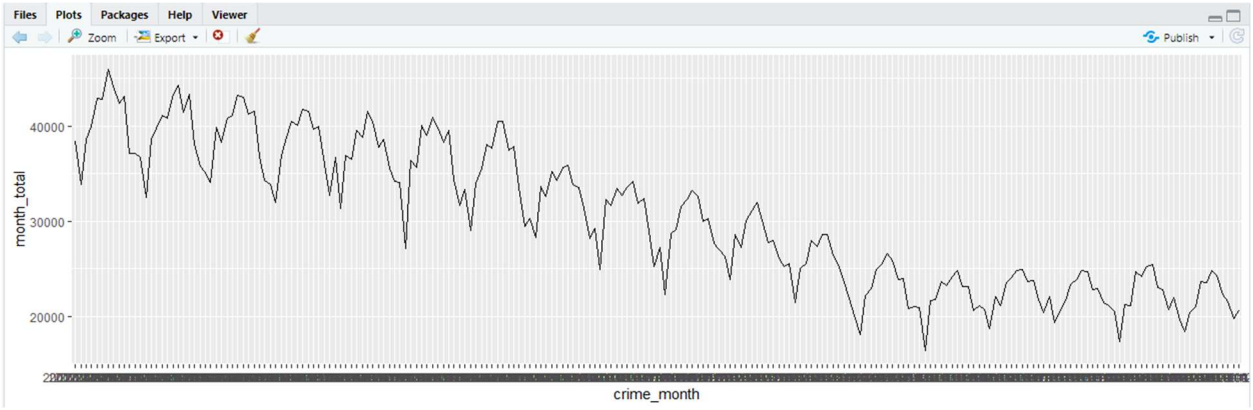
ECON 613 Assignment 3 – Emma Shin, 26 April 2021

Exercise 2:

Plot:



Merged dataset:

Filter

	crime_month	district	crime_type	crime_count
1	2002-01-01	1	drug	104
2	2002-01-01	1	other	271
3	2002-01-01	1	property	859
4	2002-01-01	1	violent	242
5	2002-01-01	2	drug	161
6	2002-01-01	2	other	270
7	2002-01-01	2	property	642
8	2002-01-01	2	violent	537
9	2002-01-01	3	drug	219
10	2002-01-01	3	other	305
11	2002-01-01	3	property	711
12	2002-01-01	3	violent	673
13	2002-01-01	4	drug	150
14	2002-01-01	4	other	327
15	2002-01-01	4	property	893
16	2002-01-01	4	violent	674
17	2002-01-01	5	drug	197
18	2002-01-01	5	other	272
19	2002-01-01	5	property	590
20	2002-01-01	5	violent	605
21	2002-01-01	6	drug	132

Panel data:

	crime_month	district	period	tot_pop	tot_white	tot_black	tot_hisp	p50_inc	drug	other	property	violent	total	totalpr	violentpr	propertypr	share_white	share_b
2150	2009-02-01	25	1	199152	29288	32850	132050	40940.78	182	276	833	505	1796	0.009018237	0.0025357516	0.004182735	0.147063549	
2151	2009-03-01	1	1	38472	22608	4953	2543	91084.91	66	229	612	183	1090	0.028332294	0.0047567062	0.015907673	0.587648160	
2152	2009-03-01	2	1	37992	630	35966	628	29890.17	88	235	468	319	1110	0.029216677	0.0083965045	0.012318383	0.016582438	
2153	2009-03-01	3	1	78629	3217	71792	1371	28047.56	148	322	703	590	1763	0.022421753	0.0075035928	0.008940722	0.040913658	
2154	2009-03-01	4	1	124519	9926	77314	35387	39010.22	262	336	763	674	2035	0.016342887	0.0054128286	0.006127579	0.079714742	
2155	2009-03-01	5	1	74384	843	70053	2524	33146.90	183	207	561	543	1494	0.020084965	0.0072999570	0.007541945	0.011333082	
2156	2009-03-01	6	1	89570	309	87288	906	34672.25	275	319	753	672	2019	0.022541029	0.0075025120	0.008406833	0.003449816	
2157	2009-03-01	7	1	71616	265	69321	1172	23960.59	255	274	685	710	1924	0.026865505	0.0099139857	0.009564902	0.003700290	
2158	2009-03-01	8	1	247373	51491	52219	139854	49069.15	219	341	1180	685	2425	0.009803010	0.0027690977	0.004770124	0.208151253	
2159	2009-03-01	9	1	154400	23416	18775	94313	36323.73	194	224	695	403	1516	0.009818653	0.0026101036	0.004501295	0.151658031	
2160	2009-03-01	10	1	117209	4204	39545	72559	29147.49	231	237	471	495	1434	0.012234555	0.0042232252	0.004018463	0.035867553	
2161	2009-03-01	11	1	72356	1794	61028	8493	26337.89	453	329	587	697	2066	0.028553264	0.0096329261	0.008112665	0.024794074	
2162	2009-03-01	12	1	67385	20983	11737	27796	52560.59	82	152	622	279	1135	0.016843511	0.0041403873	0.009230541	0.311389775	
2163	2009-03-01	13	1	56938	29374	10470	14123	61949.53	19	60	180	126	385	0.006761741	0.0022129334	0.003161333	0.515894482	
2164	2009-03-01	14	1	120999	50502	8740	55765	61849.46	61	141	777	313	1292	0.010677774	0.0025867982	0.006421541	0.417375350	
2165	2009-03-01	15	1	57816	943	53971	2142	27940.01	423	283	430	499	1635	0.028279369	0.0086306288	0.007437388	0.016310364	
2166	2009-03-01	16	1	200465	137950	2028	46478	64130.01	60	184	663	257	1164	0.005806500	0.0012820193	0.003307311	0.688150051	
2167	2009-03-01	17	1	144451	55798	4803	62490	55060.06	72	126	636	235	1069	0.007400433	0.0016268492	0.004402877	0.386276315	
2168	2009-03-01	18	1	114472	86195	10623	5698	87939.24	55	215	802	243	1315	0.011487525	0.0021227899	0.007006080	0.752978894	
2169	2009-03-01	19	1	106218	84719	2671	11360	93097.57	45	157	808	211	1221	0.011495227	0.0019864806	0.007606997	0.797595511	

