

IHME_Covid_EIA_manipulation

January 5, 2021

- 1 This notebook created the dbf files that were joined into the ArcGIS map that created a cartogram that showed Covid rates vs Net Energy generation rates. The dbf files came from csv files which came from manipulated Pandas Data Frames in this notebook.
 - 1.0.1 This is the working notebook that was used to manipulate both Covid19 data as well as Net Energy Generation data from EIA. Regrettably, there was not much time left to create a cleaner presentation. Some commenting was used as well as Markdown cells such as this which should make the code somewhat more readable.
 - 1.0.2 The main tasks completed in terms of manipulation were summarizing the daily Covid data into a form that could be joined to the ArcGIS State shapefile and was in the same level of detail (interval) as the monthly EIA Net Energy Generation. There was also much manipulation involed in “unpivoting” the EIA data to create montlhy averages and apply them to the 2020 EIA records which resulted in a “% of the norm”
 - 1.0.3 Ultimately, the Covid data and Net Gen data were not merged to use in ArcGIS until after there were separately joined in ArcGIS. They were only merged in this notebook at the end where a correlation coefficient was created between the number of covid cases per 100k and the Net Gen for March-July as a % of the average Net Gen. While there was a noticable decrease in Net Gen in earlier “lock down” months, there was almost a 0 correlation coefficeint between these two variables specifically.

[2]: `pip install geopandas`

WARNING: The directory '/home/jovyan/.cache/pip/http' or its parent directory is not owned by the current user and the cache has been disabled. Please check the permissions and owner of that directory. If executing pip with sudo, you may want sudo's -H flag.

WARNING: The directory '/home/jovyan/.cache/pip' or its parent directory is not owned by the current user and caching wheels has been disabled. check the permissions and owner of that directory. If executing pip with sudo, you may want sudo's -H flag.

Requirement already satisfied: geopandas in /opt/conda/lib/python3.7/site-packages (0.8.1)

Requirement already satisfied: shapely in /opt/conda/lib/python3.7/site-packages

```
(from geopandas) (1.7.1)
Requirement already satisfied: pyproj>=2.2.0 in /opt/conda/lib/python3.7/site-
packages (from geopandas) (2.6.1.post1)
Requirement already satisfied: fiona in /opt/conda/lib/python3.7/site-packages
(from geopandas) (1.8.17)
Requirement already satisfied: pandas>=0.23.0 in /opt/conda/lib/python3.7/site-
packages (from geopandas) (0.25.0)
Requirement already satisfied: click<8,>=4.0 in /opt/conda/lib/python3.7/site-
packages (from fiona->geopandas) (7.0)
Requirement already satisfied: click-plugins>=1.0 in
/opt/conda/lib/python3.7/site-packages (from fiona->geopandas) (1.1.1)
Requirement already satisfied: munch in /opt/conda/lib/python3.7/site-packages
(from fiona->geopandas) (2.5.0)
Requirement already satisfied: attrs>=17 in /opt/conda/lib/python3.7/site-
packages (from fiona->geopandas) (19.1.0)
Requirement already satisfied: cligj>=0.5 in /opt/conda/lib/python3.7/site-
packages (from fiona->geopandas) (0.5.0)
Requirement already satisfied: six>=1.7 in /opt/conda/lib/python3.7/site-
packages (from fiona->geopandas) (1.12.0)
Requirement already satisfied: numpy>=1.13.3 in /opt/conda/lib/python3.7/site-
packages (from pandas>=0.23.0->geopandas) (1.17.0)
Requirement already satisfied: python-dateutil>=2.6.1 in
/opt/conda/lib/python3.7/site-packages (from pandas>=0.23.0->geopandas) (2.8.0)
Requirement already satisfied: pytz>=2017.2 in /opt/conda/lib/python3.7/site-
packages (from pandas>=0.23.0->geopandas) (2019.2)
Note: you may need to restart the kernel to use updated packages.
```

```
[3]: import pandas as pd
import geopandas as gpd
import json
import numpy as np

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

[5]: ihme_covid = pd.read_csv('Worse_hospitalization_all_locs.csv')
state_names = ["Alaska", "Alabama", "Arkansas", "American Samoa", "Arizona",
→ "California", "Colorado", "Connecticut", "District ", "of Columbia",
→ "Delaware", "Florida", "Georgia", "Guam", "Hawaii", "Iowa", "Idaho",
→ "Illinois", "Indiana", "Kansas", "Kentucky", "Louisiana", "Massachusetts",
→ "Maryland", "Maine", "Michigan", "Minnesota", "Missouri", "Mississippi",
→ "Montana", "North Carolina", "North Dakota", "Nebraska", "New Hampshire",
→ "New Jersey", "New Mexico", "Nevada", "New York", "Ohio", "Oklahoma",
→ "Oregon", "Pennsylvania", "Puerto Rico", "Rhode Island", "South Carolina",
→ "South Dakota", "Tennessee", "Texas", "Utah", "Virginia", "Virgin Islands",
→ "Vermont", "Washington", "Wisconsin", "West Virginia", "Wyoming"]

[6]: ihme_locations = ihme_covid['location_name'].unique()
```

```
[7]: state_matches = [state_names[i] if state_names[i] in ihme_locations else
    → print(state_names[i], ' no match') \
        for i in range(len(state_names))]
```

```
American Samoa no match
District no match
of Columbia no match
Virgin Islands no match
```

```
[8]: #take only the rows that pertain to states in state_names AND remove the
    → country of Georgia id 35 as it is also a state name
ihme_covid_US_all = ihme_covid[ihme_covid['location_name'].isin(state_names)]
ihme_covid_US_all = ihme_covid_US_all[ihme_covid_US_all['location_id'] != 35]
# ihme_covid_US_all[ihme_covid_US_all['location_name'] == 'New York']
```

```
[9]: ihme_covid_US = ihme_covid_US_all[ihme_covid_US_all['mobility_data_type'] ==
    → 'observed']
ihme_covid_US =
    → ihme_covid_US[['location_name', 'location_id', 'date', 'confirmed_infections_p100k_rate']]
ihme_covid_US.fillna(value = {'confirmed_infections_p100k_rate':0}, inplace =
    → True)
ihme_covid_US.reset_index(inplace = True)
ihme_covid_US.drop(columns = 'index', inplace = True)
ihme_covid_US.head()
```

```
[9]: location_name location_id date confirmed_infections_p100k_rate
0 Guam 351 2/8/2020 0.0
1 Guam 351 2/9/2020 0.0
2 Guam 351 2/10/2020 0.0
3 Guam 351 2/11/2020 0.0
4 Guam 351 2/12/2020 0.0
```

```
[10]: ihme_covid_US['Month'] = [str(ihme_covid_US['date'][i]).split('/')[0] for i in
    → range(len(ihme_covid_US))]
```

```
[11]: ihme_covid_US.head()
```

```
[11]: location_name location_id date confirmed_infections_p100k_rate Month
0 Guam 351 2/8/2020 0.0 2
1 Guam 351 2/9/2020 0.0 2
2 Guam 351 2/10/2020 0.0 2
3 Guam 351 2/11/2020 0.0 2
4 Guam 351 2/12/2020 0.0 2
```

```
[12]: ihme_covid_US_grouped = ihme_covid_US.groupby(['location_name', 'Month']).
    → mean().reset_index()
```

```
[13]: ihme_covid_US_grouped.head(5)
```

```
[13]: location_name Month location_id confirmed_infections_p100k_rate
0 Alabama 2 523 0.000000
```

1	Alabama	3	523	0.639628
2	Alabama	4	523	4.085565
3	Alabama	5	523	7.040449
4	Alabama	6	523	13.455376

2 Try to run calc on all states

```
[18]: #Pivot to get the dates as columns
ihme_covid_US_pivot_monthly = ihme_covid_US_grouped.pivot(index = \
    ↪ 'location_name', columns = 'Month', values = \
    ↪ ['confirmed_infections_p100k_rate']).
    ↪ reset_index()
```

```
[19]: ihme_covid_US_pivot_monthly.tail(5)
```

```
[19]:      location_name confirmed_infections_p100k_rate \
Month      2      3      4
47      Virginia      0.000000  0.463351  5.596051
48      Washington      0.180534  3.609030  3.612462
49      West Virginia      0.000000  0.280910  1.725517
50      Wisconsin      0.000000  0.774388  3.086247
51      Wyoming      0.000000  0.766414  2.261185
```

Month	5	6	7	8	9
47	10.669320	6.969188	10.053868	11.384194	11.707315
48	3.264430	6.379900	10.302238	6.686138	4.711311
49	1.534602	1.603674	6.370768	6.363832	14.191171
50	6.338349	5.816346	13.325955	12.437960	16.690236
51	1.818251	3.189691	6.548873	5.777174	5.243327

```
[20]: ihme_covid_US_pivot_monthly.columns = ihme_covid_US_pivot_monthly.columns.
    ↪ droplevel(0)
ihme_covid_US_pivot_monthly.head()
```

```
[20]: Month      2      3      4      5      6 \
0      Alabama  0.000000  0.639628  4.085565  7.040449  13.455376
1      Alaska  0.000000  0.487129  0.998273  0.425726  2.021926
2      Arizona  0.000000  0.573107  2.935302  5.464535  27.261894
3      Arkansas  0.000000  0.539156  2.937186  4.088510  14.386104
4      California  0.001254  0.663251  3.504545  5.001565  9.971985
```

Month	7	8	9
0	32.193983	24.843117	31.299670
1	7.241437	9.304571	4.314570
2	42.174055	12.380970	6.993412
3	22.377602	20.827661	8.929306

```
4      21.789386  17.145092   7.880210
```

```
[21]: columns_renaming = {}
cols = ihme_covid_US_pivot_monthly.columns

for i in range(len(cols)):
    if cols[i] == '':
        columns_renaming[cols[i]] = 'State'
    else:
        columns_renaming[cols[i]] = str(cols[i]) + '_2020'

columns_renaming
```

```
[21]: {'': 'State',
      '2': '2_2020',
      '3': '3_2020',
      '4': '4_2020',
      '5': '5_2020',
      '6': '6_2020',
      '7': '7_2020',
      '8': '8_2020',
      '9': '9_2020'}
```

```
[22]: ihme_covid_US_pivot_monthly.rename(columns = columns_renaming, inplace = True)
```

```
[23]: ihme_covid_US_pivot_monthly.head()
```

```
[23]: Month      State      2_2020      3_2020      4_2020      5_2020      6_2020  \
0      Alabama  0.000000  0.639628  4.085565  7.040449  13.455376
1      Alaska   0.000000  0.487129  0.998273  0.425726   2.021926
2      Arizona  0.000000  0.573107  2.935302  5.464535  27.261894
3      Arkansas 0.000000  0.539156  2.937186  4.088510  14.386104
4      California 0.001254  0.663251  3.504545  5.001565   9.971985
```

```
Month      7_2020      8_2020      9_2020
0      32.193983  24.843117  31.299670
1       7.241437   9.304571   4.314570
2      42.174055  12.380970   6.993412
3      22.377602  20.827661   8.929306
4      21.789386  17.145092   7.880210
```

```
[24]: #All values are currently strings. convert values for all columns except
      → 'state' to float
cols = ihme_covid_US_pivot_monthly.columns
for i in cols:
    if i != 'State':
        ihme_covid_US_pivot_monthly[i] = ihme_covid_US_pivot_monthly[i].
        → astype(float)

#Fix any new NaN values
```

```

columns_na_fix = {}
cols = ihme_covid_US_pivot_monthly.columns

for i in range(len(cols)):
    columns_na_fix[cols[i]] = 0

# columns_na_fix
ihme_covid_US_pivot_monthly.fillna(value = columns_na_fix, inplace = True)

```

```

[25]: #write table to csv
ihme_covid_US_pivot_monthly.to_csv('ihme_covid_US_pivot_monthly.csv',
    ↪index=False)
reread_monthly = pd.read_csv('ihme_covid_US_pivot_monthly.csv')
reread_monthly.head()

```

```

[25]:      State    2_2020    3_2020    4_2020    5_2020    6_2020    7_2020  \
0   Alabama  0.000000  0.639628  4.085565  7.040449  13.455376  32.193983
1    Alaska  0.000000  0.487129  0.998273  0.425726   2.021926   7.241437
2   Arizona  0.000000  0.573107  2.935302  5.464535  27.261894  42.174055
3  Arkansas  0.000000  0.539156  2.937186  4.088510  14.386104  22.377602
4 California  0.001254  0.663251  3.504545  5.001565   9.971985  21.789386

      8_2020    9_2020
0  24.843117  31.299670
1   9.304571   4.314570
2  12.380970   6.993412
3  20.827661   8.929306
4  17.145092   7.880210

```

```

[26]: #write table to dbf using geopandas as gpd
gf_monthly = gpd.read_file('ihme_covid_US_pivot_monthly.csv')

cols = gf_monthly.columns
for i in cols:
    print(i)
    if i != 'State':
#         print('loop before convert')
        gf_monthly[i] = gf_monthly[i].astype(float)
#         print('after before convert')

# type(gf['2020-02-08'][0])
gf_monthly.to_file('ihme_covid_US_pivot_monthly.dbf')

```

```

State
2_2020
3_2020
4_2020
5_2020
6_2020

```

7_2020
8_2020
9_2020
geometry

3 Import EIA Net Gen data

```
[27]: eia_netgen_df = pd.read_csv('EIA_Net_generation_for_all_sectors_July_update.
    ↪ csv')
eia_netgen_df.head()
```

```
[27]: State      200101      200102      200103      200104      200105      200106 \
0  US-AK      590.145      546.167      587.115      488.698      484.687      488.004
1  US-AL    11326.642     9576.039     9364.445     7714.348    10048.668    11170.299
2  US-AR     3903.323     3372.020     3125.261     3349.774     3690.531     4132.866
3  US-AZ     7573.925     6616.639     7325.900     7159.997     7965.507     8174.259
4  US-CA    16618.887    14380.392    15848.633    15841.018    16874.504    18071.777
```

```
      200107      200108      200109      200110      200111      200112 \
0      553.925      586.796      640.166      579.703      564.436      633.924
1    12083.310    12520.917    11014.510    10321.847     9886.874    10317.214
2     4564.078     4538.995     4220.271     4087.246     3626.715     4580.956
3     8443.619     8257.966     7456.615     6386.127     6814.355     7736.363
4    19794.556    20307.443    16852.629    15929.260    13419.388    14657.585
```

```
      200201      200202      200203      200204      200205      200206 \
0      646.618      550.132      585.608      539.384      530.593      524.325
1    11220.297     9697.976     9429.392     9161.933    10444.214    11882.481
2     4225.011     3760.693     3131.356     3795.037     3498.511     4120.910
3     7638.722     6911.775     7346.834     6960.495     7870.515     8043.142
4    14591.101    12655.472    15788.658    13995.827    13934.158    16343.680
```

```
      200207      200208      200209      200210      200211      200212 \
0      531.314      507.302      539.958      578.506      584.503      649.079
1    13067.536    12925.950    11567.529    10343.719    11349.447    11830.201
2     4755.258     4927.186     4528.195     3667.881     3548.753     3652.850
3     8906.931     8837.457     8185.059     7184.421     7797.474     8448.838
4    19633.136    18765.891    16987.396    14336.933    12642.570    14535.214
```

```
      200301      200302      200303      200304      200305      200306 \
0      609.407      539.875      557.686      489.725      479.760      457.662
1    11998.910    10347.090    10122.699     9287.219    11678.712    12249.635
2     3934.354     3640.880     3575.540     3461.058     4017.478     4975.779
3     7712.985     6826.508     7203.211     6290.091     7363.669     7860.177
4    14215.326    13116.456    14464.511    13673.534    15699.591    16354.813
```

```
      200307      200308      200309      200310      200311      200312 \
```

