Week 4 Exploratory Lab

February 1, 2021

Exploring COVID Case Data and County GEOJSON Data

In this file I'm going to do a little more exploring of my datasets and try and get a better sense of how I want to vistually portray all my different data sources.

First thing to do is load the libraries...

0.0.1 Load Libraries

I think I'm going to load pandas, geopandas, matplot.lib, osmnx, and contextily, which is all the libraries we've worked with so far, but I want to have some flexibility in how I conduct my analysis moving forward, so I want to have all the tools we've learned thus far in the class - mapping, data visualization, creating isochrones if needed, etc.

[1]:
```
import pandas as pd
import geopandas as gpd
import matplotlib.pyplot as plt
import osmnx as ox
import contextily as ctx
```

Now that my libraries are loaded, I'm going to upload my 3 data sets: water debt, shapefile of CA counties, and COVID cases by county.

0.0.2 Upload Data Sets

Now, I will read each of my datasets: COVID data, county boundaries, and water debt.

[70]:
```
countycovid = pd.read_csv('Data/us_county_confirmed_cases.csv')

countyshape = gpd.read_file('Data/
 ↪united_states_california_administrative_boundaries_level6_counties_polygon.
 ↪geojson')

low_memory=False
```

After a bit of trouble trying to get the shape file uploaded, my 3 datasets have been added! In addition, I spent a good portion of time trying to find a shapefile that also had county names (and not just the geometry) because I needed a way to match the county names with the polygons themselves. I do not love this shapefile (for reasons described below), but its the closest thing I could find to what I need, so it is a temporary fix.

0.1 Explore & Clean COVID Data

Before I try and map the COVID data, I am going to get a sense of what it looks like using .head

```
[3]: countycovid.head()
```

```
[3]:    COUNTY             NAME      County Name State  stateFIPS  POP70  HHD70  \
     0    1001  Autauga County  Autauga County    AL          1  24457   6792
     1    1003  Baldwin County  Baldwin County    AL          1  59132  17641
     2    1005  Barbour County  Barbour County    AL          1  22484   6796
     3    1007     Bibb County     Bibb County    AL          1  13812   4015
     4    1009   Blount County   Blount County    AL          1  26844   8431

        POP80  HHD80  POP90  …  1/8/21  1/9/21  1/10/21  1/11/21  1/12/21  \
     0  32266  10199  34236  …    4770    4847     4879     4902     4970
     1  78213  26641  98277  …   15052   15202    15327    15417    15572
     2  24685   8352  25418  …    1634    1648     1658     1663     1679
     3  15680   5153  16589  …    2015    2038     2051     2060     2090
     4  36456  12679  39247  …    5018    5047     5066     5080     5134

        1/13/21  1/14/21  1/15/21  1/16/21  1/17/21
     0     4998     5075     5103     5154     5184
     1    15701    15841    16002    16176    16251
     2     1685     1696     1712     1723     1729
     3     2109     2113     2130     2144     2151
     4     5170     5219     5264     5292     5304

     [5 rows x 377 columns]
```

