IEMS308HW1

January 29, 2021

[55]:
```
import pandas as pd
import numpy as np
import csv
import matplotlib.pyplot as plt
from sklearn.cluster import KMeans
from sklearn import preprocessing
from sklearn.metrics import silhouette_score
from sklearn.cluster import AgglomerativeClustering
from scipy.cluster.hierarchy import dendrogram, linkage
```

[ ]:
```
```

[10]:
```
big_data = pd.read_csv("Medicare_Provider_Util_Payment_PUF_CY2018.
 ↪txt",delimiter = "\t").iloc[1:] ##import data, exempt 1st row
print(len(big_data.nppes_provider_country)) ##number of rows in set
```

```
/Users/brentasticc/opt/anaconda3/lib/python3.7/site-
packages/IPython/core/interactiveshell.py:3063: DtypeWarning: Columns (10) have
mixed types.Specify dtype option on import or set low_memory=False.
  interactivity=interactivity, compiler=compiler, result=result)
```

[12]:
```
#print(big_data.head())
```

[13]:
```
us = big_data[(big_data.nppes_provider_country == "US")] ##filter for just USA
```

[15]:
```
il = us[(us.nppes_provider_state == "IL")] ##filter for just Illinois
```

```
404554
```

[22]:
```
print(len(il.nppes_provider_city.unique()))  ##number of different cities␣
 ↪represented in IL
print(len(il.nppes_provider_zip.unique()))   ##number of different zip codes␣
 ↪represented in IL
```

```
782
```

[51]:
```
il.describe()
```

[51]:
```
                npi  line_srvc_cnt  bene_unique_cnt  bene_day_srvc_cnt  \
count  4.045540e+05   4.045540e+05    404554.000000      404554.000000
mean   1.497201e+09   2.454776e+02        84.482643         137.702702
std    2.877642e+08   4.524965e+03       881.161796        1408.710779
min    1.003000e+09   1.100000e+01        11.000000          11.000000
25%    1.245329e+09   2.100000e+01        17.000000          20.000000
50%    1.497734e+09   4.400000e+01        32.000000          42.000000
75%    1.740485e+09   1.230000e+02        75.000000         111.000000
max    1.992996e+09   1.803089e+06    250713.000000      391474.000000

       average_Medicare_allowed_amt  average_submitted_chrg_amt  \
count                 404554.000000               404554.000000
mean                     102.282519                  393.985725
std                      251.373917                 1105.750344
min                        0.010000                    0.010000
25%                       25.100000                   75.000000
50%                       69.620000                  166.731183
75%                      114.960000                  323.000000
max                    41510.555349                98000.000000

       average_Medicare_payment_amt  average_Medicare_standard_amt
count                 404554.000000                 404554.000000
mean                      78.252938                     76.868659
std                      195.802454                    194.573909
min                        0.000000                      0.007143
25%                       20.330000                     20.443164
50%                       50.519379                     49.823678
75%                       87.235860                     85.230000
max                    32544.273023                  32544.276395
```

[83]:
```
fig, ax = plt.subplots(figsize=(8, 6))
ax.set_xlabel('average_Medicare_payment_amt')
ax.set_ylabel('Count')
ax.set_title('Distribution of Avg Medicare Payment')
plt.hist(il.average_Medicare_payment_amt, bins='auto',range=(0,1000))
```

