Mobike Users Clustering Analysis

Background: Mobike, is an Internet short-distance travel solution developed by Beijing Mobike Technology Co., Ltd. founded by Hu Weiwei. It is an intelligent hardware with no fixed point rent-and-return mode. People can rent and return a motorbike quickly through a smartphone and complete a few kilometers' riding inside city at an affordable price. The professional design of the Mobike bicycle combines all-aluminum body, explosion-proof tires, shaft drive and other high-tech means to make it durable and reduce maintenance costs. The customized bicycle shape has a special recognition on the street. The embedded chip was integrated in the lock, with GPS module and SIM card also, to facilitate the monitoring of the specific position of the bicycle.

Question: based on the given data, processing the cluster analysis for customer segmentation using Python.

Analysis:

1. Data field definition

column	definition
user_id	user id
start_time	riding start time
end_time	riding end time
timeduration	riding timeduration
bikeid	bicycle id
tripduration	riding distance
from_station_id	start station id
from_station_name	start station name
to_station_id	end station id
to_station_name	end station name
usertype	user type
gender	gender
birthyear	birth year
age	age

2. Data cleaning and preprocessing

In [43]:
```
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
import numpy as np
%matplotlib inline
```

In [44]:
```
mobike=pd.read_csv('mobike.csv')
```

Data Cleaning & Preprocessing

[45]:
```
mobike.info()
#Unamed:0&start/end_time&station_name are all useless, need to drop;
#tripduration&age should be int or float;
#gender&birthyear got Null values
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 6427 entries, 0 to 6426
Data columns (total 15 columns):
Unnamed: 0          6427 non-null int64
user_id             6427 non-null int64
start_time          6427 non-null object
end_time            6427 non-null object
timeduration        6427 non-null int64
bikeid              6427 non-null int64
tripduration        6427 non-null object
from_station_id     6427 non-null int64
from_station_name   6427 non-null object
to_station_id       6427 non-null int64
to_station_name     6427 non-null object
usertype            6427 non-null object
gender              5938 non-null object
birthyear           5956 non-null float64
age                 6427 non-null object
dtypes: float64(1), int64(6), object(8)
```

[46]:
```
mobike.drop(['Unnamed: 0','start_time','end_time','from_station_name','to_station_name'],axis=1,inplace=True)
```

[47]:
```
mobike['age']=mobike['age'].str.replace(' ','0').astype(int)
#after investigation found that the reason why age got no null value and type is object
# is because there's spacing in excel, so need to replace spacing with 0 then convert to int type
```

[48]:
```
mobike['tripduration'] = mobike['tripduration'].str.replace(',','').astype(int)
#after investigation found that there's ',' in excel, need to remove
```

[49]:
```
mobike['gender']=pd.DataFrame(mobike.gender.replace(to_replace=np.nan,value='Unknown'))
#change the Null value in gender with Unknown, birthyear is useless in future analysis
```

[50]:
```
mobike.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 6427 entries, 0 to 6426
Data columns (total 10 columns):
user_id             6427 non-null int64
timeduration        6427 non-null int64
bikeid              6427 non-null int64
tripduration        6427 non-null int32
from_station_id     6427 non-null int64
to_station_id       6427 non-null int64
usertype            6427 non-null object
gender              6427 non-null object
birthyear           5956 non-null float64
age                 6427 non-null int32
dtypes: float64(1), int32(2), int64(5), object(2)
memory usage: 452.0+ KB
```

[51]:
```
mobike.describe()
#found that tripduration and age got something abnormal, need to dispose accordingly
```

t[51]:

	user_id	timeduration	bikeid	tripduration	from_station_id	to_station_id	birthyear	age
count	6.427000e+03	6427.000000	6427.000000	6.427000e+03	6427.000000	6427.000000	5956.000000	6427.000000
mean	2.135519e+07	11.778902	3491.637934	1.060471e+03	195.038432	198.502567	1982.488583	33.835693
std	2.181294e+05	9.692236	1912.171846	1.456811e+04	148.170025	148.939873	11.147859	14.342768
min	2.098358e+07	0.000000	2.000000	6.100000e+01	2.000000	2.000000	1906.000000	0.000000
25%	2.116805e+07	5.000000	1852.000000	3.490000e+02	77.000000	80.000000	1977.000000	27.000000
50%	2.135114e+07	9.000000	3618.000000	5.590000e+02	168.000000	172.000000	1986.000000	32.000000
75%	2.154376e+07	15.000000	5179.500000	9.320000e+02	287.000000	287.000000	1991.000000	41.000000
max	2.174223e+07	59.000000	6470.000000	1.139070e+06	662.000000	661.000000	2002.000000	113.000000