0	492.110	472.271	502.055	540.416	566.108	631.656
1	13553.964	14083.709	11762.841	10497.018	10397.157	11508.267
2	5307.824	5192.639	4324.690	3875.780	4029.835	4065.243
3	9948.056	9905.323	9159.867	7975.217	6916.873	7234.241
4	21007.159	19727.905	18012.674	16924.678	14342.394	15249.501

	200401	200402	200403	200404	200405	\
0	630.13411	566.72351	548.70260	484.84629	493.88789	
1	11708.40290	10680.46205	9497.50582	9053.43392	11607.25115	
2	4518.17312	3941.51523	3847.57910	3366.89517	4021.32083	
3	8746.79253	7765.21799	8337.05838	7874.96021	8950.59014	
4	15284.72566	14469.30193	15867.47192	15347.64255	15718.95182	

	200406	200407	200408	200409	200410	\
0	500.42705	556.77577	549.45831	524.07059	521.29793	
1	12318.16591	13731.13143	13007.01880	11649.26645	11093.33507	
2	4863.28395	5323.91642	4946.99535	4334.32109	3998.82669	
3	9196.03036	10722.92218	10539.04202	9405.41923	7698.02023	
4	16367.12348	20382.98814	19763.23865	17634.58585	15236.01696	

	200411	200412	200501	200502	200503	\
0	543.03235	607.36046	627.25294	525.35246	536.08074	
1	10742.14840	12266.64894	12093.78573	10184.83929	11411.95804	
2	4091.93061	4672.87465	4577.27678	4120.19484	3229.68963	
3	7086.99595	8241.09384	8200.25808	6578.33806	7066.50554	
4	13774.63510	14933.67294	14708.32836	13294.16640	15260.66792	

	200504	200505	200506	200507	200508	\
0	492.11086	497.43653	496.88940	562.44439	568.03328	
1	9583.05085	10869.41774	12177.98822	13377.98264	13646.35575	
2	3327.25454	4112.60931	4624.43095	4919.10550	4782.06712	
3	7449.84143	8127.64736	8531.34492	11084.11456	10423.07658	
4	15411.80797	17041.82414	17707.49813	21940.26101	21248.72095	

	200509	200510	200511	200512	200601	\
0	498.94292	558.52560	576.34982	637.23961	630.04298	
1	11960.12439	10596.52698	9885.48018	12161.07122	10550.01664	
2	4167.66958	3503.37817	3159.59094	3271.24149	3702.02594	
3	9581.73953	8046.86791	7991.05981	8397.86056	8067.78656	
4	16956.42247	15451.15270	14453.90304	16818.06498	16363.83535	

	200602	200603	200604	200605	200606	\
0	538.52211	571.12783	528.83460	523.19449	516.81095	
1	10253.95133	10319.37202	10309.89349	11357.39196	13106.03373	
2	3656.55604	3752.09895	3974.24028	4527.83570	5356.17825	
3	7155.00869	7412.94337	6360.99793	7775.41685	9345.38810	
4	14844.03781	17102.00248	15032.33798	18167.48132	20495.41178	

	200607	200608	200609	200610	200611 \
0	563.27699	558.79619	468.70618	555.94835	610.21399
1	14003.64858	14477.39262	11692.91774	11342.27306	11532.30203
2	5633.23912	5617.53100	4534.95200	3730.90818	3398.17531
3	10761.58116	11528.01089	9913.17559	8619.37350	8490.09491
4	24663.86677	21372.67321	18971.19295	17339.20706	15718.95323

	200612	200701	200702	200703	200704 \
0	608.72212	617.62020	552.26200	640.16144	539.00696
1	11950.24811	11404.46482	11039.57408	10368.01819	10357.53468
2	4284.96221	4596.78598	4309.04011	3916.18685	3802.72338
3	8962.75073	9120.02488	7521.55566	8013.87248	7936.15137
4	16727.68825	16424.34461	14729.93156	15311.88492	15310.06909

	200705	200706	200707	200708	200709 \
0	532.21206	510.92030	549.45478	542.60749	515.07507
1	11548.45025	13389.49252	14238.71969	15299.61146	12654.56417
2	4260.24831	4965.31875	5282.36036	6265.65226	4963.27126
3	9621.60755	10320.15884	11710.54454	12245.45700	10551.24021
4	16148.65074	18121.43288	22218.71640	22755.18178	19003.49251

	200710	200711	200712	200801	200802 \
0	578.65284	583.38070	660.03779	671.88114	626.64892
1	11329.93131	10328.88923	11867.02042	12544.28149	11678.66271
2	3831.65858	3764.22227	4638.76747	5095.79698	3895.54899
3	8431.04237	8523.81595	9345.49942	10069.37844	9021.76950
4	17136.28170	16580.36382	17107.23086	17533.51454	14908.00415

	200803	200804	200805	200806	200807 \
0	592.20727	537.50687	507.44230	483.76861	502.08204
1	12003.85137	10591.39260	11364.08750	13554.48424	14167.35031
2	3743.26688	3548.69176	4396.96039	5129.39548	5966.35310
3	8974.79504	8972.36834	8844.08483	10606.27494	12275.93871
4	15010.28732	17536.30444	16444.81998	17108.23929	20665.46713

	200808	200809	200810	200811	200812 \
0	503.74051	512.87511	583.24443	578.60708	674.83009
1	13753.93370	12103.39167	11161.30284	10609.72469	12337.43208
2	5734.02946	4266.77657	4645.96929	4231.13135	4396.60758
3	12496.36872	11150.10503	9759.24944	8251.79783	9037.04157
4	22110.65401	18513.59304	16871.70204	14857.22844	16424.44845

	200901	200902	200903	200904	200905 \
0	656.59326	559.76485	578.64789	541.50107	486.91031
1	13385.26929	11068.36836	11342.37446	9976.62256	11150.91311
2	4680.74348	4355.97410	4190.72402	4248.26775	4188.96093

3	8987.56129	8105.70821	8201.12297	7283.65212	9044.00442
4	15065.64303	14113.90583	15517.52562	15587.65112	16833.44259

	200906	200907	200908	200909	200910 \
0	484.50213	505.30617	491.10848	486.67134	571.26411
1	12019.60972	12931.79052	13386.07409	12253.56546	11615.88883
2	5862.02942	6157.81822	6026.76824	4426.76529	4331.35536
3	9472.60430	12237.40862	12115.61802	10727.43834	8912.45692
4	16347.09827	22092.21013	21206.69117	20479.56705	16072.94339

	200911	200912	201001	201002	201003 \
0	636.72176	703.16803	677.14457	557.64697	601.75635
1	11420.09451	12704.98472	13792.39802	12691.84575	11738.19197
2	4246.31422	4742.01802	5492.42219	4584.08035	4053.05122
3	7759.92562	9123.74941	8642.65550	7402.83975	8187.70497
4	14811.54931	16647.90474	15803.65024	14833.84684	16222.96519

	201004	201005	201006	201007	201008 \
0	561.28516	529.41447	507.58010	513.85775	517.79180
1	10265.55977	13037.78116	14300.32233	14458.21998	13794.53182
2	3909.72295	5137.80782	6049.21606	6219.67199	6236.92702
3	7731.96043	8209.95388	9906.90785	11877.54058	11947.65958
4	15748.69605	16011.94877	16349.85906	19938.18344	20680.42622

	201009	201010	201011	201012	201101 \
0	494.61339	554.95567	574.43785	669.09162	679.39106
1	12764.41519	10991.73780	10448.46884	13867.03944	14177.11699
2	5525.26763	4180.17314	4212.48804	5399.35614	5727.92774
3	10865.68046	9049.12565	8727.54521	9201.38360	8946.72175
4	18493.41110	17379.94965	15756.72910	16905.92988	15483.39989

	201102	201103	201104	201105	201106 \
0	611.14458	638.54187	531.02128	521.21658	495.31904
1	12008.83799	12346.54050	10974.66160	10659.51232	14524.56123
2	4666.78368	4116.67902	3794.02675	4847.05936	6009.32275
3	7673.96539	7590.19148	7310.55907	7974.55847	9620.37387
4	14640.44406	15764.73257	15764.72941	15248.89137	16161.55195

	201107	201108	201109	201110	201111 \
0	511.95511	493.92851	510.22394	559.96008	642.86948
1	15754.32898	15715.96287	12666.96137	11730.48314	12497.23955
2	6680.38648	6681.73721	5055.66422	4546.58247	3976.47702
3	11281.83622	11956.77009	10328.18093	8796.11696	7906.78719
4	19471.24299	20258.59138	18730.23678	16050.12956	15525.96632

	201112	201201	201202	201203	201204 \
0	675.46127	724.70722	602.62201	638.32527	532.98523

1	13283.00328	13201.65968	12049.94990	11984.83758	10219.87187
2	5204.88920	5896.27806	5770.13728	5009.51404	5078.93610
3	8739.29548	9124.81642	8438.79403	8214.70387	8003.59006
4	17704.92620	15904.50090	14595.20325	14993.48861	14506.21643

	201205	201206	201207	201208	201209	\
0	529.33538	498.28877	488.11228	533.85013	531.19269	
1	12187.92732	13751.13637	15632.07922	15011.72450	13010.08207	
2	5845.27598	6025.80473	6452.81188	6161.83653	4751.79493	
3	9076.18217	10307.06801	11122.49239	11993.09848	10189.16834	
4	15954.16540	16375.63729	18443.31707	21409.18568	19230.21152	

	201210	201211	201212	201301	201302	\
0	628.13166	626.68989	612.17829	640.20025	541.44488	
1	11455.17522	11529.48359	12844.76037	12877.58839	12283.57892	
2	4340.69234	4628.93855	5043.65757	5649.54933	5138.64749	
3	8607.54830	7568.11258	8259.41894	8809.56776	7295.05307	
4	17602.93826	15152.93708	15350.76508	15458.49307	13761.43861	

	201303	201304	201305	201306	201307	\
0	551.05035	510.57529	506.67311	463.20442	497.31814	
1	12536.05929	10616.07940	12053.91358	13093.43971	13720.43198	
2	5148.03038	3431.20489	4328.45653	5482.46125	5616.02804	
3	8101.91928	7891.45696	9076.93993	10935.13407	12350.26956	
4	14469.71735	14730.20698	15986.82837	17518.19339	20221.00993	

	201308	201309	201310	201311	201312	\
0	499.43930	503.93265	568.77441	564.70533	649.50352	
1	14092.38453	12553.64372	11848.99615	11908.04951	12988.75868	
2	6187.52073	5454.84844	4595.66642	4190.78094	5099.29770	
3	12361.97721	10918.42259	8559.20699	7552.18703	9473.85167	
4	19948.21860	18906.16829	16374.07442	15509.50258	17193.26303	

	201401	201402	201403	201404	201405	\
0	574.40270	528.77154	521.13439	500.64697	471.81749	
1	14310.18065	11351.43288	11688.36768	10818.44626	12482.36047	
2	5633.47977	5160.45751	5447.01568	4734.91514	4548.52240	
3	9028.39523	7688.51957	7867.25153	7198.43910	8866.12125	
4	15716.05878	14291.93067	14120.89424	15121.17994	16423.09834	

	201406	201407	201408	201409	201410	\
0	459.26230	470.27258	470.76558	459.58675	486.39902	
1	13076.69740	13630.34672	13732.21589	12467.67924	10951.89294	
2	5391.29759	5607.20063	5898.78828	5092.47235	4856.03638	
3	10502.50414	12289.47740	11925.66533	11161.93398	9286.83990	
4	16859.78769	20038.75731	19609.77441	19258.36000	17837.41176	

	201411	201412	201501	201502	201503	\
0	526.45283	573.31748	605.60887	577.97062	552.50192	
1	12044.20207	12786.62489	13558.68054	12241.32183	11691.75443	
2	4662.06478	4559.88615	4536.97571	4845.05039	4828.41033	
3	8065.44567	8376.59436	8410.40682	6692.96089	7932.53381	
4	14435.56772	15094.80093	14246.53253	12303.54033	14346.53259	

	201504	201505	201506	201507	201508	\
0	509.99251	501.18377	474.24377	467.23019	481.55903	
1	10328.12155	12312.56047	13776.65374	15029.14117	14174.17608	
2	4330.64923	4773.53162	5338.40247	6169.33382	5854.09978	
3	7299.07876	8741.34128	11349.30149	12459.02939	12648.28040	
4	14568.67886	15435.01408	18726.65189	20370.89691	20851.43236	

	201509	201510	201511	201512	201601	\
0	470.64824	490.13224	554.89957	598.96660	596.75576	
1	12893.95029	12263.17005	11684.71421	12523.18235	12942.33479	
2	4843.94780	3120.63601	3088.88778	3829.50260	5114.51988	
3	11252.84156	9503.67258	7956.94775	8895.65296	8599.69691	
4	19034.01811	17230.29106	14125.99144	15464.27750	14715.75869	

	201602	201603	201604	201605	201606	\
0	547.81802	575.82951	489.54473	449.66508	445.19996	
1	11433.14435	11059.52798	9630.50621	11120.13371	12472.84039	
2	4182.24325	4724.46905	4372.17737	4147.48096	6007.46063	
3	7302.89535	7518.56099	7359.01960	8404.30755	10840.93780	
4	13465.15989	14168.98808	14042.95386	15123.08358	18914.90727	