[83]:
```
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        5.1830e+03, 6.2440e+03, 5.6440e+03, 7.0890e+03, 6.6090e+03,
        5.8100e+03, 7.5500e+03, 6.2910e+03, 7.3020e+03, 6.0160e+03,
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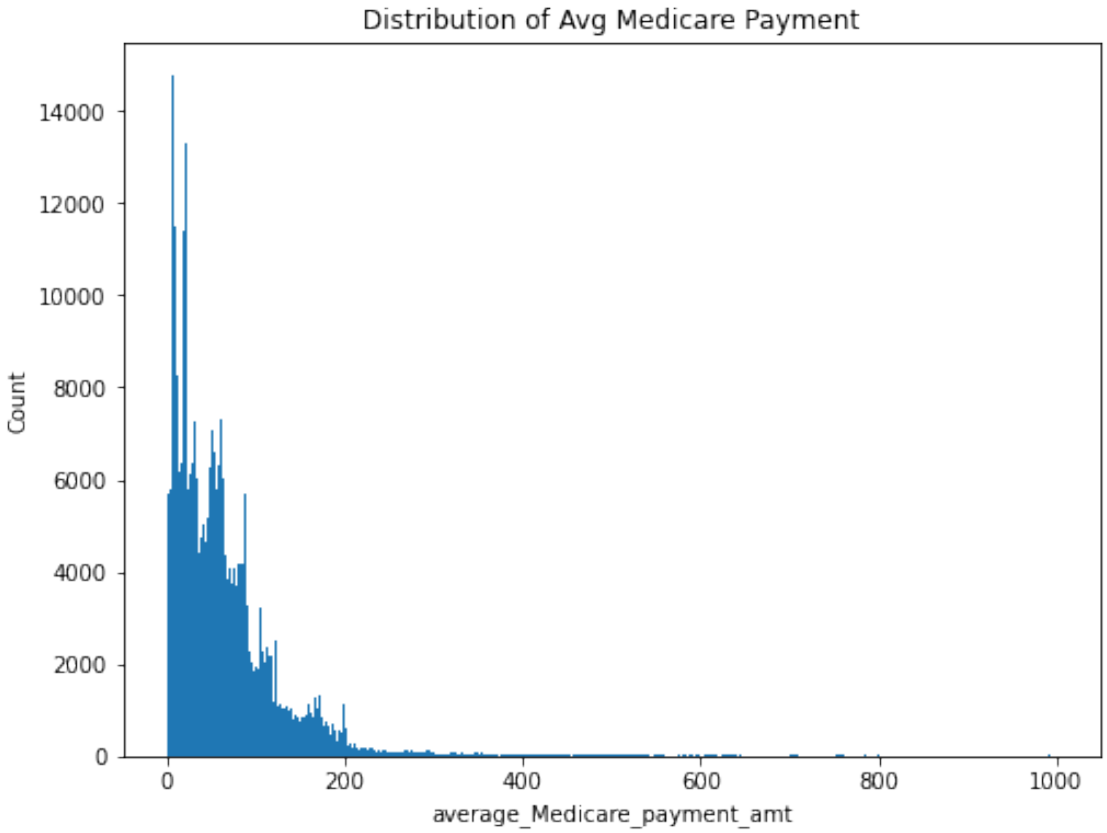

[79]:
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fig, ax = plt.subplots(figsize=(7, 5))
ax.set_xlabel('average_submitted_chrg_amt')