Before I move on, I want to override the display settings so I can see all of the columns

```
[4]: pd.set_option('display.max_columns', None)
     countycovid.head()
```

```
[4]:    COUNTY             NAME      County Name State  stateFIPS  POP70  HHD70  \
     0    1001  Autauga County  Autauga County    AL          1  24457   6792
     1    1003  Baldwin County  Baldwin County    AL          1  59132  17641
     2    1005  Barbour County  Barbour County    AL          1  22484   6796
     3    1007     Bibb County     Bibb County    AL          1  13812   4015
     4    1009   Blount County   Blount County    AL          1  26844   8431

        POP80  HHD80  POP90  HHD90   POP00  HHD00   POP10  HHD10  1/22/20  1/23/20  \
     0  32266  10199  34236  11830   43685  16007   54571  20221        0        0
     1  78213  26641  98277  37041  140406  55330  182265  73180        0        0
     2  24685   8352  25418   9217   29037  10409   27457   9820        0        0
     3  15680   5153  16589   5750   20827   7421   22915   7953        0        0
     4  36456  12679  39247  14644   51020  19264   57322  21578        0        0
```

```
   1/24/20  1/25/20  1/26/20  1/27/20  1/28/20  1/29/20  1/30/20  1/31/20  \
0        0        0        0        0        0        0        0        0   
1        0        0        0        0        0        0        0        0   
2        0        0        0        0        0        0        0        0   
3        0        0        0        0        0        0        0        0   
4        0        0        0        0        0        0        0        0   

   2/1/20  2/2/20  2/3/20  2/4/20  2/5/20  2/6/20  2/7/20  2/8/20  2/9/20  \
0       0       0       0       0       0       0       0       0       0   
1       0       0       0       0       0       0       0       0       0   
2       0       0       0       0       0       0       0       0       0   
3       0       0       0       0       0       0       0       0       0   
4       0       0       0       0       0       0       0       0       0   

   2/10/20  2/11/20  2/12/20  2/13/20  2/14/20  2/15/20  2/16/20  2/17/20  \
0        0        0        0        0        0        0        0        0   
1        0        0        0        0        0        0        0        0   
2        0        0        0        0        0        0        0        0   
3        0        0        0        0        0        0        0        0   
4        0        0        0        0        0        0        0        0   

   2/18/20  2/19/20  2/20/20  2/21/20  2/22/20  2/23/20  2/24/20  2/25/20  \
0        0        0        0        0        0        0        0        0   
1        0        0        0        0        0        0        0        0   
2        0        0        0        0        0        0        0        0   
3        0        0        0        0        0        0        0        0   
4        0        0        0        0        0        0        0        0   

   2/26/20  2/27/20  2/28/20  2/29/20  3/1/20  3/2/20  3/3/20  3/4/20  3/5/20  \
0        0        0        0        0       0       0       0       0       0   
1        0        0        0        0       0       0       0       0       0   
2        0        0        0        0       0       0       0       0       0   
3        0        0        0        0       0       0       0       0       0   
4        0        0        0        0       0       0       0       0       0   

   3/6/20  3/7/20  3/8/20  3/9/20  3/10/20  3/11/20  3/12/20  3/13/20  \
0       0       0       0       0        0        0        0        0   
1       0       0       0       0        0        0        0        0   
2       0       0       0       0        0        0        0        0   
3       0       0       0       0        0        0        0        0   
4       0       0       0       0        0        0        0        0   

   3/14/20  3/15/20  3/16/20  3/17/20  3/18/20  3/19/20  3/20/20  3/21/20  \
0        0        0        0        0        0        0        0        0   
1        1        1        1        1        1        1        2        2   
2        0        0        0        0        0        0        0        0   
3        0        0        0        0        0        0        0        0   
```

```
4        0        0        0        0        0        0        0        0

   3/22/20  3/23/20  3/24/20  3/25/20  3/26/20  3/27/20  3/28/20  3/29/20  \
0        0        0        1        4        6        6        6        6
1        3        3        4        4        5        5       10       15
2        0        0        0        0        0        0        0        0
3        0        0        0        0        0        0        0        0
4        0        0        0        1        2        5        5        5

   3/30/20  3/31/20  4/1/20  4/2/20  4/3/20  4/4/20  4/5/20  4/6/20  4/7/20  \
0        7        7      10      10      12      12      12      12      12
1       18       19      23      25      28      29      34      38      42
2        0        0       0       0       1       2       2       3       3
3        2        3       3       4       4       4       7       7       8
4        5        5       5       6       9      10      10      10      10

   4/8/20  4/9/20  4/10/20  4/11/20  4/12/20  4/13/20  4/14/20  4/15/20  \
0      12      17       17       19       19       19       23       25
1      49      59       59       66       71       78       87       98
2       3       7        9       10       10       10       11       13
3       9      11       11       13       16       17       17       19
4      10      11       12       12       13       15       16       17

   4/16/20  4/17/20  4/18/20  4/19/20  4/20/20  4/21/20  4/22/20  4/23/20  \
0       25       25       25       27       28       30       32       33
1      102      103      109      114      117      123      132      143
2       14       15       18       20       22       28       29       30
3       23       23       26       28       32       32       33       33
4       18       20       20       21       22       26       29       31

   4/24/20  4/25/20  4/26/20  4/27/20  4/28/20  4/29/20  4/30/20  5/1/20  \
0       36       37       37       39       40       42       42      42
1      147      154      161      168      171      173      174     175
2       32       33       33       35       37       37       39      42
3       34       35       38       42       42       42       42      42
4       31       31       34       34       34       36       37      39

   5/2/20  5/3/20  5/4/20  5/5/20  5/6/20  5/7/20  5/8/20  5/9/20  5/10/20  \
0      45      48      53      53      58      61      67      68       74
1     181     187     188     189     196     205     208     216      222
2      43      45      45      47      47      51      53      58       59
3      42      42      42      43      43      44      44      45       46
4      40      40      40      40      42      44      44      44       44

   5/11/20  5/12/20  5/13/20  5/14/20  5/15/20  5/16/20  5/17/20  5/18/20  \
0       84       91       93      103      103      110      110      120
1      224      227      231      243      244      254      254      260
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2       61       67       69       74       79       79       81       85
3       46       46       46       46       49       50       50       50
4       45       45       45       45       45       45       46       47

   5/19/20  5/20/20  5/21/20  5/22/20  5/23/20  5/24/20  5/25/20  5/26/20  \
0      127      136      147      149      155      159      173      189
1      262      270      270      271      273      274      276      277
2       90       96      100      104      105      110      116      122
3       51       52       52       55       58       59       62       66
4       47       47       48       49       49       49       49       51

   5/27/20  5/28/20  5/29/20  5/30/20  5/31/20  6/1/20  6/2/20  6/3/20  \
0      192      205      212      216      220     233     238     239
1      281      281      282      283      288     292     292     292
2      130      132      147      150      164     172     175     177
3       71       71       71       72       75      76      76      76
4       53       58       60       61       62      63      63      63

   6/4/20  6/5/20  6/6/20  6/7/20  6/8/20  6/9/20  6/10/20  6/11/20  6/12/20  \
0     241     248     259     265     272     282      295      312      323
1     293     296     304     313     320     325      331      343      353
2     177     183     190     193     197     199      208      214      221
3      76      76      77      77      79      85       89       93       97
4      63      64      70      72      73      75       79       87       95

   6/13/20  6/14/20  6/15/20  6/16/20  6/17/20  6/18/20  6/19/20  6/20/20  \
0      331      357      368      373      375      400      411      431
1      361      364      383      389      392      401      413      420
2      226      234      238      245      251      263      266      272
3      100      104      111      116      118      121      126      126
4      102      110      116      121      123      130      139      143

   6/21/20  6/22/20  6/23/20  6/24/20  6/25/20  6/26/20  6/27/20  6/28/20  \
0      434      442      453      469      479      488      498      503
1      430      437      450      464      477      515      555      575
2      272      277      280      288      305      312      317      317
3      127      129      135      141      149      153      161      162
4      149      153      159      168      176      184      188      189

   6/29/20  6/30/20  7/1/20  7/2/20  7/3/20  7/4/20  7/5/20  7/6/20  7/7/20  \
0      527      537     553     561     568     591     615     618     644
1      643      680     703     751     845     863     881     911     997
2      322      325     326     335     348     350     352     356     360
3      165      170     174     179     189     190     193     197     199
4      199      208     218     222     230     234     239     247     255

   7/8/20  7/9/20  7/10/20  7/11/20  7/12/20  7/13/20  7/14/20  7/15/20  \
0     651     661      670      684      706      728      746      756
1    1056    1131     1187     1224     1294     1359     1414     1518
2     366     371      381      398      403      413      428      441
3     201     211      218      224      228      231      236      242
4     262     282      292      307      331      350      366      389

   7/16/20  7/17/20  7/18/20  7/19/20  7/20/20  7/21/20  7/22/20  7/23/20  \