[52]:
```
mobike=mobike[mobike['age']<80]
mobike=mobike[mobike['tripduration']<100000]
```

n [54]:
```
mobike=pd.get_dummies(mobike)#type conversion
```

n [55]:
```
mobike.head()
```

Out[55]:

	user_id	timeduration	bikeid	tripduration	from_station_id	to_station_id	birthyear	age	usertype_Custo
0	21499218	7	2631	436	319	67	1982.0	37	
1	21694389	7	1565	445	164	195	1988.0	31	
2	21110722	18	2231	1090	163	69	1989.0	30	
3	21485409	9	4226	581	226	308	1989.0	30	
4	21445994	6	3475	390	77	621	1979.0	40	

n [56]:
```
mobike.drop(['usertype_Subscriber','gender_Unknown'],axis=1,inplace=True)
```

[71]:
```
mobike.head()
```

[71]:

	user_id	timeduration	bikeid	tripduration	from_station_id	to_station_id	birthyear	age	usertype_Customer	gender_Female	gender_Male
0	21499218	7	2631	436	319	67	1982.0	37	0	0	1
1	21694389	7	1565	445	164	195	1988.0	31	0	0	1
2	21110722	18	2231	1090	163	69	1989.0	30	1	0	1
3	21485409	9	4226	581	226	308	1989.0	30	0	1	0
4	21445994	6	3475	390	77	621	1979.0	40	0	0	1

3. Data modeling (select the proper features, data standardization, single variable analysis)

Data Modeling

ı [58]:
```
#1
mobike_=mobike[['timeduration','tripduration','age','usertype_Customer','gender_Female','gender_Male']]
# Select proper features
```

ı [59]:
```
from sklearn.preprocessing import scale
from sklearn import cluster
x=pd.DataFrame(scale(mobike_))#data standardization
```

ı [60]:
```
model=cluster.KMeans(n_clusters=3,random_state=30)
model.fit(x)
```

)ut[60]:
```
KMeans(algorithm='auto', copy_x=True, init='k-means++', max_iter=300,
    n_clusters=3, n_init=10, n_jobs=1, precompute_distances='auto',
    random_state=30, tol=0.0001, verbose=0)
```

ı [61]:
```
mobike_['cluster']=model.labels_
```

```
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```

[62]:
```
mobike_.head()
```

:[62]:

	timeduration	tripduration	age	usertype_Customer	gender_Female	gender_Male	cluster
0	7	436	37	0	0	1	1
1	7	445	31	0	0	1	1
2	18	1090	30	1	0	1	2
3	9	581	30	0	1	0	0
4	6	390	40	0	0	1	1

[63]:
```
mobike_.groupby(['cluster'])['timeduration'].describe()
# for cluster 0 and 1, the average of timeduration is similar, cluster 2 differs more with these two
```

ıt[63]:

cluster	count	mean	std	min	25%	50%	75%	max
0	1257.0	11.145585	8.167843	1.0	6.0	9.0	14.0	58.0
1	4516.0	10.152126	7.587430	0.0	5.0	8.0	13.0	59.0
2	649.0	24.234206	14.919144	0.0	12.0	21.0	34.0	59.0

The mean of timeduration shows there's no large difference between cluster0 and 1, the time of cluster2is much longer than them, but the max and min of these three are similar.

[64]:
```
mobike_.groupby(['cluster'])['tripduration'].describe()
#similar as timeduration
```

:[64]:

cluster	count	mean	std	min	25%	50%	75%	max
0	1257.0	711.914081	559.028177	61.0	367.0	556.0	875.0	7487.0
1	4516.0	650.676705	554.819359	74.0	325.0	504.5	812.0	14657.0
2	649.0	2476.251156	4042.686431	231.0	902.0	1491.0	2688.0	57368.0

[65]:
```
mobike_.groupby(['cluster'])['age'].describe()
#cluster 2 group with a large number of null age
```

t[65]:

cluster	count	mean	std	min	25%	50%	75%	max
0	1257.0	35.007955	10.377889	18.0	28.0	31.0	39.0	72.0
1	4516.0	37.033437	11.233729	0.0	29.0	34.0	43.0	79.0
2	649.0	9.058552	15.411925	0.0	0.0	0.0	23.0	63.0

From the average age, cluster1 got older age, cluster2 is younger due to much more Null values inside.