ax.set_ylabel('Count')
ax.set_title('Distribution of Avg Amount Charged')
plt.hist(il.average_submitted_chrg_amt, bins='auto',range=(0,2000))
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[79]:
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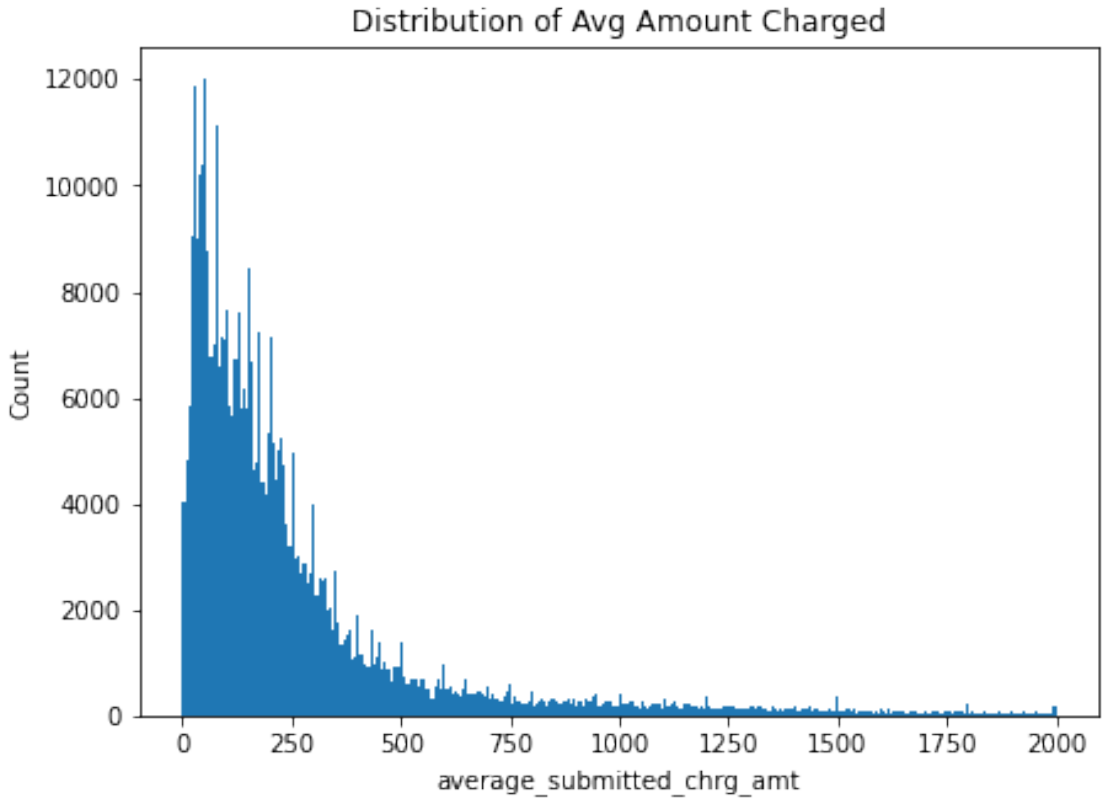

[27]:
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fig, ax = plt.subplots(figsize=(7, 5))
ax.set_xlabel('# of Distinct Beneficiaries')