0      780      789      827      842      857      865      886      905
1     1599     1689     1819     1937     2013     2102     2196     2461
2      459      463      483      495      503      514      518      534
3      247      255      264      269      279      283      287      289
4      424      440      458      482      507      524      547      585

   7/24/20  7/25/20  7/26/20  7/27/20  7/28/20  7/29/20  7/30/20  7/31/20  \
0      921      932      942      965      974      974     1002     1015
1     2513     2662     2708     2770     2835     2835     3028     3101
2      539      552      562      569      575      575      585      598
3      303      318      324      334      337      338      352      363
4      615      637      646      669      675      675      731      767

   8/1/20  8/2/20  8/3/20  8/4/20  8/5/20  8/6/20  8/7/20  8/8/20  8/9/20  \
0    1030    1052    1066    1073    1073    1096    1113    1134    1215
1    3142    3223    3265    3320    3380    3438    3504    3564    3606
2     602     610     612     614     615     619     624     628     630
3     368     372     382     389     392     421     424     434     446
4     792     813     830     836     839     874     909     923     934

   8/10/20  8/11/20  8/12/20  8/13/20  8/14/20  8/15/20  8/16/20  8/17/20  \
0     1215     1215     1241     1250     1252     1262     1273     1274
1     3714     3736     3776     3813     3860     3909     3948     3960
2      631      643      646      651      656      663      671      672
3      450      455      464      469      477      483      483      488
4      947      958      967      977      989      996     1005     1008

   8/18/20  8/19/20  8/20/20  8/21/20  8/22/20  8/23/20  8/24/20  8/25/20  \
0     1291     1293     1293     1293     1322     1324     1351     1355
1     3977     4002     4035     4054     4115     4147     4167     4190
2      674      683      690      690      699      702      720      724
3      490      503      507      509      516      523      526      527
4     1034     1049     1077     1083     1096     1099     1135     1160

   8/26/20  8/27/20  8/28/20  8/29/20  8/30/20  8/31/20  9/1/20  9/2/20  \
0     1366     1377     1389     1400     1438     1442    1452    1452
1     4265     4311     4347     4424     4525     4545    4568    4583
2      732      739      745      753      757      757     764     768
3      530      533      535      540      550      554     558     562
4     1195     1213     1219     1248     1277     1287    1303    1308
```

```
   9/3/20  9/4/20  9/5/20  9/6/20  9/7/20  9/8/20  9/9/20  9/10/20  9/11/20  \
0    1466    1475    1492    1498    1504    1508    1522     1544     1551   
1    4628    4654    4686    4713    4730    4757    4787     4833     4886   
2     771     776     776     777     778     778     778      785      786   
3     564     570     576     581     583     589     591      594      602   
4    1336    1361    1376    1379    1384    1390    1401     1430     1441   

   9/12/20  9/13/20  9/14/20  9/15/20  9/16/20  9/17/20  9/18/20  9/19/20  \
0     1565     1576     1585     1601     1619     1624     1664     1673   
1     4922     4959     4978     4992     5003     5021     5033     5047   
2      792      794      801      806      809      809      824      830   
3      604      607      610      611      612      617      619      628   
4     1446     1453     1464     1475     1487     1504     1527     1542   

   9/20/20  9/21/20  9/22/20  9/23/20  9/24/20  9/25/20  9/26/20  9/27/20  \
0     1690     1691     1714     1715     1715     1757     1764     1773   
1     5061     5087     5124     5141     5141     5456     5477     5526   
2      835      838      848      851      851      873      882      885   
3      632      635      635      638      638      652      654      656   
4     1551     1560     1573     1580     1580     1608     1611     1617   

   9/28/20  9/29/20  9/30/20  10/1/20  10/2/20  10/3/20  10/4/20  10/5/20  \
0     1785     1787     1791     1798     1805     1818     1828     1831   
1     5588     5606     5640     5997     6024     6048     6073     6085   
2      886      886      896      898      902      921      921      921   
3      657      658      664      672      675      678      686      687   
4     1618     1621     1629     1634     1642     1655     1656     1662   

   10/6/20  10/7/20  10/8/20  10/9/20  10/10/20  10/11/20  10/12/20  10/13/20  \
0     1839     1852     1863     1882      1898      1905      1911      1924   
1     6116     6134     6141     6172      6190      6203      6220      6248   
2      923      927      927      939       942       942       944       950   
3      691      703      708      719       726       736       738       744   
4     1665     1673     1681     1689      1704      1713      1722      1742   

   10/14/20  10/15/20  10/16/20  10/17/20  10/18/20  10/19/20  10/20/20  \
0      1928      1949      1966      1983      1989      1999      2010   
1      6270      6285      6333      6350      6369      6375      6405   
2       950       965       968       977       981       981       988   
3       744       761       771       775       785       789       791   
4      1750      1768      1783      1807      1827      1838      1848   

   10/21/20  10/22/20  10/23/20  10/24/20  10/25/20  10/26/20  10/27/20  \
0      2021      2023      2030      2048      2059      2074      2082   
1      6443      6475      6615      6637      6658      6694      6712   
2       996       997      1012      1031      1033      1033      1042   
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3       801       811       825       828       840       843       850
4      1873      1893      1911      1925      1932      1942      1972

   10/28/20  10/29/20  10/30/20  10/31/20  11/1/20  11/2/20  11/3/20  11/4/20  \
0      2103      2126      2141      2159     2173     2186     2197     2212
1      6743      6768      6888      6940     6966     6985     6995     7061
2      1045      1055      1056      1060     1061     1065     1074     1079
3       856       861       866       873      878      883      890      897
4      1988      2009      2039      2074     2095     2108     2162     2188

   11/5/20  11/6/20  11/7/20  11/8/20  11/9/20  11/10/20  11/11/20  11/12/20  \
0     2230     2242     2267     2283     2304      2328      2351      2385
1     7097     7134     7188     7226     7263      7348      7409      7454
2     1080     1090     1092     1095     1098      1107      1112      1113
3      907      917      924      926      932       948       961       966
4     2222     2253     2286     2297     2335      2378      2400      2429

   11/13/20  11/14/20  11/15/20  11/16/20  11/17/20  11/18/20  11/19/20  \
0      2417      2435      2456      2481      2506      2529      2554
1      7523      7596      7646      7696      7772      7849      7933
2      1117      1123      1128      1130      1134      1137      1145
3       973       978       986       993      1004      1008      1011
4      2488      2518      2549      2574      2594      2648      2683

   11/20/20  11/21/20  11/22/20  11/23/20  11/24/20  11/25/20  11/26/20  \
0      2580      2597      2617      2634      2661      2686      2704
1      8038      8131      8199      8269      8376      8473      8576
2      1151      1157      1160      1161      1167      1170      1170
3      1024      1036      1136      1142      1157      1162      1170
4      2704      2735      2754      2763      2822      2855      2879

   11/27/20  11/28/20  11/29/20  11/30/20  12/1/20  12/2/20  12/3/20  12/4/20  \
0      2716      2735      2751      2780     2818     2873     2893     2945
1      8603      8733      8820      8890     9051     9163     9341     9501
2      1171      1173      1175      1178     1189     1206     1214     1217
3      1173      1179      1188      1196     1204     1239     1252     1270
4      2888      2922      2946      2997     3061     3100     3158     3231

   12/5/20  12/6/20  12/7/20  12/8/20  12/9/20  12/10/20  12/11/20  12/12/20  \
0     2979     3005     3043     3087     3117      3186      3233      3233
1     9626     9728     9821     9974    10087     10288     10489     10489
2     1219     1223     1224     1240     1245      1258      1264      1264
3     1283     1293     1299     1317     1322      1359      1398      1398
4     3281     3299     3324     3426     3496      3600      3663      3663

   12/13/20  12/14/20  12/15/20  12/16/20  12/17/20  12/18/20  12/19/20  \
0      3233      3329      3426      3510      3570      3647      3698
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1     10489     10898     11061     11212     11364     11556     11722
2      1264      1275      1292      1296      1309      1318      1330
3      1398      1455      1504      1520      1548      1577      1601
4      3663      3803      3881      3950      4036      4118      4191

   12/20/20  12/21/20  12/22/20  12/23/20  12/24/20  12/25/20  12/26/20  \
0      3741      3780      3841      3889      3942      3990      3999
1     11827     11952     12155     12321     12521     12666     12708
2      1336      1336      1363      1383      1390      1396      1398
3      1613      1628      1660      1683      1711      1725      1739
4      4218      4234      4313      4367      4405      4441      4446

   12/27/20  12/28/20  12/29/20  12/30/20  12/31/20  1/1/21  1/2/21  1/3/21  \
0      4029      4065      4105      4164      4190    4239    4268    4305
1     12825     12962     13172     13392     13601   13823   13955   14064
2      1406      1417      1462      1492      1514    1517    1528    1530
3      1746      1762      1792      1817      1834    1854    1863    1882
4      4465      4483      4535      4584      4641    4693    4729    4746

   1/4/21  1/5/21  1/6/21  1/7/21  1/8/21  1/9/21  1/10/21  1/11/21  1/12/21  \
0    4336    4546    4645    4705    4770    4847     4879     4902     4970
1   14187   14440   14656   14845   15052   15202    15327    15417    15572
2    1533    1575    1597    1614    1634    1648     1658     1663     1679
3    1885    1923    1944    1981    2015    2038     2051     2060     2090
4    4771    4849    4898    4957    5018    5047     5066     5080     5134

   1/13/21  1/14/21  1/15/21  1/16/21 1/17/21
0     4998     5075     5103     5154    5184
1    15701    15841    16002    16176   16251
2     1685     1696     1712     1723    1729
3     2109     2113     2130     2144    2151
4     5170     5219     5264     5292    5304
```