	201607	201608	201609	201610	201611	\
0	479.00506	508.56639	523.61710	519.56652	569.36559	
1	13882.41951	14064.90778	12967.71963	10307.04102	10675.50565	
2	6596.71684	6548.62330	5539.34601	4030.07988	4011.80082	
3	12181.12004	12112.72294	10378.07782	8707.76002	7191.82364	
4	21094.70257	21239.76388	17988.47506	16864.77788	13875.05555	

	201612	201701	201702	201703	201704	\
0	630.09979	603.92717	542.52110	612.95084	534.84453	
1	11829.01721	10936.54781	9920.52656	11115.55416	11205.56996	
2	5170.14139	5571.14961	4387.96694	4115.89599	4193.29209	
3	8166.52665	7959.69780	6656.67671	7153.66818	7011.37900	
4	15469.58907	16944.26423	14061.51304	15460.99616	15030.82222	

	201705	201706	201707	201708	201709	\
0	536.42723	533.72101	543.52712	524.60240	466.34307	
1	11889.01185	12135.53738	14165.83876	13330.45210	11461.56709	
2	3838.24771	4977.73502	6515.87230	6219.85536	5526.92630	
3	8353.09413	10373.10899	11843.18556	11431.98902	10161.39744	

4	17173.69472	18889.72132	21552.92056	22609.67451	18825.34589	
	201710	201711	201712	201801	201802	\
0	475.15574	545.70776	577.73765	598.85155	544.87858	
1	11031.66892	10793.76506	11978.21047	13582.30942	9983.73215	
2	4857.34945	4512.21851	6058.70701	6293.81744	4987.43638	
3	8711.25783	7879.04433	8317.26605	8164.13687	7277.29323	
4	16799.09156	14209.30482	14589.17088	13693.12450	12702.29864	
	201803	201804	201805	201806	201807	\
0	563.56765	493.30542	539.94781	515.23249	514.15454	
1	10679.37786	11040.03710	12492.18797	13477.39956	14484.81628	
2	4813.64951	4847.48371	5432.79144	6519.37103	7175.86846	
3	7943.93447	7274.00936	8718.03118	10143.36276	12063.69619	
4	14038.57784	14811.40862	15932.21339	17513.98758	22356.08129	
	201808	201809	201810	201811	201812	\
0	506.84993	487.92000	417.92384	520.26381	544.46290	
1	13839.79191	12640.19847	10579.32895	10724.02615	11534.78805	
2	6909.43908	5361.61464	5208.90693	5013.66584	5435.30706	
3	12297.90703	11380.25088	9250.47959	8044.81335	9367.22919	
4	20994.23493	17591.57544	16863.71762	14604.62357	14363.79477	
	201901	201902	201903	201904	201905	\
0	536.45806	467.41421	497.59705	459.34850	434.68003	
1	12562.72168	10813.86116	11018.34870	9599.76711	12089.21593	
2	5840.68044	5004.37460	4944.08851	3860.74270	4845.26538	
3	9018.49393	8419.33626	8691.90148	7661.55800	8425.35651	
4	14677.04934	14460.26578	16901.04075	16467.51186	16382.55111	
	201906	201907	201908	201909	201910	\
0	506.02103	632.60762	645.20915	540.23654	521.69447	
1	12525.16021	13598.72795	13508.59529	12362.21775	10994.85131	
2	5183.37656	5771.93318	6322.04045	5853.16646	4444.56283	
3	10175.92453	12135.86444	12319.38305	10814.40168	9090.33046	
4	17795.07672	20833.44642	21729.55679	18368.00567	16927.97231	
	201911	201912	202001	202002	202003	\
0	527.86132	571.24533	607.17855	582.98042	529.81320	
1	11172.63894	11450.08465	11509.55516	10551.43952	10626.62373	
2	4697.86733	4837.11038	4207.47332	3780.48224	4069.97858	
3	7552.65440	8982.72116	8534.28599	7546.65939	7117.47238	
4	15065.73011	15425.17931	14466.49064	13289.91172	14823.10536	
	202004	202005	202006	202007		
0	462.78025	475.76947	521.94763	644.67858		
1	9195.38186	10574.93269	12385.47834	13310.79060		

```

2  2775.15453  3531.76460  4555.69440  5944.46648
3  7000.10467  9350.47862  9968.06511 11468.90529
4 14097.84274 15465.12990 17143.36636 19763.46928

```

```

[28]: eia_netgen_df['State'] = [eia_netgen_df['State'][i].split('-')[1] for i in
    ↪range(len(eia_netgen_df))]
eia_netgen_df.head()

```

```

[28]: State      200101      200102      200103      200104      200105      200106 \
0  AK      590.145      546.167      587.115      488.698      484.687      488.004
1  AL  11326.642  9576.039  9364.445  7714.348  10048.668  11170.299
2  AR   3903.323  3372.020  3125.261  3349.774   3690.531   4132.866
3  AZ   7573.925  6616.639  7325.900  7159.997   7965.507   8174.259
4  CA  16618.887 14380.392 15848.633 15841.018  16874.504  18071.777

```

```

      200107      200108      200109      200110      200111      200112 \
0   553.925      586.796      640.166      579.703      564.436      633.924
1 12083.310 12520.917 11014.510 10321.847   9886.874  10317.214
2   4564.078   4538.995   4220.271   4087.246   3626.715   4580.956
3   8443.619   8257.966   7456.615   6386.127   6814.355   7736.363
4  19794.556 20307.443 16852.629 15929.260  13419.388  14657.585

```

```

      200201      200202      200203      200204      200205      200206 \
0   646.618      550.132      585.608      539.384      530.593      524.325
1 11220.297   9697.976   9429.392   9161.933  10444.214  11882.481
2   4225.011   3760.693   3131.356   3795.037   3498.511   4120.910
3   7638.722   6911.775   7346.834   6960.495   7870.515   8043.142
4  14591.101 12655.472 15788.658 13995.827  13934.158  16343.680

```

```

      200207      200208      200209      200210      200211      200212 \
0   531.314      507.302      539.958      578.506      584.503      649.079
1 13067.536 12925.950 11567.529 10343.719  11349.447  11830.201
2   4755.258   4927.186   4528.195   3667.881   3548.753   3652.850
3   8906.931   8837.457   8185.059   7184.421   7797.474   8448.838
4  19633.136 18765.891 16987.396 14336.933  12642.570  14535.214

```

```

      200301      200302      200303      200304      200305      200306 \
0   609.407      539.875      557.686      489.725      479.760      457.662
1 11998.910 10347.090 10122.699   9287.219  11678.712  12249.635
2   3934.354   3640.880   3575.540   3461.058   4017.478   4975.779
3   7712.985   6826.508   7203.211   6290.091   7363.669   7860.177
4  14215.326 13116.456 14464.511 13673.534  15699.591  16354.813

```

```

      200307      200308      200309      200310      200311      200312 \
0   492.110      472.271      502.055      540.416      566.108      631.656
1 13553.964 14083.709 11762.841 10497.018  10397.157  11508.267
2   5307.824   5192.639   4324.690   3875.780   4029.835   4065.243
3   9948.056   9905.323   9159.867   7975.217   6916.873   7234.241

```

4 21007.159 19727.905 18012.674 16924.678 14342.394 15249.501

	200401	200402	200403	200404	200405 \
0	630.13411	566.72351	548.70260	484.84629	493.88789
1	11708.40290	10680.46205	9497.50582	9053.43392	11607.25115
2	4518.17312	3941.51523	3847.57910	3366.89517	4021.32083
3	8746.79253	7765.21799	8337.05838	7874.96021	8950.59014
4	15284.72566	14469.30193	15867.47192	15347.64255	15718.95182

	200406	200407	200408	200409	200410 \
0	500.42705	556.77577	549.45831	524.07059	521.29793
1	12318.16591	13731.13143	13007.01880	11649.26645	11093.33507
2	4863.28395	5323.91642	4946.99535	4334.32109	3998.82669
3	9196.03036	10722.92218	10539.04202	9405.41923	7698.02023
4	16367.12348	20382.98814	19763.23865	17634.58585	15236.01696

	200411	200412	200501	200502	200503 \
0	543.03235	607.36046	627.25294	525.35246	536.08074
1	10742.14840	12266.64894	12093.78573	10184.83929	11411.95804
2	4091.93061	4672.87465	4577.27678	4120.19484	3229.68963
3	7086.99595	8241.09384	8200.25808	6578.33806	7066.50554
4	13774.63510	14933.67294	14708.32836	13294.16640	15260.66792

	200504	200505	200506	200507	200508 \
0	492.11086	497.43653	496.88940	562.44439	568.03328
1	9583.05085	10869.41774	12177.98822	13377.98264	13646.35575
2	3327.25454	4112.60931	4624.43095	4919.10550	4782.06712
3	7449.84143	8127.64736	8531.34492	11084.11456	10423.07658
4	15411.80797	17041.82414	17707.49813	21940.26101	21248.72095

	200509	200510	200511	200512	200601 \
0	498.94292	558.52560	576.34982	637.23961	630.04298
1	11960.12439	10596.52698	9885.48018	12161.07122	10550.01664
2	4167.66958	3503.37817	3159.59094	3271.24149	3702.02594
3	9581.73953	8046.86791	7991.05981	8397.86056	8067.78656
4	16956.42247	15451.15270	14453.90304	16818.06498	16363.83535

	200602	200603	200604	200605	200606 \
0	538.52211	571.12783	528.83460	523.19449	516.81095
1	10253.95133	10319.37202	10309.89349	11357.39196	13106.03373
2	3656.55604	3752.09895	3974.24028	4527.83570	5356.17825
3	7155.00869	7412.94337	6360.99793	7775.41685	9345.38810
4	14844.03781	17102.00248	15032.33798	18167.48132	20495.41178

	200607	200608	200609	200610	200611 \
0	563.27699	558.79619	468.70618	555.94835	610.21399
1	14003.64858	14477.39262	11692.91774	11342.27306	11532.30203

2	5633.23912	5617.53100	4534.95200	3730.90818	3398.17531
3	10761.58116	11528.01089	9913.17559	8619.37350	8490.09491
4	24663.86677	21372.67321	18971.19295	17339.20706	15718.95323

	200612	200701	200702	200703	200704	\
0	608.72212	617.62020	552.26200	640.16144	539.00696	
1	11950.24811	11404.46482	11039.57408	10368.01819	10357.53468	
2	4284.96221	4596.78598	4309.04011	3916.18685	3802.72338	
3	8962.75073	9120.02488	7521.55566	8013.87248	7936.15137	
4	16727.68825	16424.34461	14729.93156	15311.88492	15310.06909	

	200705	200706	200707	200708	200709	\
0	532.21206	510.92030	549.45478	542.60749	515.07507	
1	11548.45025	13389.49252	14238.71969	15299.61146	12654.56417	
2	4260.24831	4965.31875	5282.36036	6265.65226	4963.27126	
3	9621.60755	10320.15884	11710.54454	12245.45700	10551.24021	
4	16148.65074	18121.43288	22218.71640	22755.18178	19003.49251	

	200710	200711	200712	200801	200802	\
0	578.65284	583.38070	660.03779	671.88114	626.64892	
1	11329.93131	10328.88923	11867.02042	12544.28149	11678.66271	
2	3831.65858	3764.22227	4638.76747	5095.79698	3895.54899	
3	8431.04237	8523.81595	9345.49942	10069.37844	9021.76950	
4	17136.28170	16580.36382	17107.23086	17533.51454	14908.00415	

	200803	200804	200805	200806	200807	\
0	592.20727	537.50687	507.44230	483.76861	502.08204	
1	12003.85137	10591.39260	11364.08750	13554.48424	14167.35031	
2	3743.26688	3548.69176	4396.96039	5129.39548	5966.35310	
3	8974.79504	8972.36834	8844.08483	10606.27494	12275.93871	
4	15010.28732	17536.30444	16444.81998	17108.23929	20665.46713	

	200808	200809	200810	200811	200812	\
0	503.74051	512.87511	583.24443	578.60708	674.83009	
1	13753.93370	12103.39167	11161.30284	10609.72469	12337.43208	
2	5734.02946	4266.77657	4645.96929	4231.13135	4396.60758	
3	12496.36872	11150.10503	9759.24944	8251.79783	9037.04157	
4	22110.65401	18513.59304	16871.70204	14857.22844	16424.44845	

	200901	200902	200903	200904	200905	\
0	656.59326	559.76485	578.64789	541.50107	486.91031	
1	13385.26929	11068.36836	11342.37446	9976.62256	11150.91311	
2	4680.74348	4355.97410	4190.72402	4248.26775	4188.96093	
3	8987.56129	8105.70821	8201.12297	7283.65212	9044.00442	
4	15065.64303	14113.90583	15517.52562	15587.65112	16833.44259	

	200906	200907	200908	200909	200910	\
--	--------	--------	--------	--------	--------	---

0	484.50213	505.30617	491.10848	486.67134	571.26411
1	12019.60972	12931.79052	13386.07409	12253.56546	11615.88883
2	5862.02942	6157.81822	6026.76824	4426.76529	4331.35536
3	9472.60430	12237.40862	12115.61802	10727.43834	8912.45692
4	16347.09827	22092.21013	21206.69117	20479.56705	16072.94339

	200911	200912	201001	201002	201003 \
0	636.72176	703.16803	677.14457	557.64697	601.75635
1	11420.09451	12704.98472	13792.39802	12691.84575	11738.19197
2	4246.31422	4742.01802	5492.42219	4584.08035	4053.05122
3	7759.92562	9123.74941	8642.65550	7402.83975	8187.70497
4	14811.54931	16647.90474	15803.65024	14833.84684	16222.96519

	201004	201005	201006	201007	201008 \
0	561.28516	529.41447	507.58010	513.85775	517.79180
1	10265.55977	13037.78116	14300.32233	14458.21998	13794.53182
2	3909.72295	5137.80782	6049.21606	6219.67199	6236.92702
3	7731.96043	8209.95388	9906.90785	11877.54058	11947.65958
4	15748.69605	16011.94877	16349.85906	19938.18344	20680.42622

	201009	201010	201011	201012	201101 \
0	494.61339	554.95567	574.43785	669.09162	679.39106
1	12764.41519	10991.73780	10448.46884	13867.03944	14177.11699
2	5525.26763	4180.17314	4212.48804	5399.35614	5727.92774
3	10865.68046	9049.12565	8727.54521	9201.38360	8946.72175
4	18493.41110	17379.94965	15756.72910	16905.92988	15483.39989

	201102	201103	201104	201105	201106 \
0	611.14458	638.54187	531.02128	521.21658	495.31904
1	12008.83799	12346.54050	10974.66160	10659.51232	14524.56123
2	4666.78368	4116.67902	3794.02675	4847.05936	6009.32275
3	7673.96539	7590.19148	7310.55907	7974.55847	9620.37387
4	14640.44406	15764.73257	15764.72941	15248.89137	16161.55195