ax.set_ylabel('Count')
ax.set_title('Distribution of Distinct Beneficiary Count')
plt.hist(il.bene_unique_cnt, bins='auto',range=(0,500))
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[27]:
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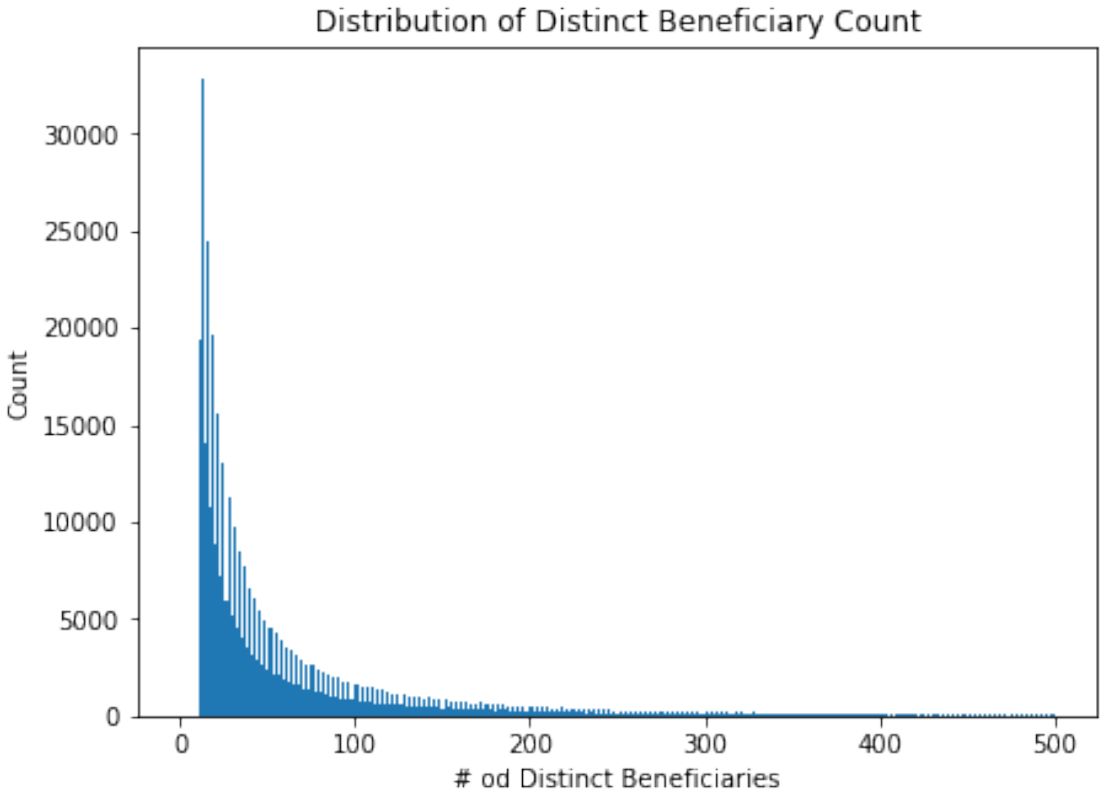
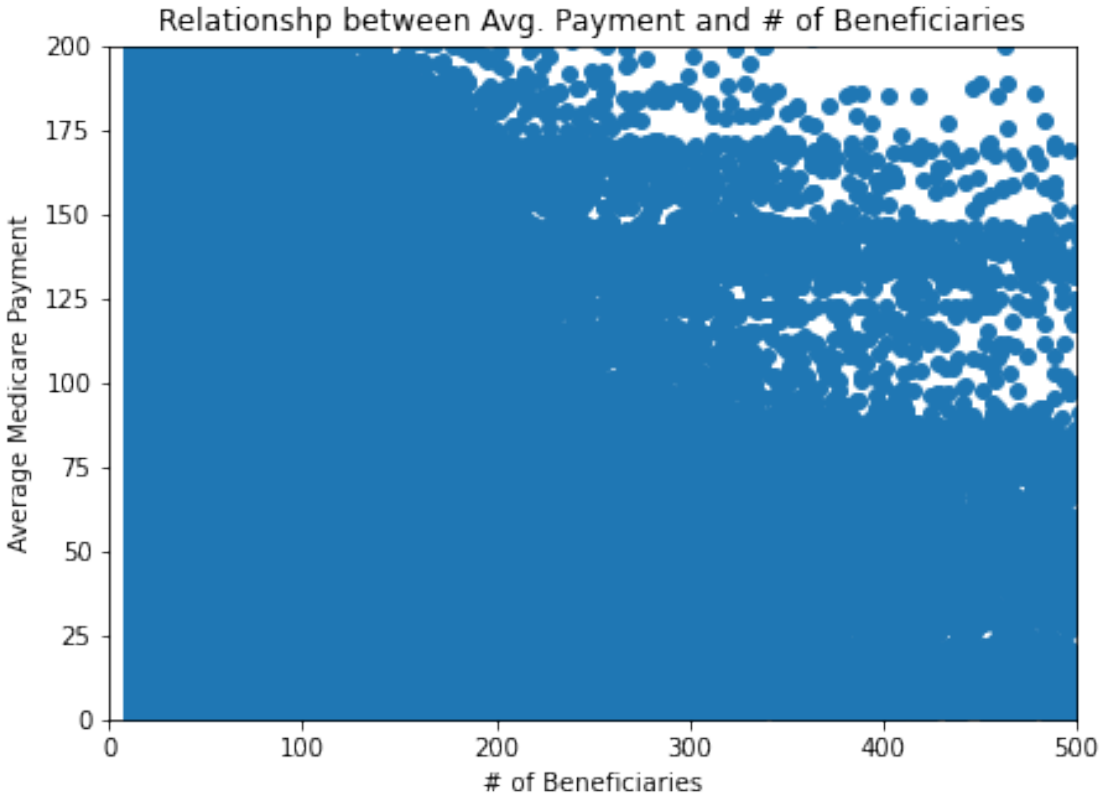


[42]:
```
fig, ax = plt.subplots(figsize=(7, 5))
plt.xlim(0,500)
plt.ylim(0,200)
```