I already can tell I'll need to clean the data a bit. First, I am only going to keep the columns I need for my analysis. Since I know the debt data for my 2nd dataset was collected at the end of November, I want that to be in line with my COVID data, so I am only going to keep the column from 11/30/20. I know I can keep this column because the COVID data itself is cumulative, so it will show how many cases that particular county has had from the beginning of the pandemic up until the end of November.

[5]:
```
countycovid1 = countycovid[['COUNTY', 'NAME', 'County Name', 'State',␣
 ↪'stateFIPS', 'POP70', 'HHD70' , 'POP80',
                               'HHD80', 'POP90', 'HHD90', 'POP00' , 'HHD00' ,␣
 ↪'POP10' , 'HHD10' , '11/30/20']]

countycovid1.head()
```

```
[5]:    COUNTY            NAME     County Name State  stateFIPS  POP70  HHD70  \
     0    1001  Autauga County  Autauga County    AL          1  24457   6792
     1    1003  Baldwin County  Baldwin County    AL          1  59132  17641
     2    1005  Barbour County  Barbour County    AL          1  22484   6796
     3    1007     Bibb County     Bibb County    AL          1  13812   4015
     4    1009   Blount County   Blount County    AL          1  26844   8431

        POP80  HHD80  POP90  HHD90   POP00  HHD00   POP10  HHD10  11/30/20
     0  32266  10199  34236  11830   43685  16007   54571  20221      2780
     1  78213  26641  98277  37041  140406  55330  182265  73180      8890
     2  24685   8352  25418   9217   29037  10409   27457   9820      1178
     3  15680   5153  16589   5750   20827   7421   22915   7953      1196
     4  36456  12679  39247  14644   51020  19264   57322  21578      2997
```