Exercise 3:

OLS model:

```
Call:
lm(formula = arrest ~ tenure + total + p50_inc + share_white +
    share_black + share_hisp, data = off_crime)

Residuals:
    Min      1Q  Median      3Q     Max
-0.5017 -0.4993 -0.4981  0.5008  5.5025

Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept)  5.067e-01  1.278e-02  39.644   <2e-16 ***
tenure      -4.161e-06  8.354e-06  -0.498    0.618
total        2.229e-07  1.805e-06   0.124    0.902
p50_inc      1.618e-08  9.186e-08   0.176    0.860
share_white -1.207e-02  1.632e-02  -0.740    0.460
share_black -8.102e-03  1.340e-02  -0.604    0.546
share_hisp  -5.363e-03  1.391e-02  -0.385    0.700
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.7068 on 1077898 degrees of freedom
  (31 observations deleted due to missingness)
Multiple R-squared:  2.032e-06, Adjusted R-squared:  -3.535e-06
F-statistic: 0.365 on 6 and 1077898 DF,  p-value: 0.9014
```

Exercise 4:

Fixed effects model:

```
Call:
lm(formula = arrest ~ . - NUID, data = off_crime1)

Residuals:
    Min      1Q  Median      3Q     Max
-0.5188 -0.4996 -0.4956  0.5009  5.5106

Coefficients: (3 not defined because of singularities)
              Estimate Std. Error t value Pr(>|t|)
(Intercept)  6.382e-01  1.630e-01   3.916 9.01e-05 ***
tenure      -3.921e-06  8.523e-06  -0.460  0.64551
total       -5.452e-06  5.064e-06  -1.077  0.28158
p50_inc     -4.490e-07  6.481e-07  -0.693  0.48844
share_white -9.871e-02  1.816e-01  -0.544  0.58665
share_black -8.625e-02  1.039e-01  -0.830  0.40660
share_hisp  -1.281e-01  2.021e-01  -0.634  0.52621
unit_1      -1.756e-02  7.514e-02  -0.234  0.81522
unit_2      -4.174e-02  8.005e-02  -0.521  0.60208
unit_3      -3.777e-02  7.882e-02  -0.479  0.63180
unit_4      -1.996e-02  4.739e-02  -0.421  0.67361
unit_5      -3.391e-02  7.907e-02  -0.429  0.66807
unit_6      -3.226e-02  8.250e-02  -0.391  0.69580
unit_7      -3.909e-02  7.869e-02  -0.497  0.61936
unit_8       1.535e-03  1.103e-02   0.139  0.88926
unit_9      -1.741e-02  1.701e-02  -1.023  0.30609
unit_10     -1.368e-02  9.684e-03  -1.413  0.15763
unit_11     -3.011e-02  6.638e-02  -0.454  0.65015
unit_12     -1.896e-02  3.233e-02  -0.586  0.55762
unit_13     -2.090e-02  4.230e-02  -0.494  0.62117
unit_14      4.204e-03  2.095e-02   0.201  0.84097
unit_15     -3.815e-02  7.696e-02  -0.496  0.62008
unit_16     -1.056e-02  4.194e-02  -0.252  0.80118
unit_17     -1.797e-02  2.927e-02  -0.614  0.53920
unit_18     -1.357e-02  6.184e-02  -0.219  0.82636
unit_19     -8.832e-03  5.414e-02  -0.163  0.87041
unit_20     -3.198e-02  5.310e-02  -0.602  0.54703
unit_21     -5.243e-02  8.778e-02  -0.597  0.55032
```

```
unit_22      -1.873e-02  7.028e-02  -0.267  0.78984
unit_23      -2.669e-02  5.807e-02  -0.460  0.64585
unit_24      -3.239e-02  5.272e-02  -0.614  0.53899
unit_25              NA         NA      NA       NA
month_01     -3.731e-05  3.351e-03  -0.011  0.99112
month_02      2.187e-03  3.364e-03   0.650  0.51557
month_03      1.112e-03  3.409e-03   0.326  0.74421
month_04      4.968e-03  3.405e-03   1.459  0.14451