```
[66]: mobike_.groupby(['cluster'])['usertype_Customer'].describe()
      #more Customer inside the cluster 2,more Subscriber in 0 and 1
```

[66]:

cluster	count	mean	std	min	25%	50%	75%	max
0	1257.0	0.011933	0.108629	0.0	0.0	0.0	0.0	1.0
1	4516.0	0.005979	0.077099	0.0	0.0	0.0	0.0	1.0
2	649.0	0.972265	0.164339	0.0	1.0	1.0	1.0	1.0

```
In [67]: mobike_.groupby(['cluster'])['gender_Female'].describe()
         #cluster 0 is totally Female customer
```

Out[67]:

cluster	count	mean	std	min	25%	50%	75%	max
0	1257.0	1.000000	0.00000	1.0	1.0	1.0	1.0	1.0
1	4516.0	0.000000	0.00000	0.0	0.0	0.0	0.0	0.0
2	649.0	0.067797	0.25159	0.0	0.0	0.0	0.0	1.0

```
In [68]: mobike_.groupby(['cluster'])['gender_Male'].describe()
         #cluster 1 got most Male customer
```

Out[68]:

cluster	count	mean	std	min	25%	50%	75%	max
0	1257.0	0.000000	0.000000	0.0	0.0	0.0	0.0	0.0
1	4516.0	0.996014	0.063014	0.0	1.0	1.0	1.0	1.0
2	649.0	0.209553	0.407304	0.0	0.0	0.0	0.0	1.0

4. Model Assessment

Model Assessment

```
In [69]: from sklearn import metrics
         x_cluster=model.fit_predict(x)
         score=metrics.silhouette_score(x,x_cluster)
```

```
In [72]: print(score)
```

0.5935125254648099

```
In [73]: centers=pd.DataFrame(model.cluster_centers_)
```

```
In [74]: centers.to_csv('center_.csv')
```

Cluster summary:

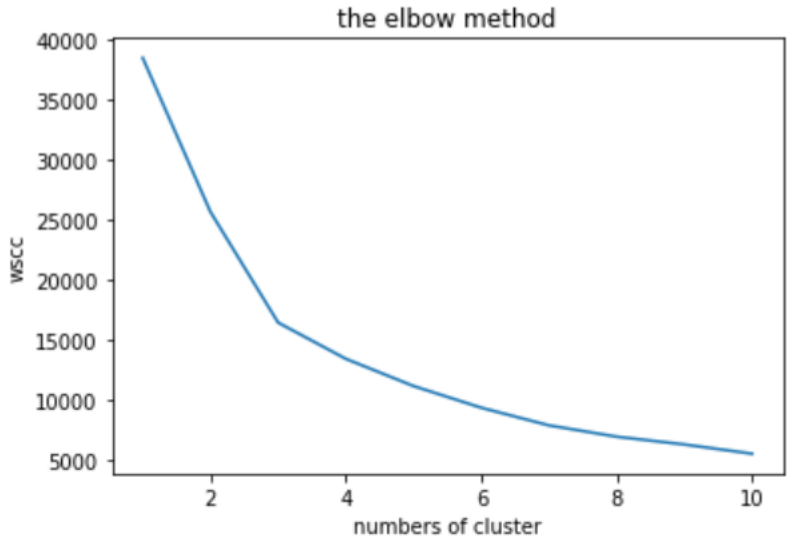
id	timeduration	tripduration	age	Customer	Female	Male	T/D/A/U/G	Remarks	user_type
0	-0.064510449	-0.090653206	0.084	-0.3031856	1.98399	-1.60988	S+S+M+S+F	Female with middle age like short tour	Subscriber
1	-0.167197725	-0.131701663	0.2261	-0.3226261	-0.50404	0.612271	M+M+O+S+M	Male with middle age like middle tour	Subscriber
2	1.288373745	1.092012	-1.736	2.83217825	-0.33536	-1.14236	L+L+Y/U+C+U	Long tour liker, more younger	Customer

5. Model Optimization

Model Optimization

[77]:
```
from sklearn.cluster import KMeans
```

[78]:
```
wscc=[]
for i in range (1,11):
    kmeans=KMeans(n_clusters=i,init='k-means++',random_state=30)
    kmeans.fit(x)
    wscc.append(kmeans.inertia_)
plt.plot(range(1,11),wscc)
plt.title('the elbow method')
plt.xlabel('numbers of cluster')
plt.ylabel('wscc')
plt.show()
#from chart can see the best k value shuold be 3
```



[83]:
```
#2, still can try 5 clusters
model2=cluster.KMeans(n_clusters=5,random_state=30)
model2.fit(x)
```

t[83]:
```
KMeans(algorithm='auto', copy_x=True, init='k-means++', max_iter=300,
    n_clusters=5, n_init=10, n_jobs=1, precompute_distances='auto',
    random_state=30, tol=0.0001, verbose=0)
```

[84]:
```
x_cluster=model2.fit_predict(x)
score=metrics.silhouette_score(x,x_cluster)
print(score)
```

```
0.49229935259233326
```

The model's efficiency got worse with 5 groups; silhouette score is 0.49<original score 0.59.