	201107	201108	201109	201110	201111 \
0	511.95511	493.92851	510.22394	559.96008	642.86948
1	15754.32898	15715.96287	12666.96137	11730.48314	12497.23955
2	6680.38648	6681.73721	5055.66422	4546.58247	3976.47702
3	11281.83622	11956.77009	10328.18093	8796.11696	7906.78719
4	19471.24299	20258.59138	18730.23678	16050.12956	15525.96632

	201112	201201	201202	201203	201204 \
0	675.46127	724.70722	602.62201	638.32527	532.98523
1	13283.00328	13201.65968	12049.94990	11984.83758	10219.87187
2	5204.88920	5896.27806	5770.13728	5009.51404	5078.93610
3	8739.29548	9124.81642	8438.79403	8214.70387	8003.59006
4	17704.92620	15904.50090	14595.20325	14993.48861	14506.21643

	201205	201206	201207	201208	201209 \
0	529.33538	498.28877	488.11228	533.85013	531.19269
1	12187.92732	13751.13637	15632.07922	15011.72450	13010.08207
2	5845.27598	6025.80473	6452.81188	6161.83653	4751.79493
3	9076.18217	10307.06801	11122.49239	11993.09848	10189.16834
4	15954.16540	16375.63729	18443.31707	21409.18568	19230.21152

	201210	201211	201212	201301	201302 \
0	628.13166	626.68989	612.17829	640.20025	541.44488
1	11455.17522	11529.48359	12844.76037	12877.58839	12283.57892
2	4340.69234	4628.93855	5043.65757	5649.54933	5138.64749
3	8607.54830	7568.11258	8259.41894	8809.56776	7295.05307
4	17602.93826	15152.93708	15350.76508	15458.49307	13761.43861

	201303	201304	201305	201306	201307 \
0	551.05035	510.57529	506.67311	463.20442	497.31814
1	12536.05929	10616.07940	12053.91358	13093.43971	13720.43198
2	5148.03038	3431.20489	4328.45653	5482.46125	5616.02804
3	8101.91928	7891.45696	9076.93993	10935.13407	12350.26956
4	14469.71735	14730.20698	15986.82837	17518.19339	20221.00993

	201308	201309	201310	201311	201312 \
0	499.43930	503.93265	568.77441	564.70533	649.50352
1	14092.38453	12553.64372	11848.99615	11908.04951	12988.75868
2	6187.52073	5454.84844	4595.66642	4190.78094	5099.29770
3	12361.97721	10918.42259	8559.20699	7552.18703	9473.85167
4	19948.21860	18906.16829	16374.07442	15509.50258	17193.26303

	201401	201402	201403	201404	201405 \
0	574.40270	528.77154	521.13439	500.64697	471.81749
1	14310.18065	11351.43288	11688.36768	10818.44626	12482.36047
2	5633.47977	5160.45751	5447.01568	4734.91514	4548.52240
3	9028.39523	7688.51957	7867.25153	7198.43910	8866.12125
4	15716.05878	14291.93067	14120.89424	15121.17994	16423.09834

	201406	201407	201408	201409	201410 \
0	459.26230	470.27258	470.76558	459.58675	486.39902
1	13076.69740	13630.34672	13732.21589	12467.67924	10951.89294
2	5391.29759	5607.20063	5898.78828	5092.47235	4856.03638
3	10502.50414	12289.47740	11925.66533	11161.93398	9286.83990
4	16859.78769	20038.75731	19609.77441	19258.36000	17837.41176

	201411	201412	201501	201502	201503 \
0	526.45283	573.31748	605.60887	577.97062	552.50192
1	12044.20207	12786.62489	13558.68054	12241.32183	11691.75443
2	4662.06478	4559.88615	4536.97571	4845.05039	4828.41033

3	8065.44567	8376.59436	8410.40682	6692.96089	7932.53381
4	14435.56772	15094.80093	14246.53253	12303.54033	14346.53259

	201504	201505	201506	201507	201508	\
0	509.99251	501.18377	474.24377	467.23019	481.55903	
1	10328.12155	12312.56047	13776.65374	15029.14117	14174.17608	
2	4330.64923	4773.53162	5338.40247	6169.33382	5854.09978	
3	7299.07876	8741.34128	11349.30149	12459.02939	12648.28040	
4	14568.67886	15435.01408	18726.65189	20370.89691	20851.43236	

	201509	201510	201511	201512	201601	\
0	470.64824	490.13224	554.89957	598.96660	596.75576	
1	12893.95029	12263.17005	11684.71421	12523.18235	12942.33479	
2	4843.94780	3120.63601	3088.88778	3829.50260	5114.51988	
3	11252.84156	9503.67258	7956.94775	8895.65296	8599.69691	
4	19034.01811	17230.29106	14125.99144	15464.27750	14715.75869	

	201602	201603	201604	201605	201606	\
0	547.81802	575.82951	489.54473	449.66508	445.19996	
1	11433.14435	11059.52798	9630.50621	11120.13371	12472.84039	
2	4182.24325	4724.46905	4372.17737	4147.48096	6007.46063	
3	7302.89535	7518.56099	7359.01960	8404.30755	10840.93780	
4	13465.15989	14168.98808	14042.95386	15123.08358	18914.90727	

	201607	201608	201609	201610	201611	\
0	479.00506	508.56639	523.61710	519.56652	569.36559	
1	13882.41951	14064.90778	12967.71963	10307.04102	10675.50565	
2	6596.71684	6548.62330	5539.34601	4030.07988	4011.80082	
3	12181.12004	12112.72294	10378.07782	8707.76002	7191.82364	
4	21094.70257	21239.76388	17988.47506	16864.77788	13875.05555	

	201612	201701	201702	201703	201704	\
0	630.09979	603.92717	542.52110	612.95084	534.84453	
1	11829.01721	10936.54781	9920.52656	11115.55416	11205.56996	
2	5170.14139	5571.14961	4387.96694	4115.89599	4193.29209	
3	8166.52665	7959.69780	6656.67671	7153.66818	7011.37900	
4	15469.58907	16944.26423	14061.51304	15460.99616	15030.82222	

	201705	201706	201707	201708	201709	\
0	536.42723	533.72101	543.52712	524.60240	466.34307	
1	11889.01185	12135.53738	14165.83876	13330.45210	11461.56709	
2	3838.24771	4977.73502	6515.87230	6219.85536	5526.92630	
3	8353.09413	10373.10899	11843.18556	11431.98902	10161.39744	
4	17173.69472	18889.72132	21552.92056	22609.67451	18825.34589	

	201710	201711	201712	201801	201802	\
0	475.15574	545.70776	577.73765	598.85155	544.87858	

1	11031.66892	10793.76506	11978.21047	13582.30942	9983.73215
2	4857.34945	4512.21851	6058.70701	6293.81744	4987.43638
3	8711.25783	7879.04433	8317.26605	8164.13687	7277.29323
4	16799.09156	14209.30482	14589.17088	13693.12450	12702.29864

	201803	201804	201805	201806	201807 \
0	563.56765	493.30542	539.94781	515.23249	514.15454
1	10679.37786	11040.03710	12492.18797	13477.39956	14484.81628
2	4813.64951	4847.48371	5432.79144	6519.37103	7175.86846
3	7943.93447	7274.00936	8718.03118	10143.36276	12063.69619
4	14038.57784	14811.40862	15932.21339	17513.98758	22356.08129

	201808	201809	201810	201811	201812 \
0	506.84993	487.92000	417.92384	520.26381	544.46290
1	13839.79191	12640.19847	10579.32895	10724.02615	11534.78805
2	6909.43908	5361.61464	5208.90693	5013.66584	5435.30706
3	12297.90703	11380.25088	9250.47959	8044.81335	9367.22919
4	20994.23493	17591.57544	16863.71762	14604.62357	14363.79477

	201901	201902	201903	201904	201905 \
0	536.45806	467.41421	497.59705	459.34850	434.68003
1	12562.72168	10813.86116	11018.34870	9599.76711	12089.21593
2	5840.68044	5004.37460	4944.08851	3860.74270	4845.26538
3	9018.49393	8419.33626	8691.90148	7661.55800	8425.35651
4	14677.04934	14460.26578	16901.04075	16467.51186	16382.55111

	201906	201907	201908	201909	201910 \
0	506.02103	632.60762	645.20915	540.23654	521.69447
1	12525.16021	13598.72795	13508.59529	12362.21775	10994.85131
2	5183.37656	5771.93318	6322.04045	5853.16646	4444.56283
3	10175.92453	12135.86444	12319.38305	10814.40168	9090.33046
4	17795.07672	20833.44642	21729.55679	18368.00567	16927.97231

	201911	201912	202001	202002	202003 \
0	527.86132	571.24533	607.17855	582.98042	529.81320
1	11172.63894	11450.08465	11509.55516	10551.43952	10626.62373
2	4697.86733	4837.11038	4207.47332	3780.48224	4069.97858
3	7552.65440	8982.72116	8534.28599	7546.65939	7117.47238
4	15065.73011	15425.17931	14466.49064	13289.91172	14823.10536

	202004	202005	202006	202007
0	462.78025	475.76947	521.94763	644.67858
1	9195.38186	10574.93269	12385.47834	13310.79060
2	2775.15453	3531.76460	4555.69440	5944.46648
3	7000.10467	9350.47862	9968.06511	11468.90529
4	14097.84274	15465.12990	17143.36636	19763.46928

3.1 Reduce the data down to the last 5 years before taking an average for each month

```
[29]: eia_cols = eia_netgen_df.columns
keep_years = ['2015', '2016', '2017', '2018', '2019', '2020']
eia_keep_cols = []

for i in eia_cols:
    year = str(i[:4])
    if year in keep_years:
        eia_keep_cols.append(i)
    elif i == 'State':
        eia_keep_cols.append(i)
```

```
[30]: eia_netgen_df = eia_netgen_df[eia_keep_cols]
eia_netgen_df.head()
```

```
[30]: State      201501      201502      201503      201504      201505 \
0    AK      605.60887      577.97062      552.50192      509.99251      501.18377
1    AL    13558.68054    12241.32183    11691.75443    10328.12155    12312.56047
2    AR     4536.97571     4845.05039     4828.41033     4330.64923     4773.53162
3    AZ     8410.40682     6692.96089     7932.53381     7299.07876     8741.34128
4    CA    14246.53253    12303.54033    14346.53259    14568.67886    15435.01408

      201506      201507      201508      201509      201510 \
0      474.24377      467.23019      481.55903      470.64824      490.13224
1    13776.65374    15029.14117    14174.17608    12893.95029    12263.17005
2     5338.40247     6169.33382     5854.09978     4843.94780     3120.63601
3    11349.30149    12459.02939    12648.28040    11252.84156     9503.67258
4    18726.65189    20370.89691    20851.43236    19034.01811    17230.29106

      201511      201512      201601      201602      201603 \
0     554.89957     598.96660     596.75576     547.81802     575.82951
1    11684.71421    12523.18235    12942.33479    11433.14435    11059.52798
2     3088.88778     3829.50260     5114.51988     4182.24325     4724.46905
3     7956.94775     8895.65296     8599.69691     7302.89535     7518.56099
4    14125.99144    15464.27750    14715.75869    13465.15989    14168.98808

      201604      201605      201606      201607      201608 \
0     489.54473     449.66508     445.19996     479.00506     508.56639
1     9630.50621    11120.13371    12472.84039    13882.41951    14064.90778
2     4372.17737     4147.48096     6007.46063     6596.71684     6548.62330
3     7359.01960     8404.30755    10840.93780    12181.12004    12112.72294
4    14042.95386    15123.08358    18914.90727    21094.70257    21239.76388

      201609      201610      201611      201612      201701 \
0     523.61710     519.56652     569.36559     630.09979     603.92717
1    12967.71963    10307.04102    10675.50565    11829.01721    10936.54781
2     5539.34601     4030.07988     4011.80082     5170.14139     5571.14961
```

3	10378.07782	8707.76002	7191.82364	8166.52665	7959.69780
4	17988.47506	16864.77788	13875.05555	15469.58907	16944.26423

	201702	201703	201704	201705	201706 \
0	542.52110	612.95084	534.84453	536.42723	533.72101
1	9920.52656	11115.55416	11205.56996	11889.01185	12135.53738
2	4387.96694	4115.89599	4193.29209	3838.24771	4977.73502
3	6656.67671	7153.66818	7011.37900	8353.09413	10373.10899
4	14061.51304	15460.99616	15030.82222	17173.69472	18889.72132

	201707	201708	201709	201710	201711 \
0	543.52712	524.60240	466.34307	475.15574	545.70776
1	14165.83876	13330.45210	11461.56709	11031.66892	10793.76506
2	6515.87230	6219.85536	5526.92630	4857.34945	4512.21851
3	11843.18556	11431.98902	10161.39744	8711.25783	7879.04433
4	21552.92056	22609.67451	18825.34589	16799.09156	14209.30482

	201712	201801	201802	201803	201804 \
0	577.73765	598.85155	544.87858	563.56765	493.30542
1	11978.21047	13582.30942	9983.73215	10679.37786	11040.03710
2	6058.70701	6293.81744	4987.43638	4813.64951	4847.48371
3	8317.26605	8164.13687	7277.29323	7943.93447	7274.00936
4	14589.17088	13693.12450	12702.29864	14038.57784	14811.40862

	201805	201806	201807	201808	201809 \
0	539.94781	515.23249	514.15454	506.84993	487.92000
1	12492.18797	13477.39956	14484.81628	13839.79191	12640.19847
2	5432.79144	6519.37103	7175.86846	6909.43908	5361.61464
3	8718.03118	10143.36276	12063.69619	12297.90703	11380.25088
4	15932.21339	17513.98758	22356.08129	20994.23493	17591.57544

	201810	201811	201812	201901	201902 \
0	417.92384	520.26381	544.46290	536.45806	467.41421
1	10579.32895	10724.02615	11534.78805	12562.72168	10813.86116
2	5208.90693	5013.66584	5435.30706	5840.68044	5004.37460
3	9250.47959	8044.81335	9367.22919	9018.49393	8419.33626
4	16863.71762	14604.62357	14363.79477	14677.04934	14460.26578

	201903	201904	201905	201906	201907 \
0	497.59705	459.34850	434.68003	506.02103	632.60762
1	11018.34870	9599.76711	12089.21593	12525.16021	13598.72795
2	4944.08851	3860.74270	4845.26538	5183.37656	5771.93318
3	8691.90148	7661.55800	8425.35651	10175.92453	12135.86444
4	16901.04075	16467.51186	16382.55111	17795.07672	20833.44642