month_05      9.644e-03  3.556e-03   2.712  0.00669 **
month_06      2.000e-03  3.548e-03   0.564  0.57294
month_07      4.521e-03  3.657e-03   1.236  0.21632
month_08      1.698e-03  3.632e-03   0.467  0.64017
month_09      4.829e-03  3.462e-03   1.395  0.16308
month_10      2.602e-03  3.470e-03   0.750  0.45347
month_11      1.958e-04  3.345e-03   0.059  0.95332
month_12             NA         NA      NA       NA
year_2007     3.675e-03  4.647e-03   0.791  0.42898
year_2008     5.738e-03  4.509e-03   1.273  0.20319
year_2009     1.054e-03  4.114e-03   0.256  0.79788
year_2010     2.823e-03  3.920e-03   0.720  0.47151
year_2011     2.881e-03  3.772e-03   0.764  0.44504
year_2012     2.520e-03  3.559e-03   0.708  0.47899
year_2013     5.963e-03  3.363e-03   1.773  0.07617 .
year_2014     5.840e-04  3.262e-03   0.179  0.85793
year_2015     5.198e-04  3.261e-03   0.159  0.87335
year_2016    -5.036e-04  3.263e-03  -0.154  0.87733
year_2017            NA         NA      NA       NA
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.7068 on 1077853 degrees of freedom
  (31 observations deleted due to missingness)
Multiple R-squared:  3.415e-05, Adjusted R-squared:  -1.316e-05
F-statistic: 0.7218 on 51 and 1077853 DF,  p-value: 0.9324
```

Exercise 5:

Between estimator:

```
Call:
lm(formula = m_arrest ~ m_tenure + m_total + m_p50_inc + m_s_white +
    m_s_black + m_s_hisp, data = off_crime2)

Residuals:
     Min       1Q   Median       3Q      Max
-0.50945 -0.06213 -0.00365  0.05342  2.49864

Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept)  4.676e-01  2.687e-02  17.399   <2e-16 ***
m_tenure     1.211e-05  1.440e-05   0.841   0.4003
m_total     -7.854e-06  4.428e-06  -1.774   0.0761 .
m_p50_inc    1.421e-07  1.902e-07   0.747   0.4550
m_s_white    2.151e-02  3.350e-02   0.642   0.5209
m_s_black    3.979e-02  2.839e-02   1.402   0.1611
m_s_hisp     4.836e-02  2.942e-02   1.644   0.1003
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.1467 on 13015 degrees of freedom
  (7 observations deleted due to missingness)
Multiple R-squared:  0.0005283, Adjusted R-squared:  6.758e-05
F-statistic: 1.147 on 6 and 13015 DF,  p-value: 0.3322
```

Within estimator:

```
Call:
lm(formula = dm_arrest ~ dm_tenure + dm_total + dm_p50_inc +
    dm_s_white + dm_s_black + dm_s_hisp, data = off_crime3)

Residuals:
    Min      1Q  Median      3Q     Max
-1.7500 -0.5074 -0.4283  0.4929  5.5116

Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept) -1.131e-15  6.768e-04   0.000    1.000
dm_tenure    2.554e-05  2.395e-05   1.067    0.286
dm_total     3.522e-06  2.875e-06   1.225    0.220
dm_p50_inc  -2.858e-07  2.428e-07  -1.177    0.239
dm_s_white  -3.408e-02  4.203e-02  -0.811    0.417
dm_s_black  -4.796e-02  3.182e-02  -1.507    0.132
dm_s_hisp   -5.417e-02  3.391e-02  -1.597    0.110

Residual standard error: 0.7025 on 1077278 degrees of freedom
  (651 observations deleted due to missingness)
Multiple R-squared:  4.627e-06, Adjusted R-squared:  -9.424e-07
F-statistic: 0.8308 on 6 and 1077278 DF,  p-value: 0.5458
```