```
[89]: #3, re-select the features
mobike_3=mobike[['timeduration','age','usertype_Customer','gender_Female','gender_Male']]

[90]: x3=pd.DataFrame(scale(mobike_3))

[91]: model3=cluster.KMeans(n_clusters=3,random_state=30)
model3.fit(x3)

t[91]: KMeans(algorithm='auto', copy_x=True, init='k-means++', max_iter=300,
    n_clusters=3, n_init=10, n_jobs=1, precompute_distances='auto',
    random_state=30, tol=0.0001, verbose=0)

[95]: mobike_3['cluster']=model3.labels_

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[92]: x3_cluster=model3.fit_predict(x3)
score=metrics.silhouette_score(x3,x3_cluster)
print(score)

0.6140404077479052

[93]: centers3=pd.DataFrame(model3.cluster_centers_)

[94]: centers3.to_csv('center3.csv')
```

If using timeduration only (without tripduration), the model got better, score is 0.61.

```
In [96]: mobike_3.groupby(['cluster'])['timeduration'].describe()
```

Out[96]:

cluster	count	mean	std	min	25%	50%	75%	max
0	4519.0	10.275725	7.884352	0.0	5.0	8.0	13.0	59.0
1	1258.0	11.240064	8.314306	1.0	6.0	9.0	14.0	58.0
2	645.0	23.269767	14.617221	0.0	12.0	20.0	32.0	59.0

```
In [97]: mobike_3.groupby(['cluster'])['age'].describe()
```

Out[97]:

cluster	count	mean	std	min	25%	50%	75%	max
0	4519.0	37.041602	11.249575	0.0	29.0	34.0	43.0	79.0
1	1258.0	35.069952	10.422951	18.0	28.0	31.0	39.0	72.0
2	645.0	8.710078	14.819137	0.0	0.0	0.0	22.0	63.0

Cluster Summary:

id	timeduration	age	Customer	Female	Male	T/A/U/G	Remarks	user_type
0	-0.15442212	0.2266814	-0.329863814	-0.504035656	0.611782868	S+O+S+M	older short-trip male Subscriber	Subscriber
1	-0.054744794	0.08838508	-0.308407153	1.983986623	-1.609882789	S+M+S+F	middle-age short-trip female Subscriber	Subscriber
2	1.188686066	-1.7605607	2.91260585	-0.338167504	-1.146378654	L+Y/U+C+U	younger long-trip customer	Customer

```
[98]: #4, change the features
mobike_4=mobike[['tripduration','age','usertype_Customer','gender_Female','gender_Male']]

[99]: x4=pd.DataFrame(scale(mobike_4))

[101]: model4=cluster.KMeans(n_clusters=3,random_state=30)
model4.fit(x4)

[101]: KMeans(algorithm='auto', copy_x=True, init='k-means++', max_iter=300,
    n_clusters=3, n_init=10, n_jobs=1, precompute_distances='auto',
    random_state=30, tol=0.0001, verbose=0)

[102]: mobike_4['cluster']=model4.labels_

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[103]: x4_cluster=model4.fit_predict(x4)
score=metrics.silhouette_score(x4,x4_cluster)
print(score)

0.6870453015153136

[104]: centers4=pd.DataFrame(model4.cluster_centers_)

[106]: centers4.to_csv('centers4.csv')
```

If using tripduration only (without timeduration), the model got more efficient, score is 0.687.

id	tripduration	age	Customer	Female	Male	D/A/U/G	Remarks	user_type
0	-0.124257716	0.226547	-0.332734981	-0.504035656	0.611764149	S+O+S+M	older short-trip male Subscriber	Subscriber
1	-0.076687871	0.087953	-0.31611024	1.983986623	-1.609882789	S+M+S+F	middle-age short-trip female Subscriber	Subscriber
2	0.99782506	-1.7204	2.88303496	-0.326319779	-1.125020204	L+Y/U+C+U	younger long-trip customer	Customer

Conclusion: after data modeling, assessment and optimization, divided customers into 3 groups:

1. Male customer with older age which prefer short tour, is subscriber: (we can offer some discount coupon or lucky draw activities especially for older male users, such as users can obtain the benefits as long as their riding times or distance reach the requirement so that can encourage them to use the product more and for business promotion)
2. Female user with middle age which prefer short riding, too, is subscriber: (similar as above, just change the marketing type to aim at middle-age female users)
3. Younger long-trip rider, is general customer: (consider convert this part of users from usual customer to subscriber, enhance the customers' loyalty)