	201908	201909	201910	201911	201912 \
0	645.20915	540.23654	521.69447	527.86132	571.24533

1	13508.59529	12362.21775	10994.85131	11172.63894	11450.08465
2	6322.04045	5853.16646	4444.56283	4697.86733	4837.11038
3	12319.38305	10814.40168	9090.33046	7552.65440	8982.72116
4	21729.55679	18368.00567	16927.97231	15065.73011	15425.17931

	202001	202002	202003	202004	202005	\
0	607.17855	582.98042	529.81320	462.78025	475.76947	
1	11509.55516	10551.43952	10626.62373	9195.38186	10574.93269	
2	4207.47332	3780.48224	4069.97858	2775.15453	3531.76460	
3	8534.28599	7546.65939	7117.47238	7000.10467	9350.47862	
4	14466.49064	13289.91172	14823.10536	14097.84274	15465.12990	

	202006	202007
0	521.94763	644.67858
1	12385.47834	13310.79060
2	4555.69440	5944.46648
3	9968.06511	11468.90529
4	17143.36636	19763.46928

3.1.1 Try melting

```
[31]: eia_netgen_melt = eia_netgen_df.melt(id_vars = 'State', var_name = 'Date',
      ↳value_name = 'Thousand_MWh')
```

```
[32]: eia_netgen_melt.head(5)
```

```
[32]: State    Date    Thousand_MWh
0     AK  201501      605.60887
1     AL  201501     13558.68054
2     AR  201501      4536.97571
3     AZ  201501      8410.40682
4     CA  201501     14246.53253
```

3.1.2 Add a month column to allow grouping by state and month to take each states avg for the month.

3.1.3 This controls for seasonality

```
[33]: eia_netgen_melt['Month'] = [eia_netgen_melt['Date'][i][4:] for i in
      ↳range(len(eia_netgen_melt))]
```

```
[34]: eia_netgen_melt.head()
```

```
[34]: State    Date    Thousand_MWh Month
0     AK  201501      605.60887    01
1     AL  201501     13558.68054    01
2     AR  201501      4536.97571    01
3     AZ  201501      8410.40682    01
```

4 CA 201501 14246.53253 01

3.1.4 Group by State and month and take the mean of each state over its months

```
[35]: eia_date_grouped = eia_netgen_melt.groupby(['State', 'Month']).mean().  
      ↪reset_index()
```

```
[36]: eia_date_grouped.head(5)
```

```
[36]:   State Month  Thousand_MWh  
0    AK     01    591.463327  
1    AK     02    543.930492  
2    AK     03    555.376695  
3    AK     04    491.635990  
4    AK     05    489.612232
```

```
[37]: eia_date_grouped.rename(columns = {'Thousand_MWh': 'ThsdMWh_avg'}, inplace =  
      ↪True)
```

```
[38]: eia_netgen_melt_merge = eia_netgen_melt.merge(eia_date_grouped, how = 'left', \  
      left_on=['State', 'Month'], \  
      ↪right_on=['State', 'Month'])
```

```
[39]: eia_netgen_melt_merge.head(5)
```

```
[39]:   State   Date  Thousand_MWh  Month  ThsdMWh_avg  
0    AK  201501    605.60887    01    591.463327  
1    AL  201501   13558.68054    01   12515.358233  
2    AR  201501    4536.97571    01    5260.769400  
3    AZ  201501    8410.40682    01    8447.786387  
4    CA  201501   14246.53253    01   14790.536655
```

3.1.5 Calculate average column, then pivot dates back out to prepare to join back to arcgis

```
[40]: eia_netgen_melt_merge['ThsdMWh_%norm'] =  
      ↪round(eia_netgen_melt_merge['Thousand_MWh']/\  
      ↪eia_netgen_melt_merge['ThsdMWh_avg'] * 100, 2)
```

```
[41]: eia_netgen_melt_merge.head(50)
```

```
[41]:   State   Date  Thousand_MWh  Month  ThsdMWh_avg  ThsdMWh_%norm  
0    AK  201501    605.60887    01    591.463327    102.39  
1    AL  201501   13558.68054    01   12515.358233    108.34  
2    AR  201501    4536.97571    01    5260.769400     86.24  
3    AZ  201501    8410.40682    01    8447.786387     99.56  
4    CA  201501   14246.53253    01   14790.536655     96.32  
5    CO  201501    4682.75358    01    4811.128125     97.33  
6    CT  201501    3502.33279    01    3453.224020    101.42  
7    DC  201501     1.71289     01     7.482503     22.89
```


8	DE	201501	656.85482	01	466.095357	140.93
9	FL	201501	17985.57273	01	18450.567073	97.48
10	GA	201501	10953.43920	01	10804.877332	101.37
11	HI	201501	731.09633	01	785.512195	93.07
12	IA	201501	5404.02534	01	5431.670523	99.49
13	ID	201501	1201.85674	01	1432.336255	83.91
14	IL	201501	17955.97148	01	16889.928402	106.31
15	IN	201501	10170.84337	01	9686.710528	105.00
16	KS	201501	4007.81750	01	4381.509613	91.47
17	KY	201501	8206.29180	01	7226.629880	113.56
18	LA	201501	9382.95970	01	8582.300012	109.33
19	MA	201501	2272.24466	01	2365.779892	96.05
20	MD	201501	3230.05888	01	3192.297980	101.18
21	ME	201501	1289.16604	01	1077.474940	119.65
22	MI	201501	10124.48308	01	10463.529150	96.76
23	MN	201501	5274.47477	01	5320.471388	99.14
24	MO	201501	8151.09508	01	7810.956565	104.35
25	MS	201501	5579.56217	01	5464.178435	102.11
26	MT	201501	2795.34427	01	2551.855657	109.54
27	NC	201501	11875.27896	01	11782.286645	100.79
28	ND	201501	3478.19531	01	3710.790027	93.73
29	NE	201501	3393.33796	01	3389.969748	100.10
30	NH	201501	2064.16112	01	1650.821572	125.04
31	NJ	201501	6150.80626	01	6032.975000	101.95
32	NM	201501	2528.58213	01	2785.597238	90.77
33	NV	201501	2685.91098	01	2989.554425	89.84
34	NY	201501	11758.72464	01	11429.571858	102.88
35	OH	201501	12703.15372	01	11455.702070	110.89
36	OK	201501	6385.66552	01	6721.235277	95.01
37	OR	201501	5501.10745	01	5905.213532	93.16
38	PA	201501	20541.64980	01	20083.542965	102.28
39	RI	201501	332.12824	01	458.637367	72.42
40	SC	201501	8710.17762	01	8745.877250	99.59
41	SD	201501	947.94153	01	1061.123212	89.33
42	TN	201501	7702.73427	01	7443.859817	103.48
43	TX	201501	38033.77948	01	37445.129232	101.57
44	UT	201501	3796.73320	01	3513.539635	108.06
45	VA	201501	7697.30236	01	8588.327040	89.63
46	VT	201501	169.38540	01	200.300605	84.57
47	WA	201501	10673.95780	01	10204.365603	104.60
48	WI	201501	6108.42564	01	5897.009342	103.59
49	WV	201501	7889.67144	01	6700.682390	117.74

```
[42]: eia_netgen_pivot = eia_netgen_melt_merge.pivot(index = 'State', columns = 'Date', values = 'ThsdMWh_%norm').reset_index()
```

```
[43]: # eia_netgen_pivot.columns = eia_netgen_pivot.columns.droplevel(0)
```

```
[44]: eia_netgen_pivot.head(50)
```

```
[44]: Date State 201501 201502 201503 201504 201505 201506 201507 201508 \
0 AK 102.39 106.26 99.48 103.73 102.36 94.96 85.44 90.29
1 AL 108.34 113.09 105.98 101.59 104.82 107.67 106.75 102.83
2 AR 86.24 106.93 105.36 106.58 107.80 98.31 96.97 91.89
3 AZ 99.56 91.48 102.67 100.43 100.88 108.35 103.61 104.00
4 CA 96.32 91.95 95.92 98.19 96.96 103.10 97.03 97.05
5 CO 97.33 94.91 97.47 92.82 95.33 98.09 92.62 96.72
6 CT 101.42 105.04 97.82 105.89 106.74 95.39 90.23 96.15
7 DC 22.89 24.09 22.97 27.98 39.41 83.40 89.69 119.07
8 DE 140.93 129.45 93.51 147.82 134.98 115.05 95.50 97.59
9 FL 97.48 100.74 101.55 102.41 99.28 97.54 95.23 95.13
10 GA 101.37 114.91 107.84 105.76 102.53 104.54 103.62 100.27
11 HI 93.07 101.43 100.43 104.31 101.20 101.56 107.15 106.69
12 IA 99.49 109.09 110.59 98.25 100.74 88.35 91.08 97.21
13 ID 83.91 96.88 85.08 103.84 89.79 100.86 99.44 91.47
14 IL 106.31 111.61 107.33 104.82 106.71 105.93 102.25 102.90
15 IN 105.00 120.26 104.57 100.27 107.02 104.22 99.68 101.91
16 KS 91.47 90.21 77.94 90.30 95.36 92.83 95.61 94.27
17 KY 113.56 138.54 121.25 123.15 121.23 105.99 106.64 98.71
18 LA 109.33 110.98 97.30 100.54 101.33 100.25 103.91 104.15
19 MA 96.05 112.91 102.65 110.73 121.41 118.44 122.94 118.17
20 MD 101.18 122.67 89.36 93.74 104.48 109.34 98.52 83.63
21 ME 119.65 133.17 114.80 93.54 83.46 91.33 87.65 99.51
22 MI 96.76 104.41 103.07 106.14 106.49 95.22 93.99 96.80
23 MN 99.14 103.82 98.64 93.09 95.24 97.92 99.29 92.91
24 MO 104.35 110.99 105.14 107.04 95.73 109.41 104.25 102.30
25 MS 102.11 115.51 108.24 97.96 97.38 104.11 99.33 93.15
26 MT 109.54 95.87 106.72 114.34 123.05 128.59 103.64 93.81
27 NC 100.79 118.13 102.60 95.93 98.18 106.18 98.65 94.50
28 ND 93.73 93.04 95.11 100.92 100.37 90.88 92.82 92.82
29 NE 100.10 101.99 109.97 112.33 107.63 106.16 106.67 108.05
30 NH 125.04 132.56 125.75 136.88 123.28 113.82 102.82 103.08
31 NJ 101.95 104.04 98.48 93.39 112.61 101.66 97.11 93.60
32 NM 90.77 93.99 97.30 109.96 104.83 94.35 93.64 97.83
33 NV 89.84 96.20 95.09 109.15 95.30 99.54 90.93 97.51
34 NY 102.88 109.95 107.69 106.23 109.30 101.93 98.47 101.15
35 OH 110.89 122.28 110.93 95.28 97.33 101.82 99.47 99.59
36 OK 95.01 103.70 97.23 91.83 89.54 92.61 97.17 95.34
37 OR 93.16 94.11 94.01 89.30 85.48 88.64 88.39 91.19
38 PA 102.28 104.56 108.77 102.21 97.26 97.22 91.86 97.17
39 RI 72.42 81.17 86.29 63.70 121.85 115.02 105.11 107.13
40 SC 99.59 108.86 94.96 101.92 100.86 99.94 99.23 98.20
41 SD 89.33 86.88 69.26 79.23 70.73 64.16 65.09 100.07
42 TN 103.48 107.88 97.21 100.91 93.30 101.40 95.50 95.76
43 TX 101.57 100.81 97.15 96.45 92.54 96.25 96.80 98.37
```

44	UT	108.06	109.57	121.34	126.26	125.89	118.13	101.60	100.91
45	VA	89.63	101.15	87.20	80.01	92.31	94.33	86.63	90.75
46	VT	84.57	74.65	72.27	98.20	97.72	124.51	115.20	89.47
47	WA	104.60	104.22	105.32	92.38	80.23	84.43	91.50	100.46
48	WI	103.59	104.25	106.61	107.91	107.49	102.40	99.73	98.26
49	WV	117.74	133.98	122.27	98.00	98.86	100.65	97.46	97.14

Date	201509	201510	201511	201512	201601	201602	201603	201604	201605	\
0	94.55	101.08	102.07	102.47	100.89	100.71	103.68	99.57	91.84	
1	103.44	111.13	106.13	105.56	103.41	105.63	100.25	94.73	94.67	
2	89.29	72.03	72.43	75.59	97.22	92.30	103.09	107.60	93.66	
3	104.22	104.98	103.00	101.71	101.80	99.82	97.31	101.26	96.99	
4	103.66	101.73	98.26	102.67	99.49	100.63	94.73	94.65	95.00	
5	99.38	94.29	94.81	100.70	99.45	98.52	99.12	103.74	100.75	
6	100.30	92.32	95.02	96.90	91.73	98.57	95.46	100.00	97.24	
7	99.33	116.49	110.73	85.79	85.78	90.81	84.83	104.50	133.54	
8	119.87	84.54	106.67	119.54	115.84	123.23	121.60	135.57	111.38	
9	95.10	93.30	102.86	102.12	97.69	99.87	97.60	99.53	97.31	
10	94.69	87.71	94.79	93.33	105.94	108.12	102.44	102.67	103.17	
11	104.27	102.11	105.60	104.13	103.21	102.76	102.37	102.15	102.52	
12	95.31	94.05	83.58	86.33	94.67	94.08	85.58	85.05	75.62	
13	96.22	90.66	82.38	92.63	89.42	88.07	108.04	117.74	105.57	
14	103.89	106.11	102.35	98.36	100.98	99.42	95.60	103.82	96.02	
15	102.96	97.60	91.18	85.19	98.60	103.29	94.70	96.57	101.11	
16	99.39	96.85	85.71	83.10	93.82	95.44	94.17	96.97	95.52	
17	102.75	104.63	97.34	95.22	104.79	110.38	105.20	112.74	95.59	
18	101.76	107.03	105.22	108.10	105.93	108.90	110.26	107.34	107.00	
19	124.29	125.72	112.72	99.73	102.49	106.91	111.36	128.70	144.68	
20	88.56	89.17	88.34	78.85	89.74	100.99	98.22	92.95	82.19	
21	110.87	119.39	110.48	103.69	112.13	113.12	88.12	100.21	103.28	
22	96.95	102.37	105.19	99.63	100.49	101.61	98.37	100.50	103.02	
23	100.81	99.77	93.49	95.83	97.00	98.75	100.58	111.99	105.25	
24	108.17	105.98	98.71	94.87	101.54	97.12	92.26	94.85	91.51	
25	95.88	94.84	110.49	104.84	109.56	109.95	84.93	95.70	107.80	
26	97.05	102.56	94.53	100.63	93.02	94.74	87.27	98.15	105.61	
27	90.87	94.53	95.02	90.40	105.88	108.20	90.19	102.71	93.10	
28	93.86	89.83	86.64	82.87	92.01	89.55	83.45	81.89	87.71	
29	110.68	115.03	105.09	102.15	106.20	99.10	92.33	96.27	100.94	
30	105.02	62.34	88.90	104.49	96.01	100.40	86.13	135.99	113.17	
31	105.69	105.50	102.39	100.89	108.27	105.45	112.39	114.77	105.73	
32	95.52	91.67	96.95	102.97	105.91	95.23	95.65	73.99	96.53	
33	101.25	104.99	101.88	110.54	109.07	105.12	103.35	103.16	107.46	
34	106.44	106.57	102.94	96.84	98.30	103.48	100.07	101.52	104.39	
35	106.17	100.66	85.63	77.83	95.61	91.45	83.39	99.63	87.20	
36	88.12	88.81	102.33	98.52	96.87	91.97	94.46	92.25	96.56	
37	95.82	100.70	104.01	98.89	92.32	97.01	106.46	105.29	98.40	
38	98.33	94.40	95.30	88.17	98.19	98.34	84.05	96.89	101.25	