Now that I have my columns of interest, I need to remove all states that are not California from the State column.

```
[6]: countycovid1 = countycovid1.loc[countycovid1['State'] == 'CA']
```

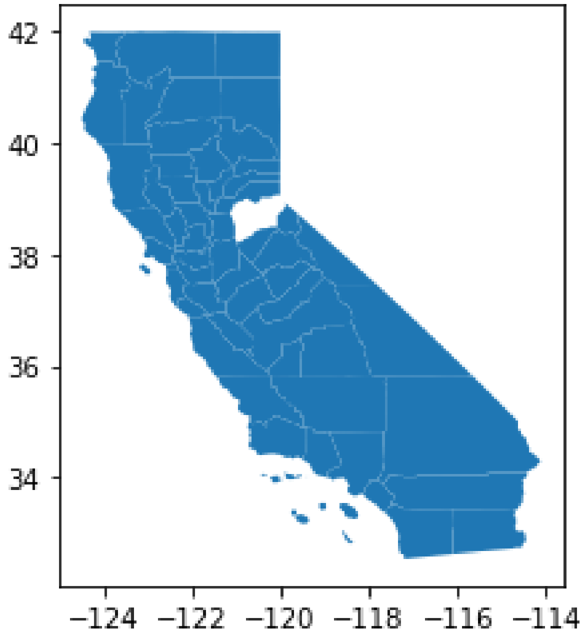
Great! Now I only have values for California and COVID infection rates from the 30th of November.

0.2 Exploring and Cleaning County GEOJSON File

Now, it's time to examine my shapefile. I'm going to plot it to see if everything looks okay.

```
[7]: countyshape.plot()
```

```
[7]: <matplotlib.axes._subplots.AxesSubplot at 0x7f60ed3e97f0>
```



Yepp! That's a map of California! The only issue is the small county missing in the middle of the state? Let's try and figure out why that's happening…First, let's take a look at the top 5 rows of data.

[8]:
```
countyshape.head()
```

[8]:
```
        gid admin_level  area        boundary               name   place  \
0   -396505           6  None  administrative     Ventura County    None
1  40501106           6   yes  administrative               None  island
2  40501107           6   yes  administrative               None  island
3  40501108           6   yes  administrative               None  island
4   -396479           6  None  administrative  Los Angeles County    None

  population  z_order      way_area   tid territory_name  \
0     850536        0  1.548730e+08  None           None
1       None        0  2.226610e+03  None           None
2       None        0  3.716340e+03  None           None
3       None        0  5.450680e+03  None           None
4       None        0  2.456990e+08  None           None

                                            geometry
0  POLYGON ((-119.75770 33.36296, -119.75715 33.3…
1  POLYGON ((-118.50165 32.85270, -118.50161 32.8…
2  POLYGON ((-118.53169 32.89987, -118.53167 32.8…
3  POLYGON ((-118.53422 32.90499, -118.53420 32.9…
4  POLYGON ((-118.60965 33.01726, -118.60643 33.0…
```

This didn't really tell met much. Let's get a better sense of missing values and datatype with .info

[9]:
```
countyshape.info()
```

```
<class 'geopandas.geodataframe.GeoDataFrame'>
RangeIndex: 116 entries, 0 to 115
Data columns (total 12 columns):
 #   Column          Non-Null Count  Dtype
---  ------          --------------  -----
 0   gid             116 non-null    int64
 1   admin_level     116 non-null    object
 2   area            46 non-null     object
 3   boundary        116 non-null    object
 4   name            71 non-null     object
 5   place           47 non-null     object
 6   population      52 non-null     object
 7   z_order         116 non-null    int64
 8   way_area        116 non-null    float64
 9   tid             0 non-null      object
 10  territory_name  0 non-null      object
 11  geometry        116 non-null    geometry
dtypes: float64(1), geometry(1), int64(2), object(8)
memory usage: 11.0+ KB
```

Okay, we see there are 58 rows of data - overall it is consistent across all columns, which seems promising. How about we list the county names to see if anything looks weird there?