```
ax.set_xlabel('# of Beneficiaries')
ax.set_ylabel('Average Medicare Payment')
ax.set_title('Relationshp between Avg. Payment and # of Beneficiaries')
ax.scatter(il.bene_unique_cnt,il.average_Medicare_payment_amt)
```

[42]: <matplotlib.collections.PathCollection at 0x7f8bbda1a5d0>



[50]:
```
fig, ax = plt.subplots(figsize=(7, 5))
ax.set_xlabel('# of Distinct Beneficiaries')
ax.set_ylabel('Count')
ax.set_title('Distribution of Distinct Beneficiary Count')
plt.hist(np.log2(il.bene_unique_cnt), bins='auto')
```

[50]:
```
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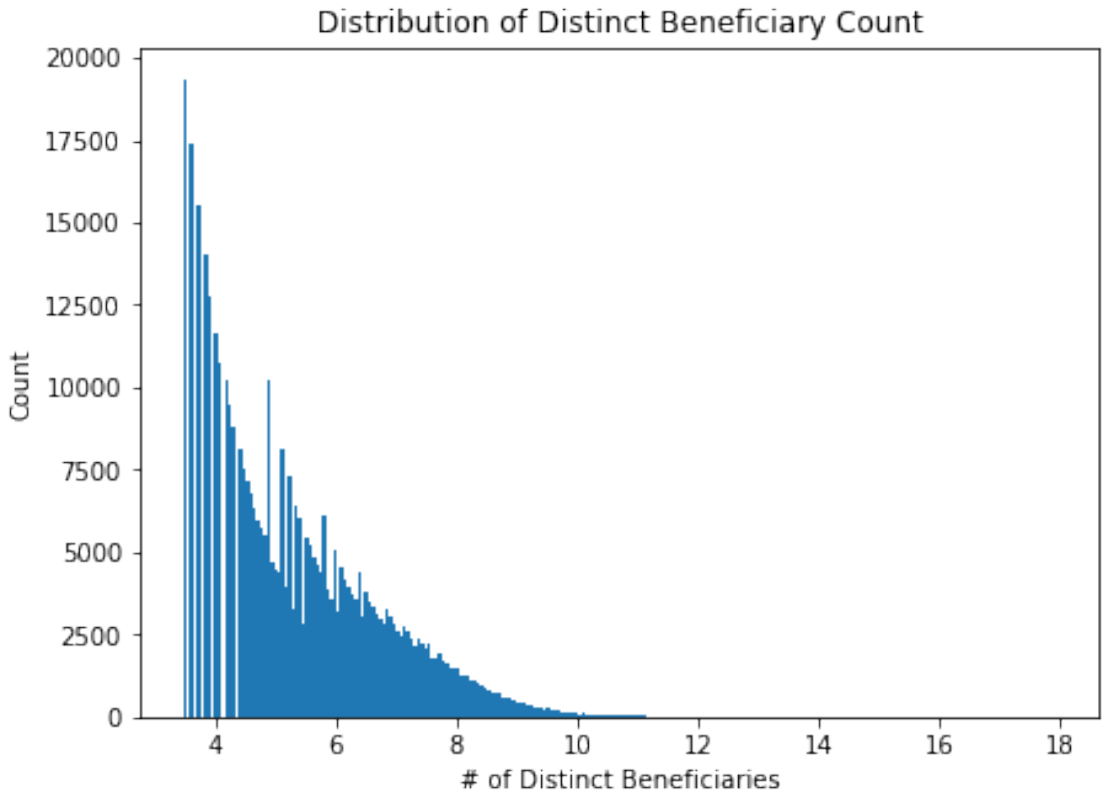