39	69.80	74.10	92.96	83.64	75.30	83.06	116.54	74.53	105.72
40	99.86	95.62	97.87	94.42	102.15	104.51	99.41	99.36	97.97
41	105.37	100.31	83.85	71.36	103.46	93.95	92.87	105.00	71.95
42	89.60	88.82	88.30	78.88	90.37	93.73	84.33	98.59	102.94
43	99.01	95.01	93.64	94.29	95.31	95.42	96.27	98.58	95.19
44	108.76	102.00	89.07	99.85	99.87	96.79	90.78	97.71	91.60
45	95.01	89.10	83.57	92.26	96.71	102.80	92.15	84.13	106.14
46	72.75	105.26	96.41	105.68	111.65	120.77	130.23	111.77	70.90
47	99.13	104.33	104.27	100.17	93.49	95.09	104.14	109.96	102.12
48	106.41	98.75	96.38	99.51	101.13	97.88	93.10	100.83	104.10
49	108.14	80.45	105.25	95.60	107.33	115.46	104.69	125.85	98.95

Date	201606	201607	201608	201609	201610	201611	201612	201701	201702	\
0	89.15	87.59	95.35	105.20	107.15	104.74	107.80	102.11	99.74	
1	97.48	98.61	102.04	104.03	93.40	96.96	99.71	87.39	91.65	
2	110.63	103.68	102.79	102.11	93.02	94.07	102.05	105.90	96.84	
3	103.49	101.30	99.59	96.12	96.19	93.10	93.38	94.22	90.99	
4	104.13	100.47	98.86	97.97	99.57	96.51	102.70	114.56	105.09	
5	104.36	103.43	98.34	96.92	97.89	97.56	99.54	102.38	95.79	
6	83.75	90.06	95.54	98.43	108.74	102.48	91.74	95.40	89.67	
7	92.31	91.38	124.92	99.85	102.71	103.67	83.62	129.86	84.11	
8	136.86	129.72	130.28	120.68	137.90	137.04	109.93	86.15	103.31	
9	100.68	102.61	99.88	99.83	93.11	94.01	99.50	97.33	95.79	
10	111.01	109.20	106.80	101.53	101.19	96.41	100.68	96.43	94.63	
11	100.89	103.06	100.94	98.47	97.78	98.19	101.06	101.84	100.23	
12	95.86	95.90	97.18	93.52	92.76	88.60	102.96	97.26	81.26	
13	93.05	95.63	98.98	81.98	78.10	69.20	80.65	110.58	88.86	
14	104.23	102.80	105.69	104.00	100.81	92.18	106.98	99.41	93.53	
15	105.60	97.34	102.14	99.39	95.68	89.71	106.68	98.73	93.84	
16	98.76	99.10	107.51	84.12	87.22	86.52	101.45	101.34	93.36	
17	102.18	105.73	109.52	104.18	106.88	99.75	113.27	96.34	84.92	
18	101.59	104.85	101.66	99.02	92.76	102.89	102.49	94.83	89.01	
19	136.14	114.90	112.26	105.17	93.83	101.22	112.47	109.15	107.19	
20	96.45	105.84	118.89	104.40	102.05	77.32	94.01	84.11	75.41	
21	102.90	119.71	122.76	107.60	92.70	87.94	95.87	94.97	98.80	
22	103.88	97.50	103.19	99.70	95.15	95.02	94.50	92.86	90.43	
23	100.18	96.19	107.40	99.96	101.08	97.81	107.35	104.02	100.25	
24	106.33	100.63	102.57	98.85	90.88	90.10	99.78	101.31	96.07	
25	108.37	94.67	104.95	103.60	87.27	75.75	93.12	74.71	76.49	
26	102.19	105.47	93.86	99.86	100.67	107.28	110.18	100.41	100.94	
27	100.84	101.94	106.81	106.75	95.08	90.32	101.47	93.08	89.74	
28	99.50	101.45	105.51	95.35	99.60	94.08	99.22	95.63	102.16	
29	99.72	97.25	103.73	96.32	90.58	90.61	99.93	96.53	95.96	
30	97.47	101.88	105.40	108.09	124.01	112.22	108.00	86.11	92.31	
31	102.41	93.53	112.48	100.55	107.77	101.79	100.53	104.77	98.52	
32	106.19	102.05	83.27	89.25	114.45	100.74	106.99	113.45	103.44	
33	103.69	100.27	96.61	93.11	93.74	103.28	96.91	101.90	92.84	

34	100.67	100.16	107.78	102.30	96.46	94.82	98.24	91.76	91.08
35	102.55	104.22	109.69	102.62	98.05	97.52	105.45	89.28	93.72
36	96.37	97.85	95.74	101.19	112.66	103.20	97.95	90.62	84.84
37	93.01	87.13	94.73	100.60	94.84	92.50	105.41	107.20	94.61
38	96.25	100.35	104.11	101.47	95.08	98.99	101.48	93.12	93.62
39	89.91	91.45	87.91	87.70	63.24	76.88	82.51	89.07	82.34
40	99.77	100.83	99.92	91.96	96.32	103.11	101.48	92.88	89.49
41	97.70	98.90	114.24	108.99	85.41	96.72	100.87	85.71	84.05
42	104.28	98.92	105.46	102.69	110.83	110.34	105.43	97.53	99.01
43	99.06	99.42	97.60	100.25	101.38	95.43	97.89	94.33	91.22
44	108.31	100.94	96.99	97.79	102.99	95.38	98.04	105.56	90.88
45	100.56	101.22	105.02	102.03	98.68	98.23	97.49	93.51	85.52
46	89.59	75.94	77.56	71.69	55.14	57.61	87.43	85.64	92.47
47	101.04	96.08	98.79	100.77	102.83	104.61	111.48	104.86	94.12
48	109.65	103.72	108.07	100.71	93.03	94.93	92.73	99.06	97.37
49	109.14	105.92	109.42	103.51	112.68	106.44	124.88	106.09	93.53

Date	201703	201704	201705	201706	201707	201708	201709	201710	201711	\
0	110.37	108.79	109.56	106.87	99.39	98.36	93.69	97.99	100.38	
1	100.76	110.22	101.21	94.84	100.62	96.71	91.95	99.97	98.03	
2	89.81	103.20	86.68	91.67	102.41	97.63	101.88	112.12	105.80	
3	92.59	96.48	96.40	99.03	98.49	94.00	94.11	96.23	101.99	
4	103.37	101.31	107.88	104.00	102.66	105.24	102.53	99.18	98.84	
5	97.89	98.43	102.86	101.75	100.94	96.65	97.10	99.33	97.73	
6	91.91	78.84	93.04	89.60	88.91	91.02	88.57	87.13	91.90	
7	121.94	62.96	93.23	82.69	73.61	46.83	85.06	85.06	74.03	
8	135.07	85.43	143.11	124.18	108.91	92.07	99.53	100.49	95.45	
9	98.57	99.46	102.40	96.37	99.44	101.54	94.59	100.43	98.46	
10	105.61	104.45	102.62	98.36	97.15	99.07	94.90	103.03	97.29	
11	107.84	104.38	102.01	100.56	97.89	94.74	97.48	98.91	95.24	
12	94.70	102.24	111.06	103.52	94.46	96.35	96.95	98.76	103.50	
13	96.40	92.35	90.70	90.11	103.49	107.24	109.52	116.50	124.12	
14	99.96	105.09	97.99	99.99	96.61	93.39	97.51	100.68	103.29	
15	96.72	91.65	87.54	96.34	98.52	95.21	88.53	100.39	95.12	
16	107.69	103.45	99.87	99.61	101.25	92.44	104.35	111.27	106.44	
17	104.38	104.36	105.19	101.86	99.50	95.58	81.94	87.88	98.87	
18	95.75	92.90	94.39	94.92	90.03	90.93	94.10	96.47	97.14	
19	134.36	130.80	117.56	128.07	100.80	103.09	114.83	118.44	115.60	
20	85.22	85.97	91.57	88.55	91.80	81.63	91.24	87.45	104.68	
21	108.40	120.32	122.58	116.64	102.62	89.63	84.88	82.13	99.52	
22	103.17	106.67	108.29	104.37	101.86	92.29	92.20	102.53	99.17	
23	107.06	95.12	99.70	99.20	96.43	92.63	96.09	103.33	105.65	
24	111.76	119.35	123.30	106.40	105.21	100.80	101.68	99.30	94.95	
25	115.50	95.31	103.23	94.51	98.72	90.38	76.05	97.27	98.35	
26	94.10	97.84	95.33	89.28	116.51	114.87	101.76	98.66	100.34	
27	104.89	103.90	104.64	97.75	100.33	97.25	93.96	98.08	97.85	
28	103.29	101.31	110.92	99.90	102.59	95.22	107.13	112.17	106.99	

29	93.06	86.50	93.39	96.14	98.19	95.82	93.59	95.43	98.60
30	101.71	64.46	100.73	102.35	92.63	94.47	102.76	115.87	103.61
31	115.71	102.55	102.28	110.93	102.42	96.42	99.99	98.68	97.13
32	120.31	103.03	95.53	99.90	96.54	106.38	92.59	94.80	91.90
33	93.83	89.57	95.61	98.72	101.09	97.87	94.86	102.72	95.19
34	100.44	96.74	96.57	99.37	93.70	91.45	97.69	97.12	96.83
35	102.72	110.43	106.95	98.63	96.01	94.81	93.94	91.19	105.16
36	95.53	95.95	87.55	90.91	93.45	84.88	93.80	100.63	90.79
37	93.42	102.97	106.92	106.64	107.00	102.32	102.14	104.36	92.41
38	97.79	98.94	96.12	97.76	96.41	94.68	95.72	103.58	100.25
39	81.06	152.31	79.92	81.27	94.61	88.22	110.37	123.25	119.98
40	96.54	101.04	92.76	95.15	93.19	94.56	94.78	100.54	98.24
41	94.27	87.26	124.89	92.98	92.55	80.76	86.65	95.71	89.01
42	98.50	97.00	90.08	99.06	95.08	101.14	102.31	110.36	95.30
43	98.90	100.66	98.58	97.54	99.23	95.81	93.47	97.23	99.51
44	83.32	93.06	99.59	97.87	100.67	97.44	96.60	97.81	97.99
45	103.14	104.01	92.98	98.71	96.55	95.36	89.36	100.24	111.08
46	95.39	106.22	121.92	113.54	111.21	106.49	104.42	93.77	112.28
47	108.48	112.58	103.10	107.28	105.15	95.85	103.02	100.95	96.57
48	98.27	89.65	89.89	102.27	103.67	93.97	98.61	106.78	110.63
49	112.15	109.38	110.15	113.03	106.49	99.54	103.36	116.08	101.11

Date	201712	201801	201802	201803	201804	201805	201806	201807	201808	\
0	98.84	101.25	100.17	101.47	100.34	110.28	103.17	94.02	95.03	
1	100.97	108.53	92.24	96.80	108.59	106.35	105.33	102.89	100.41	
2	119.59	119.64	110.07	105.04	119.30	122.69	120.05	112.79	108.45	
3	95.10	96.64	99.47	102.82	100.09	100.61	96.83	100.32	101.12	
4	96.86	92.58	94.93	93.86	99.83	100.09	96.42	106.48	97.72	
5	96.36	96.54	98.13	100.47	101.28	102.15	104.82	105.50	102.49	
6	99.59	101.24	93.75	103.28	112.15	106.54	106.28	101.34	109.04	
7	75.73	92.71	116.18	121.26	155.55	77.06	91.41	118.27	84.14	
8	144.21	124.46	100.26	110.74	97.01	81.70	64.72	69.28	95.39	
9	98.79	107.14	99.91	95.30	98.37	96.90	100.34	98.44	101.37	
10	105.20	114.31	94.81	107.73	92.49	95.76	101.13	94.65	94.42	
11	96.70	100.70	101.00	98.97	99.85	100.54	100.96	99.27	96.41	
12	99.22	107.00	96.63	100.62	114.43	115.19	108.13	99.74	102.79	
13	116.38	99.25	102.58	117.51	110.53	100.26	103.60	104.59	106.12	
14	103.71	104.69	101.56	106.47	96.37	106.94	102.11	98.58	104.29	
15	112.26	116.18	94.29	110.24	115.73	119.10	117.40	103.11	108.93	
16	105.78	111.92	105.40	109.67	96.11	101.30	99.43	94.32	101.61	
17	99.07	106.32	88.53	92.07	101.55	109.06	108.95	100.70	104.85	
18	103.22	102.50	95.87	91.21	96.14	101.13	101.40	99.10	99.93	
19	112.63	111.14	103.44	100.11	79.61	92.68	87.37	98.83	105.13	
20	108.48	124.38	97.68	117.47	123.47	129.65	107.90	96.40	112.98	
21	100.73	104.76	86.75	110.49	103.18	98.93	86.88	94.11	102.75	
22	104.99	108.48	103.20	100.25	102.94	106.10	107.26	105.69	103.60	
23	106.56	105.89	103.16	108.23	111.80	110.32	109.23	102.56	104.09	