[10]:
```
countyshape['name'].value_counts()
```

[10]:
```
Ventura County                    7
Santa Barbara County              5
Los Angeles County                3
San Francisco City and County     2
Nevada County                     1
San Joaquin County                1
Alameda County                    1
Yuba County                       1
Fresno County                     1
Calaveras County                  1
Kern County                       1
Mendocino County                  1
Butte County                      1
Goat Island                       1
Mariposa County                   1
Glenn County                      1
Madera County                     1
Orange County                     1
Sutter County                     1
Colusa County                     1
Sacramento County                 1
Trinity County                    1
San Luis Obispo County            1
Placer County                     1
Monterey County                   1
Lassen County                     1
Merced County                     1
San Diego County                  1
Lake County                       1
Sierra County                     1
Inyo County                       1
Riverside County                  1
Modoc County                      1
San Benito County                 1
Stanislaus County                 1
Santa Cruz County                 1
Yolo County                       1
Humboldt County                   1
```

```
Marin County                       1
Santa Clara County                 1
Tulare County                      1
Plumas County                      1
San Mateo County                   1
Imperial County                    1
Contra Costa County                1
Kings County                       1
Mono County                        1
Shasta County                      1
Tehama County                      1
Del Norte County                   1
Napa County                        1
San Bernardino County              1
Solano County                      1
Siskiyou County                    1
Tuolumne County                    1
Sonoma County                      1
Bird Island                        1
Alpine County                      1
Name: name, dtype: int64
```

Ah, the problem is that El Dorado County is missing from the dataset. I'm going to continue my analysis with this in mind, but I might want to consider finding a complete dataset if I want to include these COVID numbers in my analysis. This particular dataset was from a website called IGISMap.com.

I had a difficult time trying to find a dataset of county boundaries that could easily be merged with my COVID data, but I might need to continue looking.

For now, I am going to try and merge the existing datasets together though a common column.

0.3 Merging Datasets

The first thing I need to do is rename the column titles so 1 from each data set match.

[11]:

```python
list(countyshape)
```

[11]:

```
['gid',
 'admin_level',
 'area',
 'boundary',
 'name',
 'place',
 'population',
 'z_order',
 'way_area',
 'tid',
 'territory_name',
 'geometry']
```

[12]:

```
countyshape.columns = ['gid',
 'admin_level',
 'area',
 'boundary',
 'County Name',
 'place',
 'population',
 'z_order',
 'way_area',
 'tid',
 'territory_name',
 'geometry']
```

You can see above that I changed the “Name” column in my Countyshape file so that it was named “County Name” and could be matched with my countycovid1 file.

Now, let’s check to make sure it renamed.

[13]:

```
countyshape.head()
```

[13]:

```
        gid admin_level  area        boundary        County Name   place  \
0   -396505           6  None  administrative     Ventura County    None
1  40501106           6   yes  administrative               None  island
2  40501107           6   yes  administrative               None  island
3  40501108           6   yes  administrative               None  island
4   -396479           6  None  administrative  Los Angeles County    None

  population  z_order      way_area   tid territory_name  \
0     850536        0  1.548730e+08  None           None
1       None        0  2.226610e+03  None           None
2       None        0  3.716340e+03  None           None
3       None        0  5.450680e+03  None           None
4       None        0  2.456990e+08  None           None

                                            geometry
0  POLYGON ((-119.75770 33.36296, -119.75715 33.3…
1  POLYGON ((-118.50165 32.85270, -118.50161 32.8…
2  POLYGON ((-118.53169 32.89987, -118.53167 32.8…
3  POLYGON ((-118.53422 32.90499, -118.53420 32.9…
4  POLYGON ((-118.60965 33.01726, -118.60643 33.0…
```

It worked! Now that the column, “County Name” on my shape file matches my COVID data file. I am going to merge the files via this column.

[18]:

```
merged = countycovid1.merge(countyshape,
                            on='County Name')
```

Through a lot of Googling, I figured out the code for merging, and I did so by my renamed column.