[48]:
```
fig, ax = plt.subplots(figsize=(7, 5))
ax.set_xlabel('# of Distinct Beneficiaries')
ax.set_ylabel('Count')
ax.set_title('Distribution of Distinct Beneficiary Count')
plt.hist(np.log2(il.average_Medicare_payment_amt+1), bins='auto')
```

[48]:
```
(array([2.0300e+02, 2.0600e+02, 1.1590e+03, 7.6000e+01, 6.2000e+01,
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        1.6700e+02, 3.0000e+01, 6.9000e+01, 4.4000e+01, 6.5000e+01,
        9.0000e+01, 5.6000e+01, 1.2300e+02, 9.7000e+01, 1.8400e+02,
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        4.5310e+03, 1.7700e+02, 7.9900e+02, 1.4380e+03, 1.4200e+02,
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        1.7350e+03, 1.9800e+03, 1.8440e+03, 1.9120e+03, 3.4300e+03,
```

```
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       5.1410e+03, 4.6710e+03, 4.2360e+03, 3.1050e+03, 3.5640e+03,
       3.8490e+03, 4.2500e+03, 4.2060e+03, 4.5650e+03, 5.0720e+03,
       5.1050e+03, 6.5160e+03, 5.9730e+03, 8.5780e+03, 6.7520e+03,
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14.65827493, 14.71358917, 14.76890342, 14.82421766, 14.87953191,
```
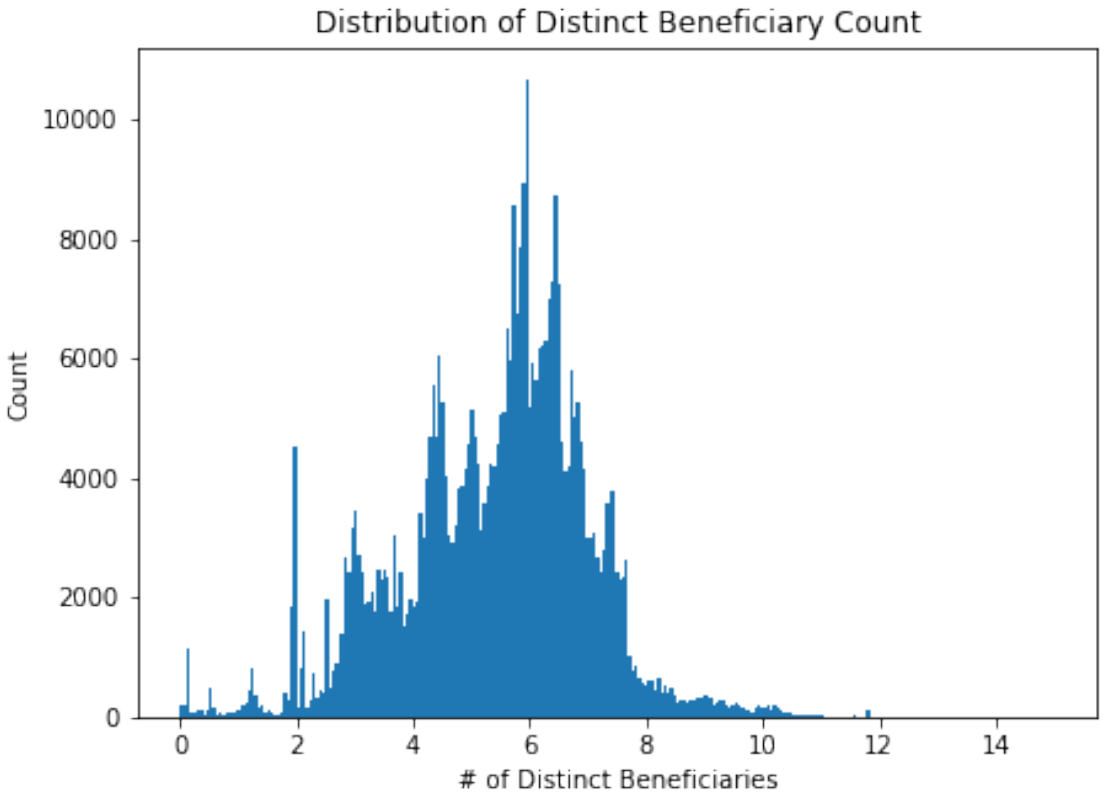

```
       14.93484615, 14.9901604 ]),
 <a list of 271 Patch objects>)
```



[47]:

[47]:
```
12          229.0
13         3123.0
14          255.0
15           74.0
16          118.0
            ...
9961462      21.0
9961463      14.0
9961464      12.0
9961465      18.0
9961466      82.0
Name: bene_unique_cnt, Length: 404554, dtype: float64
```

[107]:
```
##create frames for clustering, remove outliers
il_cluster = il[["bene_unique_cnt","average_submitted_chrg_amt"]]
```

```
il_cluster = il_cluster[(il_cluster.bene_unique_cnt <= np.mean(il_cluster.
 ↪bene_unique_cnt)+(2*np.std(il_cluster.bene_unique_cnt)))]
il_cluster = il_cluster[(il_cluster.average_submitted_chrg_amt <=np.
 ↪mean(il_cluster.average_submitted_chrg_amt)+(2*np.std(il_cluster.
 ↪average_submitted_chrg_amt)))]
il_cluster.bene_unique_cnt = il_cluster.bene_unique_cnt + 1
il_cluster.average_submitted_chrg_amt = il_cluster.average_submitted_chrg_amt +␣
 ↪1
```

[108]:
```
scaler = preprocessing.StandardScaler().fit(il_cluster)
ilNorm = scaler.transform(il_cluster)
```

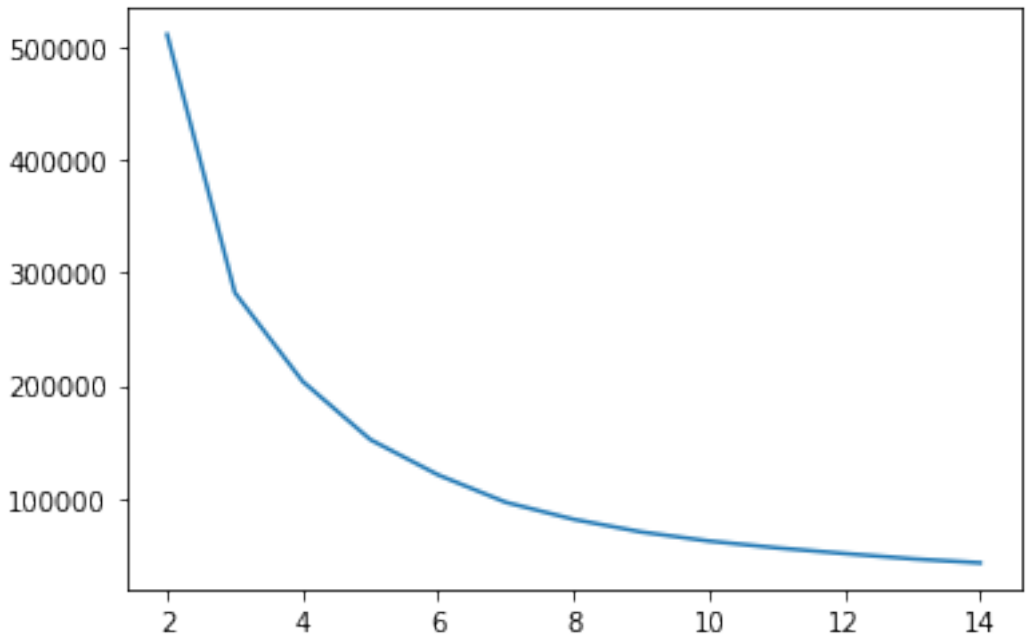
[109]:
```
maxClusters = 15
sse = []
for nClusters in range(2,maxClusters):
    kmeans = KMeans(n_clusters=nClusters, random_state=0).fit(ilNorm)
    sse.append(kmeans.inertia_)
```

[111]:
```
print(sse)
```

```
[510449.5552135208, 281962.99636889994, 203484.4651243761, 151951.6939226736,
120740.64323800248, 96467.73781608882, 81424.029956355, 70233.23438819459,
62209.13830426972, 56193.87606745972, 51168.999875926274, 46486.10671252256,
42921.8987112508]
```

[112]:
```
plt.plot(range(2,maxClusters),sse)
```

[112]:
```
[<matplotlib.lines.Line2D at 0x7f8b643497d0>]
```



[113]:
```
kmeans = KMeans(n_clusters=5, random_state=0).fit(ilNorm)
```

[114]:
```
data = pd.concat([il_cluster,pd.DataFrame(kmeans.
 ↪labels_,columns=["Cluster"])],axis=1)
```

[92]:
```
data.head(20)
```

[92]:

	bene_unique_cnt	average_submitted_chrg_amt	Cluster
0	NaN	NaN	1.0
1	NaN	NaN	1.0
2	NaN	NaN	1.0
3	NaN	NaN	1.0
4	NaN	NaN	1.0
5	NaN	NaN	1.0
6	NaN	NaN	1.0
7	NaN	NaN	1.0
8	NaN	NaN	1.0
9	NaN	NaN	1.0
10	NaN	NaN	1.0
11	NaN	NaN	1.0
12	229.0	116.000000	1.0
13	3123.0	171.000000	1.0
14	255.0	89.000000	1.0
15	74.0	69.000000	1.0
16	118.0	92.213675	1.0
17	187.0	147.331818	1.0
18	279.0	128.000000	1.0
19	68.0	176.000000	1.0

[115]:
```
data['Cluster'].value_counts()
```

[115]:
```
0.0    287124
1.0     48712
4.0     38670
3.0     16883
2.0      4365
Name: Cluster, dtype: int64
```

[117]:
```
data[(data['Cluster'] == 0) | (data['Cluster'] == 1) | (data['Cluster'] == 2)|
     (data['Cluster'] == 3)| (data['Cluster'] == 4)| (data['Cluster'] == 5) |
     (data['Cluster'] == 6)].groupby('Cluster').mean()
```

[117]:

Cluster	bene_unique_cnt	average_submitted_chrg_amt
0.0	73.721724	279.223905

1.0	74.110647	307.585229
2.0	77.112745	261.075728
3.0	66.260997	288.345827
4.0	73.187378	275.104137

[110]:
```
np.mean(il_cluster.bene_unique_cnt)+(2*np.std(il_cluster.bene_unique_cnt))
```

[110]: 310.7637132548417

[ ]:
```

```