24	106.55	104.62	102.27	103.02	109.47	114.23	106.53	103.64	102.70
25	108.06	112.64	94.12	102.25	105.57	96.15	89.12	90.91	100.47
26	104.43	102.06	104.39	117.39	107.11	96.07	99.66	86.21	93.70
27	106.26	114.97	91.60	108.86	106.39	105.89	103.75	93.12	98.11
28	104.87	107.38	102.99	106.48	121.23	100.56	105.98	106.87	103.54
29	94.42	95.83	96.43	100.96	105.18	106.72	102.50	98.44	94.52
30	101.11	105.87	89.30	91.50	107.73	89.69	99.11	99.46	99.62
31	102.03	94.29	102.70	107.89	106.67	108.22	102.62	107.75	105.58
32	85.09	72.93	75.76	95.10	105.31	102.90	96.65	97.36	98.83
33	95.81	93.83	95.57	98.03	98.00	101.38	102.66	107.75	104.60
34	100.94	104.83	89.73	98.31	98.92	100.79	98.96	98.22	101.85
35	109.99	105.87	98.78	107.18	105.67	104.31	93.95	97.39	101.89
36	95.53	105.83	104.60	101.92	113.84	129.11	117.22	101.40	110.76
37	99.25	100.09	103.85	106.45	108.63	109.54	107.03	110.22	107.57
38	103.92	96.70	94.24	97.85	100.91	99.39	99.07	95.12	99.29
39	111.66	103.81	101.88	89.96	102.19	91.54	101.97	109.89	118.76
40	101.06	104.29	93.53	99.27	94.03	101.99	105.31	101.69	107.38
41	93.91	95.96	97.43	102.24	101.76	103.74	104.67	120.52	95.77
42	115.51	117.83	100.09	103.89	106.34	116.47	105.46	101.55	96.57
43	103.86	107.00	100.95	100.43	101.18	109.73	105.82	102.18	102.55
44	92.39	89.22	90.78	95.53	95.56	95.81	95.46	111.37	108.83
45	96.70	108.30	97.16	100.79	97.56	100.91	100.69	93.98	100.77
46	91.11	104.51	105.38	107.71	104.73	99.21	68.96	72.18	104.43
47	105.19	106.26	113.29	104.71	108.60	111.96	111.41	108.43	104.81
48	112.13	104.17	102.80	106.38	102.95	100.85	96.02	98.65	102.26
49	108.96	106.57	90.66	93.05	99.25	99.48	103.51	98.54	105.11

Date	201809	201810	201811	201812	201901	201902	201903	201904	201905	\
0	98.02	86.19	95.70	93.15	90.70	85.93	89.60	93.43	88.78	
1	101.40	95.87	97.40	97.23	100.38	99.91	99.88	94.42	102.92	
2	98.83	120.23	117.56	107.29	111.02	110.44	107.88	95.02	109.42	
3	105.40	102.18	104.14	107.10	106.76	115.08	112.50	105.42	97.23	
4	95.81	99.57	101.59	95.36	99.23	108.07	113.00	110.99	102.91	
5	102.79	101.04	102.83	102.46	104.52	106.19	103.76	103.85	103.10	
6	106.06	100.82	96.67	105.89	99.99	98.98	102.35	95.33	100.18	
7	98.32	68.82	72.65	105.63	121.87	103.37	126.03	139.43	119.26	
8	94.69	113.12	80.16	67.66	61.14	72.97	85.66	62.17	66.07	
9	105.18	104.49	105.56	100.21	99.49	98.09	98.75	96.63	105.26	
10	102.78	106.64	107.81	103.47	96.68	91.15	89.58	106.55	106.90	
11	98.41	101.00	100.10	97.37	99.98	94.78	94.26	98.54	104.17	
12	108.29	114.50	113.73	110.17	108.07	109.75	118.29	104.32	103.17	
13	118.49	110.35	116.83	108.80	100.39	96.20	88.64	94.38	101.21	
14	100.61	96.42	101.75	98.79	102.34	100.62	102.57	101.16	100.65	
15	109.35	112.54	115.68	108.32	103.09	102.24	109.99	112.36	105.90	
16	99.91	107.25	107.25	110.21	101.37	112.83	106.13	102.45	104.93	
17	107.30	109.47	115.62	102.49	99.18	92.00	103.74	84.24	94.09	
18	99.30	103.00	97.47	94.08	90.63	89.49	93.86	99.76	97.46	

19	94.22	93.69	96.74	91.48	100.73	97.20	104.38	94.93	77.04
20	117.10	118.70	123.32	117.11	111.82	103.65	115.54	101.89	106.14
21	100.25	120.75	111.47	102.83	88.73	85.39	92.23	89.45	93.39
22	105.36	95.55	100.64	92.38	100.44	103.44	101.66	104.29	100.62
23	103.74	99.67	107.40	99.42	99.84	99.55	95.71	99.98	101.75
24	99.15	108.73	113.68	104.85	100.96	100.05	102.62	89.19	91.72
25	104.50	103.48	112.01	88.08	93.76	88.62	101.31	112.32	99.86
26	104.52	112.56	101.09	94.03	105.61	106.16	109.93	93.57	91.91
27	98.27	107.98	110.02	104.52	94.74	92.32	101.23	95.99	107.70
28	107.88	103.78	104.18	103.67	104.35	97.26	107.13	94.17	93.02
29	96.44	95.97	99.41	100.00	99.60	100.46	103.55	101.01	84.49
30	91.56	63.17	99.01	89.68	94.90	86.75	99.59	111.27	85.51
31	100.89	91.87	95.63	95.48	99.58	100.62	91.43	100.99	92.08
32	105.40	94.85	111.03	107.68	104.21	122.30	88.32	105.15	98.98
33	108.28	96.21	97.81	95.85	102.57	106.70	102.50	96.97	94.60
34	95.57	101.11	102.83	100.17	100.59	100.16	91.95	98.02	98.46
35	99.38	118.41	117.23	107.34	99.57	96.59	106.80	97.62	111.05
36	104.24	90.37	106.37	104.11	105.69	103.63	105.79	104.57	94.49
37	102.33	92.68	102.22	95.06	99.42	94.25	96.82	102.59	96.72
38	98.61	99.32	99.42	101.15	105.66	104.33	107.87	103.77	105.75
39	139.26	138.96	104.44	107.73	109.74	106.21	115.06	99.79	106.93
40	112.00	103.99	100.22	99.59	102.59	100.38	102.73	107.66	114.14
41	94.97	115.21	120.07	124.45	106.28	102.12	114.16	114.06	107.09
42	99.44	96.42	94.99	99.84	98.61	95.02	114.88	106.65	120.15
43	97.80	100.63	104.22	100.43	102.60	103.11	103.76	101.24	104.30
44	101.63	103.23	114.20	108.97	106.37	118.51	117.21	97.99	99.35
45	109.11	103.46	108.88	107.94	103.02	105.28	99.48	105.50	98.96
46	117.74	136.45	127.86	114.04	110.83	97.24	93.94	87.46	100.77
47	101.98	93.21	91.62	87.16	92.83	86.61	86.78	92.31	96.56
48	100.79	102.22	102.89	101.50	97.59	98.15	97.97	102.75	104.62
49	91.09	98.97	87.82	91.49	100.72	82.80	92.18	92.44	102.11

Date	201906	201907	201908	201909	201910	201911	201912	202001	202002	\
0	101.33	115.68	120.97	108.54	107.59	97.10	97.73	102.66	107.18	
1	97.89	96.59	98.00	99.17	99.63	101.48	96.52	91.96	97.48	
2	95.45	90.72	99.23	107.89	102.59	110.15	95.48	79.98	83.43	
3	97.14	100.92	101.29	100.16	100.42	97.77	102.71	101.02	103.15	
4	97.97	99.23	101.14	100.04	99.95	104.80	102.41	97.81	99.32	
5	92.05	101.34	105.78	103.81	107.45	107.07	100.94	99.77	106.45	
6	107.69	110.74	108.25	106.63	110.99	113.92	105.88	110.21	113.98	
7	119.22	83.97	125.03	117.43	126.92	138.93	149.22	146.89	181.44	
8	70.14	99.83	84.66	65.24	63.96	80.67	58.65	71.48	70.78	
9	101.63	100.63	102.08	105.30	108.68	99.11	99.38	100.86	105.61	
10	98.97	99.70	99.45	106.10	101.44	103.71	97.32	85.26	96.39	
11	103.64	101.94	101.22	101.37	100.19	100.86	100.74	101.19	99.80	
12	104.85	113.13	106.47	105.93	99.92	110.60	101.32	93.50	109.20	
13	100.69	89.73	96.19	93.79	104.39	107.46	101.54	116.45	127.42	

14	94.32	99.39	93.73	93.99	95.98	100.43	92.15	86.26	93.26
15	87.35	105.92	91.82	99.77	93.79	108.31	87.55	78.40	86.08
16	92.22	102.11	104.18	112.23	97.41	114.09	99.46	100.07	102.76
17	93.43	91.96	91.35	103.83	91.14	88.42	89.96	79.82	85.62
18	100.81	100.22	103.32	105.81	100.74	97.29	92.11	96.79	105.75
19	63.81	77.47	61.36	61.50	68.32	73.72	83.69	80.45	72.35
20	97.14	103.28	102.87	98.70	102.63	106.34	101.55	88.77	99.60
21	96.93	98.38	85.35	96.40	85.03	90.59	96.87	79.75	82.77
22	100.42	108.22	104.11	105.79	104.40	99.98	108.50	100.98	96.91
23	103.70	103.31	102.96	99.40	96.16	95.64	90.84	94.11	94.47
24	86.34	94.48	91.64	92.15	95.10	102.56	93.95	87.22	93.50
25	95.93	108.62	111.04	119.97	117.14	103.40	105.90	107.21	115.30
26	95.08	97.81	103.77	96.82	85.55	96.76	90.73	89.35	97.89
27	97.13	104.01	103.32	110.16	104.33	106.78	97.35	90.54	100.02
28	94.74	96.66	102.90	95.78	94.62	108.12	109.36	106.90	115.00
29	96.19	98.13	97.88	102.97	102.99	106.30	103.51	101.74	106.06
30	98.40	104.53	97.42	92.56	134.60	96.26	96.71	92.08	98.68
31	91.01	100.04	91.92	92.88	96.19	103.06	101.08	91.12	88.67
32	99.63	103.91	113.68	117.23	104.22	99.37	97.28	112.73	109.28
33	97.01	100.51	103.40	102.51	102.33	101.84	100.89	102.78	103.57
34	98.06	104.13	97.77	98.00	98.74	102.58	103.81	101.64	105.61
35	102.54	98.20	94.02	97.89	91.69	94.46	99.40	98.78	97.18
36	95.64	102.95	113.28	112.64	107.52	97.31	103.89	105.99	111.27
37	100.66	100.16	104.19	99.11	107.43	108.86	101.39	107.82	116.17
38	103.25	106.64	104.75	105.88	107.62	106.04	105.28	104.05	104.91
39	95.24	98.44	97.98	92.87	100.45	105.75	114.46	149.66	145.34
40	102.24	102.30	99.95	101.41	103.53	100.56	103.44	98.50	103.23
41	104.04	96.50	109.15	104.02	103.36	110.34	109.40	119.25	135.56
42	93.21	105.13	101.08	105.95	93.57	111.07	100.34	92.18	104.28
43	99.87	100.22	105.67	109.47	105.75	107.20	103.52	99.18	108.49
44	91.72	96.88	95.84	95.22	93.97	103.36	100.74	90.93	93.47
45	105.12	107.91	108.11	104.49	108.53	98.24	105.62	108.83	108.10
46	96.55	119.20	122.05	133.40	109.38	105.84	101.74	102.80	109.51
47	90.63	93.02	100.09	95.10	98.68	102.92	96.00	97.95	106.68
48	88.72	95.28	97.44	93.48	99.23	95.17	94.14	94.46	99.55
49	90.84	98.83	88.80	93.90	91.82	99.39	79.06	61.55	83.56

Date	202003	202004	202005	202006	202007
0	95.40	94.13	97.17	104.52	117.89
1	96.33	90.45	90.03	96.80	94.55
2	88.81	68.30	79.76	83.89	93.43
3	92.12	96.32	107.91	95.16	95.37
4	99.11	95.02	97.15	94.38	94.13
5	101.28	99.87	95.81	98.94	96.17
6	109.19	107.79	96.26	117.28	118.71
7	122.96	109.57	137.50	130.96	143.08
8	53.42	72.00	62.77	89.04	96.76