Now, let's check to see if it worked…

```
[19]: merged.head()
```

```
[19]:   COUNTY              NAME       County Name State  stateFIPS    POP70  \
     0    6001    Alameda County    Alameda County    CA          6  1066698
     1    6003    Alpine County     Alpine County    CA          6      481
     2    6007     Butte County      Butte County    CA          6   101959
     3    6009  Calaveras County  Calaveras County    CA          6    13517
     4    6011     Colusa County     Colusa County    CA          6    12420

          HHD70    POP80   HHD80    POP90   HHD90    POP00   HHD00    POP10   HHD10  \
     0  365015  1101902  426043  1275749  478544  1443745  523359  1510271  545138
     1     178     1092     384     1116     451     1208     483     1175     497
     2   34896   143850   56906   182122   71662   203168   79566   220000   87618
     3    4683    20639    7975    31996   12650    40553   16467    45578   18886
     4    4132    12752    4676    16277    5614    18803    6098    21419    7056

        11/30/20     gid admin_level  area        boundary place population  \
     0     29668 -396499           6  None  administrative  None    1638215
     1        47 -396497           6  None  administrative  None       None
     2      4131 -396508           6  None  administrative  None     225411
     3       450 -396470           6  None  administrative  None      44828
     4       737 -396476           6  None  administrative  None       None

        z_order      way_area   tid territory_name  \
     0        0  3.393090e+09  None           None
     1        0  3.149070e+09  None           None
     2        0  7.339060e+09  None           None
     3        0  4.351060e+09  None           None
     4        0  4.992720e+09  None           None

                                                 geometry
     0  POLYGON ((-122.37384 37.88364, -122.37381 37.8…
     1  POLYGON ((-120.07258 38.44718, -120.07221 38.4…
     2  POLYGON ((-122.06926 39.84005, -122.06922 39.8…
     3  POLYGON ((-120.99564 38.22533, -120.98791 38.2…
     4  POLYGON ((-122.78509 39.38297, -122.78469 39.3…
```

It worked!!! Now, let's map COVID rates by county…

0.4 Data Normalization and Maps

Now I want to map the number of COVID infections by County. First, I need to standardize the data so I have a plot of COVID cases by population.

However, I realized my data for "11/30/20" (aka COVID cases) and "population" are both strings and not integers (though a lot of errors) I need to change them accordingly.

[56]:

```
merged = pd.DataFrame(merged)
merged['11/30/20'] = merged['11/30/20'].astype(int)
```

Though some Googling, I looked up how to change my data from string to integer, but I need to check to make sure it worked.

[61]:

```
print (merged)
print (merged.dtypes)
```

```
    COUNTY              NAME       County Name State  stateFIPS    POP70  \
0     6001    Alameda County    Alameda County    CA          6  1066698
1     6003     Alpine County     Alpine County    CA          6      481
2     6007      Butte County      Butte County    CA          6   101959
3     6009  Calaveras County  Calaveras County    CA          6    13517
4     6011     Colusa County     Colusa County    CA          6    12420
..     …                …               …   …        …      …
62    6111    Ventura County    Ventura County    CA          6   376420
63    6111    Ventura County    Ventura County    CA          6   376420
64    6111    Ventura County    Ventura County    CA          6   376420
65    6113       Yolo County       Yolo County    CA          6    91790
66    6115       Yuba County       Yuba County    CA          6    44739

     HHD70    POP80   HHD80    POP90   HHD90    POP00   HHD00    POP10  \
0   365015  1101902  426043  1275749  478544  1443745  523359  1510271
1      178     1092     384     1116     451     1208     483     1175
2    34896   143850   56906   182122   71662   203168   79566   220000
3     4683    20639    7975    31996   12650    40553   16467    45578
4     4132    12752    4676    16277    5614    18803    6098    21419
..     …      …     …      …      …      …     …      …
62  106492   528867  172824   669221  217386   753507  243340   823318
63  106492   528867  172824   669221  217386   753507  243340   823318
64  106492   528867  172824   669221  217386   753507  243340   823318
65   28323   113391   41305   141113   50981   168661   59376   200849
66   13075    49739   17507    58233   19778    60219   20534    72155

     HHD10  11/30/20     gid admin_level  area        boundary place  \
0   545138     29668 -396499           6  None  administrative  None
1      497        47 -396497           6  None  administrative  None
2    87618      4131 -396508           6  None  administrative  None
3    18886       450 -396470           6  None  administrative  None
4     7056       737 -396476           6  None  administrative  None
..     …       …     …         …   …            …   …
62  266920     20066 -396505           6  None  administrative  None
63  266920     20066 -396505           6  None  administrative  None
64  266920     20066 -396505           6  None  administrative  None
65   70872      4893 -396507           6  None  administrative  None
```

```
66   24307      2088 -396475           6  None  administrative  None

    population  z_order      way_area   tid territory_name  \
0    1638215.0        0  3.393090e+09  None           None
1          NaN        0  3.149070e+09  None           None
2     225411.0        0  7.339060e+09  None           None
3      44828.0        0  4.351060e+09  None           None
4          NaN        0  4.992720e+09  None           None
..         …      …            …    …              …
62    850536.0        0  2.985070e+03  None           None
63    850536.0        0  9.238970e+05  None           None
64    850536.0        0  7.624770e+09  None           None
65    213016.0        0  4.347000e+09  None           None
66     74492.0        0  2.785720e+09  None           None

                                             geometry
0   POLYGON ((-122.37384 37.88364, -122.37381 37.8…
1   POLYGON ((-120.07258 38.44718, -120.07221 38.4…
2   POLYGON ((-122.06926 39.84005, -122.06922 39.8…
3   POLYGON ((-120.99564 38.22533, -120.98791 38.2…
4   POLYGON ((-122.78509 39.38297, -122.78469 39.3…
..                                                …
62  POLYGON ((-119.40795 34.00598, -119.40794 34.0…
63  POLYGON ((-119.40761 34.00581, -119.40743 34.0…
64  POLYGON ((-119.50095 34.32692, -119.48422 34.3…
65  POLYGON ((-122.42293 38.90283, -122.42291 38.9…
66  POLYGON ((-121.63634 39.24632, -121.63634 39.2…

[67 rows x 27 columns]
COUNTY               int64
NAME                object
County Name         object
State               object
stateFIPS            int64
POP70                int64
HHD70                int64
POP80                int64
HHD80                int64
POP90                int64
HHD90                int64
POP00                int64
HHD00                int64
POP10                int64
HHD10                int64
11/30/20             int64
gid                  int64
admin_level         object
area                object
```

```
boundary            object
place               object
population         float64
z_order              int64
way_area           float64
tid                 object
territory_name      object
geometry          geometry
dtype: object
```

It seems that based on my conversion above, both ‘population’ and ‘11/30/20’ have been converted from a string. Now I just need to see if I can divide them….

[63]:

```
merged['COVID Cases by Population'] = merged['11/30/20'] /␣
 ↪merged['population']*100
```

Now that I have divided COVID Cases by population, I need to check that a new column appeared with the proper calcaultions.

[64]:

```
merged.head()
```

[64]:

```
   COUNTY              NAME       County Name State  stateFIPS    POP70  \
0    6001    Alameda County    Alameda County    CA          6  1066698
1    6003     Alpine County     Alpine County    CA          6      481
2    6007      Butte County      Butte County    CA          6   101959
3    6009  Calaveras County  Calaveras County    CA          6    13517
4    6011     Colusa County     Colusa County    CA          6    12420

    HHD70    POP80   HHD80    POP90   HHD90    POP00   HHD00    POP10   HHD10  \
0  365015  1101902  426043  1275749  478544  1443745  523359  1510271  545138
1     178     1092     384     1116     451     1208     483     1175     497
2   34896   143850   56906   182122   71662   203168   79566   220000   87618
3    4683    20639    7975    31996   12650    40553   16467    45578   18886
4    4132    12752    4676    16277    5614    18803    6098    21419    7056

   11/30/20     gid admin_level  area        boundary place  population  \
0     29668 -396499           6  None  administrative  None   1638215.0
1        47 -396497           6  None  administrative  None         NaN
2      4131 -396508           6  None  administrative  None    225411.0
3       450 -396470           6  None  administrative  None     44828.0
4       737 -396476           6  None  administrative  None         NaN

   z_order      way_area   tid territory_name  \
0        0  3.393090e+09  None           None
1        0  3.149070e+09  None           None
2        0  7.339060e+09  None           None
3        0  4.351060e+09  None           None
4        0  4.992720e+09  None           None
```

```
                                            geometry  \
0  POLYGON ((-122.37384 37.88364, -122.37381 37.8…
1  POLYGON ((-120.07258 38.44718, -120.07221 38.4…
2  POLYGON ((-122.06926 39.84005, -122.06922 39.8…
3  POLYGON ((-120.99564 38.22533, -120.98791 38.2…
4  POLYGON ((-122.78509 39.38297, -122.78469 39.3…

   COVID Cases by Population
0                   1.810996
1                        NaN
2                   1.832652
3                   1.003837
4                        NaN
```

It worked! And the math checks out!

Another thing I realized (through a lot of errors) is that in order to map a dataset with geopandas, the dataset itself must be a GeoDataFrame… so, now that I have conducted the calculations I need, I can convert this dataset to a GeoDataFrame.

```
[67]: merged = gpd.GeoDataFrame(merged)
```

Now to check if it worked…

```
[68]: type(merged)
```

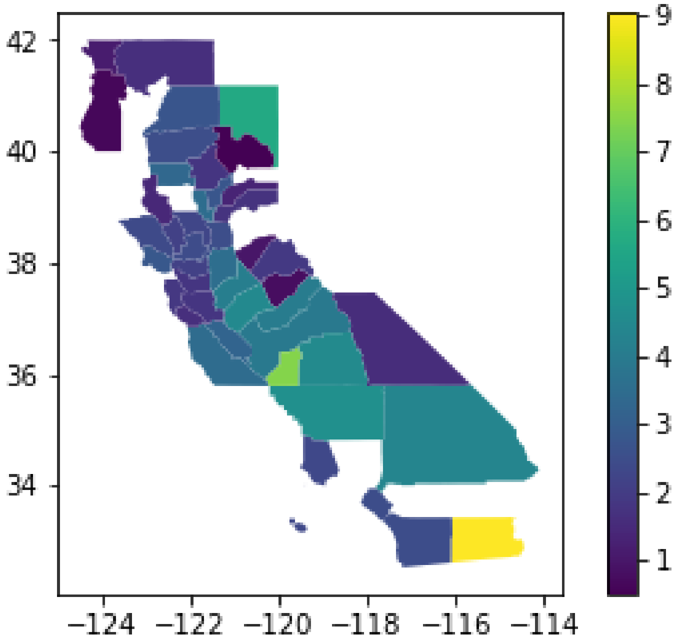
```
[68]: geopandas.geodataframe.GeoDataFrame
```

It worked!

Last on the list is to map (finally!)

```
[66]: merged.plot('COVID Cases by Population', legend=True)
```

```
[66]: <matplotlib.axes._subplots.AxesSubplot at 0x7f60e4b8d760>
```



I did it! Above you can see a nice map of COVID cases by Population in each county in California! The highest percentage seems to be in Imperial County (and by a long shot too). I think is it definitely worth looking into this trend. However, there are also some higer numbers in San Bernardino and Kern, and up through Kings and Fresno. These are some interesting trends and it might be nice to compare them to other factors (like my water bill debt and demographics data).

TBD on if I want to keep this as part of my final project - I think there are still some kinks to work out. But overall, I think this was a helpful exercise, and if I decide to include it in my final project, it will be a nice supplement to my existing data.