First difference estimator:

```
Call:
lm(formula = fd_arrest ~ fd_tenure + fd_total + fd_p50_inc +
    fd_white + fd_black + fd_hisp, data = off_crime4)

Residuals:
    Min      1Q  Median      3Q     Max
-6.0005 -0.9992  0.0000  0.9994  6.0005

Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept) -5.409e-04  1.191e-03  -0.454    0.650
fd_tenure    4.839e-04  6.714e-04   0.721    0.471
fd_total    -2.730e-06  6.923e-06  -0.394    0.693
fd_p50_inc   1.129e-07  1.163e-06   0.097    0.923
fd_white    -1.115e-01  2.155e-01  -0.517    0.605
fd_black    -9.099e-02  1.590e-01  -0.572    0.567
fd_hisp     -1.095e-01  1.688e-01  -0.649    0.517

Residual standard error: 0.9995 on 1064865 degrees of freedom
  (13064 observations deleted due to missingness)
Multiple R-squared:  1.256e-06, Adjusted R-squared:  -4.379e-06
F-statistic: 0.2229 on 6 and 1064865 DF,  p-value: 0.9696
```

GMM (note that I wrote code for a model that includes fixed effects but am presenting results for a model without fixed effects because the large amount of data with the fixed effects was difficult to process):

```
initial  value 123943856788909712.000000
iter   2 value 21846372876971812.000000
iter   3 value 21841254926162424.000000
iter   3 value 21841254926162424.000000
iter   4 value 3849708235384732.500000
iter   5 value 3848846157086389.500000
iter   5 value 3848846157086389.500000
iter   6 value 678388482152478.000000
iter   7 value 678243256760593.250000
iter   8 value 678220879217930.875000
iter   9 value 184713791118232.656250
iter  10 value 182105305449524.437500
iter  11 value 177713713171842.656250
iter  11 value 177713713171842.656250
iter  12 value 34016815676337.671875
iter  13 value 31390721184245.531250
iter  14 value 31388900528807.628906
iter  15 value 4510286983602.906250
iter  16 value 4452896903037.026367
iter  17 value 4421142016813.948242
iter  17 value 4421142016813.948242
iter  18 value 1241582051329.170898
iter  19 value 797972173327.803589
iter  20 value 797808459544.605469
iter  20 value 797808459544.605469
iter  21 value 237499124831.563782
iter  22 value 162779565149.939301
iter  23 value 162766084002.947174
iter  24 value 48075906836.673866
iter  25 value 47800295942.471695
iter  26 value 24385062563.369877
iter  27 value 20987852449.270672
iter  28 value 7070140598.840301
iter  29 value 2066483880.683900
iter  30 value 2049929675.222795
iter  31 value 1949221707.530820
iter  31 value 1949221707.530820
```

```
iter  32 value 1944873124.471317
iter  33 value 1937516081.793834
iter  34 value 1883862672.046693
iter  34 value 1883862672.046693
iter  35 value 1882293219.143320
iter  36 value 1880989239.428624
iter  37 value 1877510083.173027
iter  37 value 1877510083.173027
iter  38 value 1877220519.847978
iter  39 value 1877000759.226971
iter  40 value 1876813494.689661
iter  40 value 1876813494.689661
iter  41 value 1876761027.194197
iter  42 value 1876726398.708799
iter  43 value 1876714219.220683
iter  44 value 1876713971.342478
iter  45 value 1876712292.060971
iter  45 value 1876712292.060971
iter  46 value 1876695534.699741
iter  47 value 1876685766.484189
iter  48 value 1876684672.528830
iter  49 value 1876019487.221724
iter  50 value 1875881866.839263
iter  50 value 1875881866.839263
iter  51 value 1874768882.889224
iter  52 value 1874767333.081393
iter  53 value 1874763727.182580
iter  54 value 1874565323.305976
iter  55 value 1874565089.156189
iter  56 value 1874563792.702301
iter  56 value 1874563792.696649
iter  57 value 1874533811.889458
iter  58 value 1874533779.771443
iter  59 value 1874528557.621185
iter  60 value 1874528387.884350
iter  61 value 1874527557.383259
iter  61 value 1874527548.451146

iter  62 value 1874527407.280578
iter  62 value 1874527407.213745
iter  62 value 1874527385.012675
final  value 1874527385.012675
converged
> res$par
[1]  1.431409e-04  1.127218e-04  2.429291e-05 -8.608327e+00 -5.938011e+00 -5.467557e+00  5.318526e+00
```