9	108.23	103.61	98.85	103.44	103.66
10	86.79	88.07	89.03	86.00	95.68
11	96.13	90.76	89.56	92.40	90.69
12	90.22	95.71	94.22	99.30	105.69
13	104.32	81.16	112.46	111.69	107.12
14	88.07	88.75	91.69	93.42	100.37
15	83.78	83.42	79.33	89.09	95.43
16	104.40	110.72	103.02	117.15	107.61
17	73.36	73.97	74.84	87.60	95.46
18	111.62	103.32	98.69	101.04	101.90
19	47.14	55.22	46.64	66.17	85.06
20	94.19	101.99	85.97	100.62	104.16
21	85.96	93.29	98.37	105.33	97.54
22	93.48	79.45	75.50	88.86	92.75
23	89.77	88.02	87.74	89.76	102.22
24	85.19	80.11	83.50	84.99	91.80
25	87.77	93.14	95.58	107.96	107.76
26	84.60	89.00	88.04	85.19	90.36
27	92.22	95.09	90.49	94.35	101.95
28	104.53	100.49	107.42	109.00	99.62
29	100.13	98.70	106.82	99.29	101.33
30	95.33	43.68	87.62	88.85	98.68
31	74.10	81.62	79.08	91.37	99.16
32	103.32	102.56	101.24	103.28	106.49
33	107.21	103.15	105.64	98.38	99.46
34	101.55	98.57	90.49	101.01	105.32
35	88.97	91.38	93.15	100.52	104.72
36	105.07	101.56	102.75	107.25	107.18
37	102.84	91.22	102.94	104.02	107.10
38	103.67	97.27	100.23	106.45	109.62
39	111.10	107.48	94.04	116.59	100.49
40	107.08	95.99	92.28	97.59	102.75
41	127.21	112.70	121.61	136.45	126.44
42	101.19	90.51	77.06	96.59	103.81
43	103.48	101.89	99.67	101.46	102.13
44	91.81	89.42	87.76	88.51	88.55
45	117.23	128.79	108.69	100.59	113.71
46	100.46	91.62	109.48	106.85	106.27
47	90.58	84.17	106.03	105.21	105.82
48	97.67	95.91	93.05	100.93	98.95
49	75.66	75.08	90.46	82.83	92.76

```
[45]: #write table to csv
eia_netgen_pivot.to_csv('eia_netgen_pivot.csv', index=False)
reread = pd.read_csv('eia_netgen_pivot.csv')
reread.columns
```

```
[45]: Index(['State', '201501', '201502', '201503', '201504', '201505', '201506',
          '201507', '201508', '201509', '201510', '201511', '201512', '201601',
          '201602', '201603', '201604', '201605', '201606', '201607', '201608',
          '201609', '201610', '201611', '201612', '201701', '201702', '201703',
          '201704', '201705', '201706', '201707', '201708', '201709', '201710',
          '201711', '201712', '201801', '201802', '201803', '201804', '201805',
          '201806', '201807', '201808', '201809', '201810', '201811', '201812',
          '201901', '201902', '201903', '201904', '201905', '201906', '201907',
          '201908', '201909', '201910', '201911', '201912', '202001', '202002',
          '202003', '202004', '202005', '202006', '202007'],
          dtype='object')
```

```
[46]: #Read csv back in with geopandas then use geopandas to write file to dbf format
eia_netgen_gf = gpd.read_file('eia_netgen_pivot.csv')
eia_netgen_gf.columns
```

```
gf_fix_columns = {}
bad_columns = eia_netgen_gf.columns
# print(bad_columns)
# print(len(bad_columns))
good_columns = reread.columns
# print(len(good_columns))
# print(good_columns)

for i in range(len(bad_columns)-1):
    gf_fix_columns[bad_columns[i]] = good_columns[i]
```

```
[47]: eia_netgen_gf.rename(columns = gf_fix_columns, inplace = True)
```

```
[48]: eia_netgen_gf.drop([0], inplace = True)
```

```
[49]: eia_netgen_gf.head()
```

```
[49]: State 201501 201502 201503 201504 201505 201506 201507 201508 \
1 AK 102.39 106.26 99.48 103.73 102.36 94.96 85.44 90.29
2 AL 108.34 113.09 105.98 101.59 104.82 107.67 106.75 102.83
3 AR 86.24 106.93 105.36 106.58 107.8 98.31 96.97 91.89
4 AZ 99.56 91.48 102.67 100.43 100.88 108.35 103.61 104.0
5 CA 96.32 91.95 95.92 98.19 96.96 103.1 97.03 97.05

201509 201510 201511 201512 201601 201602 201603 201604 201605 \
1 94.55 101.08 102.07 102.47 100.89 100.71 103.68 99.57 91.84
2 103.44 111.13 106.13 105.56 103.41 105.63 100.25 94.73 94.67
3 89.29 72.03 72.43 75.59 97.22 92.3 103.09 107.6 93.66
4 104.22 104.98 103.0 101.71 101.8 99.82 97.31 101.26 96.99
5 103.66 101.73 98.26 102.67 99.49 100.63 94.73 94.65 95.0

201606 201607 201608 201609 201610 201611 201612 201701 201702 \
1 89.15 87.59 95.35 105.2 107.15 104.74 107.8 102.11 99.74
```

2	97.48	98.61	102.04	104.03	93.4	96.96	99.71	87.39	91.65
3	110.63	103.68	102.79	102.11	93.02	94.07	102.05	105.9	96.84
4	103.49	101.3	99.59	96.12	96.19	93.1	93.38	94.22	90.99
5	104.13	100.47	98.86	97.97	99.57	96.51	102.7	114.56	105.09
	201703	201704	201705	201706	201707	201708	201709	201710	201711 \
1	110.37	108.79	109.56	106.87	99.39	98.36	93.69	97.99	100.38
2	100.76	110.22	101.21	94.84	100.62	96.71	91.95	99.97	98.03
3	89.81	103.2	86.68	91.67	102.41	97.63	101.88	112.12	105.8
4	92.59	96.48	96.4	99.03	98.49	94.0	94.11	96.23	101.99
5	103.37	101.31	107.88	104.0	102.66	105.24	102.53	99.18	98.84
	201712	201801	201802	201803	201804	201805	201806	201807	201808 \
1	98.84	101.25	100.17	101.47	100.34	110.28	103.17	94.02	95.03
2	100.97	108.53	92.24	96.8	108.59	106.35	105.33	102.89	100.41
3	119.59	119.64	110.07	105.04	119.3	122.69	120.05	112.79	108.45
4	95.1	96.64	99.47	102.82	100.09	100.61	96.83	100.32	101.12
5	96.86	92.58	94.93	93.86	99.83	100.09	96.42	106.48	97.72
	201809	201810	201811	201812	201901	201902	201903	201904	201905 \
1	98.02	86.19	95.7	93.15	90.7	85.93	89.6	93.43	88.78
2	101.4	95.87	97.4	97.23	100.38	99.91	99.88	94.42	102.92
3	98.83	120.23	117.56	107.29	111.02	110.44	107.88	95.02	109.42
4	105.4	102.18	104.14	107.1	106.76	115.08	112.5	105.42	97.23
5	95.81	99.57	101.59	95.36	99.23	108.07	113.0	110.99	102.91
	201906	201907	201908	201909	201910	201911	201912	202001	202002 \
1	101.33	115.68	120.97	108.54	107.59	97.1	97.73	102.66	107.18
2	97.89	96.59	98.0	99.17	99.63	101.48	96.52	91.96	97.48
3	95.45	90.72	99.23	107.89	102.59	110.15	95.48	79.98	83.43
4	97.14	100.92	101.29	100.16	100.42	97.77	102.71	101.02	103.15
5	97.97	99.23	101.14	100.04	99.95	104.8	102.41	97.81	99.32
	202003	202004	202005	202006	202007	geometry			
1	95.4	94.13	97.17	104.52	117.89	None			
2	96.33	90.45	90.03	96.8	94.55	None			
3	88.81	68.3	79.76	83.89	93.43	None			
4	92.12	96.32	107.91	95.16	95.37	None			
5	99.11	95.02	97.15	94.38	94.13	None			

```
[50]: eia_netgen_gf_cols = eia_netgen_gf.columns
      for i in eia_netgen_gf_cols:
          if i != 'State':
              eia_netgen_gf[i] = eia_netgen_gf[i].astype(float)
```

```
[51]: eia_netgen_gf.to_file('eia_netgen_pivot.dbf',)
```

3.2 Merge covid and EIA netgen dfs to run correlation coefficient

```
[52]: eia_netgen_melt_merge.head(5)
```

```
[52]: State      Date      Thousand_MWh Month      ThsdMWh_avg  ThsdMWh_%norm
0      AK      201501      605.60887    01      591.463327      102.39
1      AL      201501      13558.68054   01      12515.358233     108.34
2      AR      201501      4536.97571    01      5260.769400      86.24
3      AZ      201501      8410.40682    01      8447.786387      99.56
4      CA      201501      14246.53253   01      14790.536655     96.32
```

```
[53]: #Get only values for 2020 in EIA. Also remove the month of January as it does
      ↪not exist in the covid data
eia_netgen_melt_merge['year'] = [eia_netgen_melt_merge['Date'][i][:4] for i in
      ↪range(len(eia_netgen_melt_merge))]
```

```
[54]: eia_netgen_2020 = eia_netgen_melt_merge[eia_netgen_melt_merge['year'] == '2020']
eia_netgen_2020 = eia_netgen_2020[(eia_netgen_2020['Month'] != '01') &
      ↪(eia_netgen_2020['Month'] != '02')]
# eia_netgen_2020['Month'] = [str(eia_netgen_2020['Month'][i])[1:] for i in
      ↪range(len(eia_netgen_2020))]

month_dict = {}
for i in eia_netgen_2020['Month'].unique():
    month_dict[i] = str(i)[1:]

month_dict

eia_netgen_2020['Month'] = [month_dict[i] for i in eia_netgen_2020['Month']]
```

```
[55]: eia_netgen_2020.head()
```

```
[55]: State      Date      Thousand_MWh Month      ThsdMWh_avg  ThsdMWh_%norm  year
3162    AK      202003      529.81320    3      555.376695      95.40  2020
3163    AL      202003      10626.62373   3      11031.864477     96.33  2020
3164    AR      202003      4069.97858    3      4582.748662      88.81  2020
3165    AZ      202003      7117.47238    3      7726.345218      92.12  2020
3166    CA      202003      14823.10536   3      14956.540130     99.11  2020
```

```
[56]: ihme_covid_US_grouped.head(5)
```

```
[56]: location_name Month      location_id  confirmed_infections_p100k_rate
0      Alabama      2          523              0.000000
1      Alabama      3          523              0.639628
2      Alabama      4          523              4.085565
3      Alabama      5          523              7.040449
4      Alabama      6          523             13.455376
```

```
[57]: #Reduce covid df down to month 7 as the eai data is only months 3-7
include_months = ['3', '4', '5', '6', '7']
```

```
# ihme_covid_US_eia_months = ihme_covid_US_grouped[True if
→ihme_covid_US_grouped['Month'][i] in include_months \
#                                     for i in
→range(len(ihme_covid_US_grouped))]

ihme_covid_US_eia_months = ihme_covid_US_grouped[ihme_covid_US_grouped['Month'].
→isin(include_months)]
```

[58]: `ihme_covid_US_eia_months.tail()`

```
[58]:   location_name Month  location_id  confirmed_infections_p100k_rate
408      Wyoming      3          573              0.766414
409      Wyoming      4          573              2.261185
410      Wyoming      5          573              1.818251
411      Wyoming      6          573              3.189691
412      Wyoming      7          573              6.548873
```

[59]: *#Give covid state names corresponding abbreviations to join dia data to.*

```
us_state_abbrev = {
    'Alabama': 'AL',
    'Alaska': 'AK',
    'American Samoa': 'AS',
    'Arizona': 'AZ',
    'Arkansas': 'AR',
    'California': 'CA',
    'Colorado': 'CO',
    'Connecticut': 'CT',
    'Delaware': 'DE',
    'District of Columbia': 'DC',
    'Florida': 'FL',
    'Georgia': 'GA',
    'Guam': 'GU',
    'Hawaii': 'HI',
    'Idaho': 'ID',
    'Illinois': 'IL',
    'Indiana': 'IN',
    'Iowa': 'IA',
    'Kansas': 'KS',
    'Kentucky': 'KY',
    'Louisiana': 'LA',
    'Maine': 'ME',
    'Maryland': 'MD',
    'Massachusetts': 'MA',
    'Michigan': 'MI',
    'Minnesota': 'MN',
    'Mississippi': 'MS',
    'Missouri': 'MO',
    'Montana': 'MT',
```

```

'Nebraska': 'NE',
'Nevada': 'NV',
'New Hampshire': 'NH',
'New Jersey': 'NJ',
'New Mexico': 'NM',
'New York': 'NY',
'North Carolina': 'NC',
'North Dakota': 'ND',
'Northern Mariana Islands': 'MP',
'Ohio': 'OH',
'Oklahoma': 'OK',
'Oregon': 'OR',
'Pennsylvania': 'PA',
'Puerto Rico': 'PR',
'Rhode Island': 'RI',
'South Carolina': 'SC',
'South Dakota': 'SD',
'Tennessee': 'TN',
'Texas': 'TX',
'Utah': 'UT',
'Vermont': 'VT',
'Virgin Islands': 'VI',
'Virginia': 'VA',
'Washington': 'WA',
'West Virginia': 'WV',
'Wisconsin': 'WI',
'Wyoming': 'WY'
}

```

```
[60]: ihme_covid_US_eia_months['State'] = [us_state_abbrev[i] for i in
      ↪ihme_covid_US_eia_months['location_name']]
```

```
[61]: ihme_covid_US_eia_months[ihme_covid_US_eia_months['State'] == 'NY']
```

```
[61]:
```

	location_name	Month	location_id	confirmed_infections_p100k_rate	State
257	New York	3	555	12.869898	NY
258	New York	4	555	39.319803	NY
259	New York	5	555	10.737384	NY
260	New York	6	555	3.803534	NY
261	New York	7	555	3.517678	NY

```
[62]: eia_netgen_2020[eia_netgen_2020['State'] == 'NY']
```

```
[62]:
```

	State	Date	Thousand_MWh	Month	ThsdMWh_avg	ThsdMWh_%norm	year
3196	NY	202003	10460.63245	3	10301.463820	101.55	2020
3247	NY	202004	9234.29933	4	9368.273927	98.57	2020
3298	NY	202005	9284.43924	5	10260.597458	90.49	2020
3349	NY	202006	11346.79500	6	11233.499627	101.01	2020
3400	NY	202007	14318.77774	7	13595.523858	105.32	2020

3.2.1 Merge covid data with eia data on combination of state abbrev and month columns and calc r squared

```
[63]: ihme_covid_US_eia_netgen = ihme_covid_US_eia_months.merge(eia_netgen_2020, on = ['State', 'Month'], how = 'inner')

[73]: ihme_covid_US_eia_netgen_ny = ihme_covid_US_eia_netgen[ihme_covid_US_eia_netgen['State'] == 'FL']

[74]: line_fig = px.line(ihme_covid_US_eia_netgen_ny, y = 'ThsdMWh_%norm', x = 'Date')
line_fig.show()

[75]: regression_line = px.scatter(ihme_covid_US_eia_netgen,
                                x = 'confirmed_infections_p100k_rate', y = 'ThsdMWh_%norm', trendline = 'ols')
regression_line.show()

[76]: results = px.get_trendline_results(regression_line)
print(results)

results.px_fit_results.iloc[0].summary()
```

```
px_fit_results
0 <statsmodels.regression.linear_model.Regressio...
```

```
[76]: <class 'statsmodels.iolib.summary.Summary'>
"""
```

```

                                OLS Regression Results
=====
Dep. Variable:                  y      R-squared:                0.001
Model:                            OLS      Adj. R-squared:           -0.003
Method:                    Least Squares      F-statistic:                0.3340
Date:                Sun, 27 Sep 2020      Prob (F-statistic):          0.564
Time:                22:45:58      Log-Likelihood:            -988.17
No. Observations:                250      AIC:                        1980.
Df Residuals:                    248      BIC:                        1987.
Df Model:                        1
Covariance Type:                nonrobust
=====

```

	coef	std err	t	P> t	[0.025	0.975]
const	95.4775	1.079	88.491	0.000	93.352	97.603
x1	0.0543	0.094	0.578	0.564	-0.131	0.240

```

=====
Omnibus:                48.854      Durbin-Watson:           2.134
Prob(Omnibus):           0.000      Jarque-Bera (JB):        136.834
Skew:                   -0.848      Prob(JB):                1.94e-30
Kurtosis:                6.203      Cond. No.                15.5
=====

```


Warnings:

[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.

""

[]: