K-Means Clustering

Neccessary Imports

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import plotly as py
import plotly.graph_objs as go
from sklearn.cluster import KMeans
import warnings
import os
warnings.filterwarnings("ignore")
```

Exploring the Dataset

```
dataframe = pd.read_csv("Mall_Customers.csv")
dataframe.head()
```

	CustomerID	Gender	Age	Annual Income (k$)	Spending Score (1-100)
0	1	Male	19	15	39
1	2	Male	21	15	81
2	3	Female	20	16	6
3	4	Female	23	16	77
4	5	Female	31	17	40

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```
dataframe.shape
```

```
(200, 5)
```

```
dataframe.describe()
```

	CustomerID	Age	Annual Income (k$)	Spending Score (1-100)
count	200.000000	200.000000	200.000000	200.000000
mean	100.500000	38.850000	60.560000	50.200000
std	57.879185	13.969007	26.264721	25.823522
min	1.000000	18.000000	15.000000	1.000000
25%	50.750000	28.750000	41.500000	34.750000
50%	100.500000	36.000000	61.500000	50.000000
75%	150.250000	49.000000	78.000000	73.000000
max	200.000000	70.000000	137.000000	99.000000

```
dataframe.dtypes
```

	0
CustomerID	int64
Gender	object
Age	int64
Annual Income (k$)	int64
Spending Score (1-100)	int64

```
dataframe.isnull().sum()
```

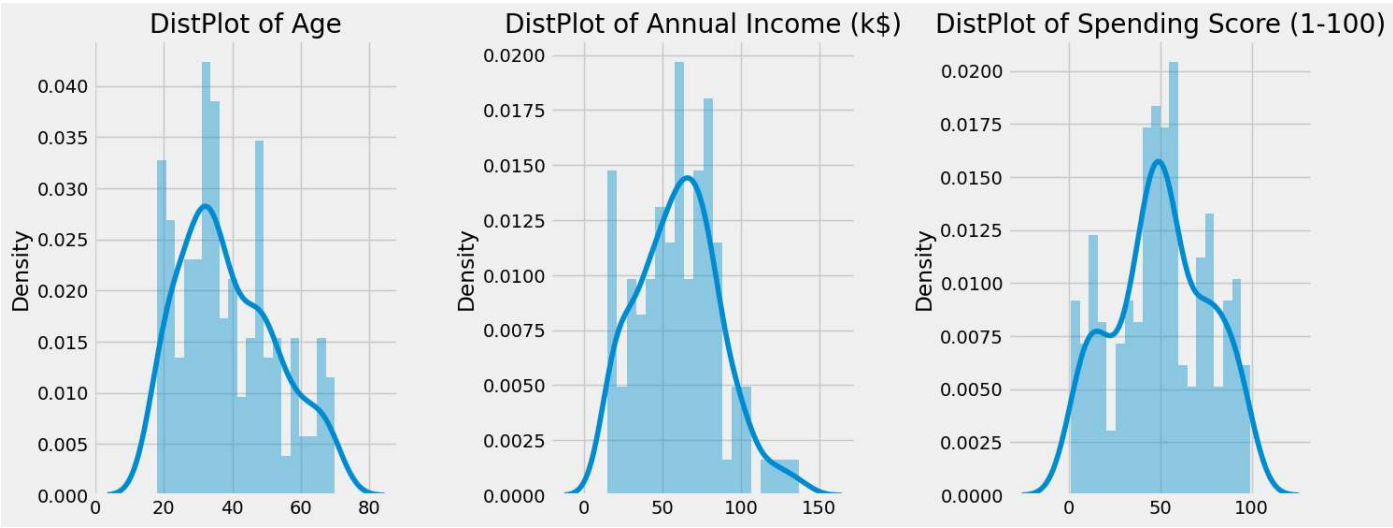
	0
CustomerID	0
Gender	0
Age	0
Annual Income (k$)	0
Spending Score (1-100)	0

Data Visulization

```
plt.style.use('fivethirtyeight')
```

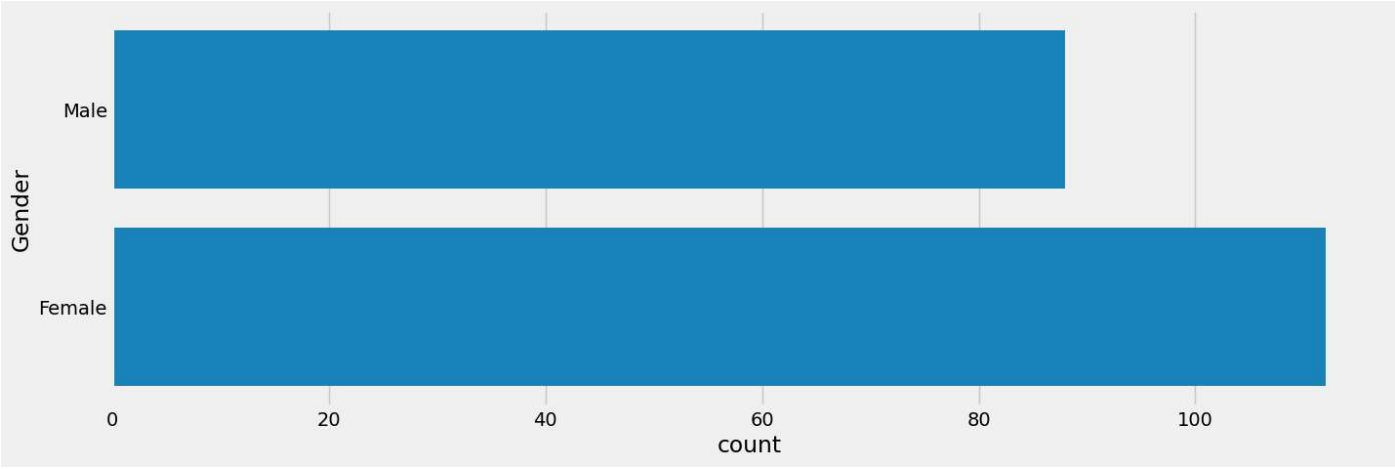
Histograms

```
plt.figure(1, figsize=(15, 6))
iterator = 0
for i in ['Age', 'Annual Income (k$)', 'Spending Score (1-100)']:
  iterator += 1
  plt.subplot(1, 3, iterator)
  plt.subplots_adjust(hspace=0.5, wspace=0.5)
  sns.distplot([dataframe[i]], bins=20)
  plt.title('DistPlot of {}'.format(i))
plt.show()
```



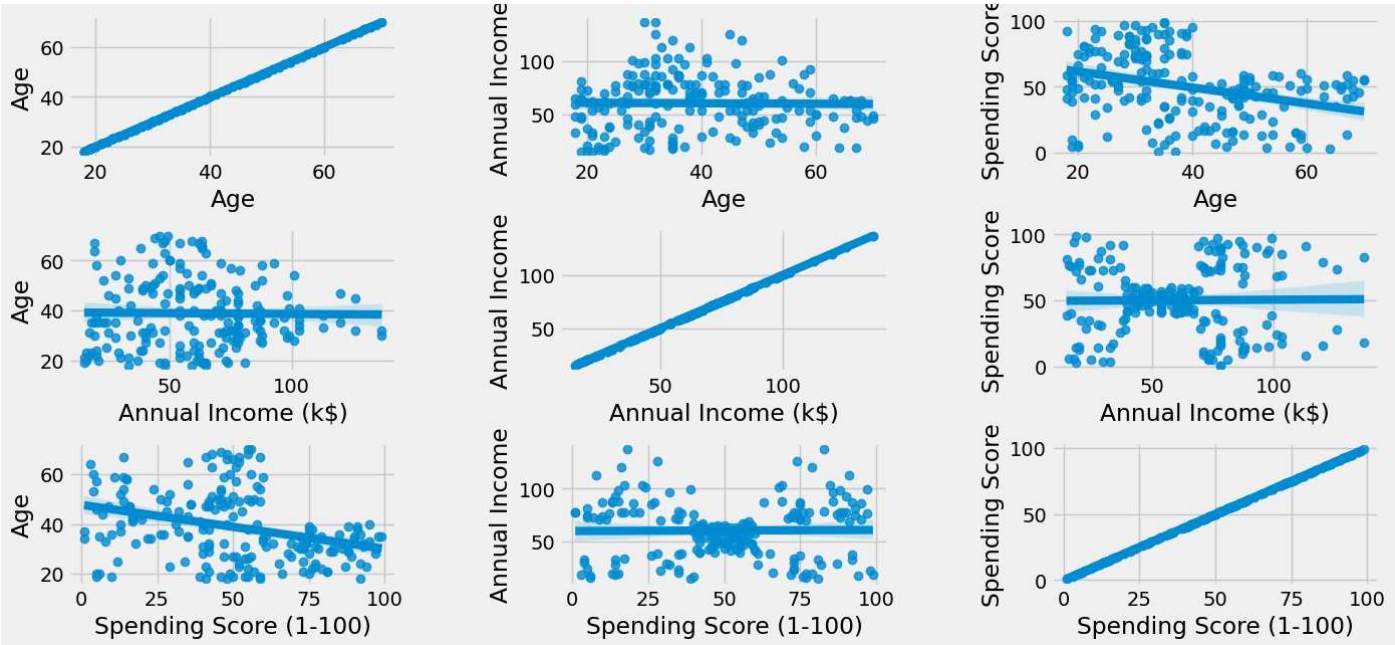
Ploting the Count of Gender

```
plt.figure(1, figsize=(15, 5))
sns.countplot(y='Gender', data = dataframe)
plt.show()
```



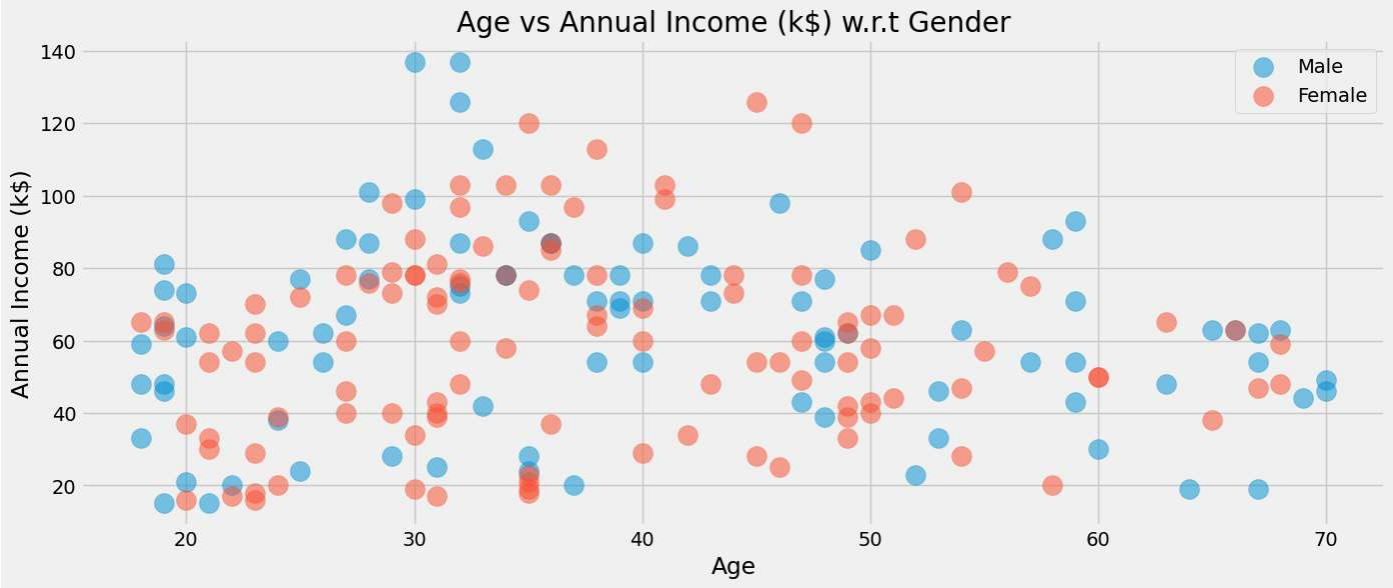
Plotting a relation between the Age, Annual Income (k$) and Spending Score

```
plt.figure(1, figsize=(15, 7))
iterartor = 0
for i in ['Age', 'Annual Income (k$)', 'Spending Score (1-100)']:
  for j in ['Age', 'Annual Income (k$)', 'Spending Score (1-100)']:
    iterartor += 1
    plt.subplot(3, 3, iterartor)
    plt.subplots_adjust(hspace=0.5, wspace=0.5)
    sns.regplot(x=i, y=j, data=dataframe)
    plt.ylabel(j.split()[0]+' '+j.split()[1] if len(j.split()) > 1 else j)
plt.show()
```



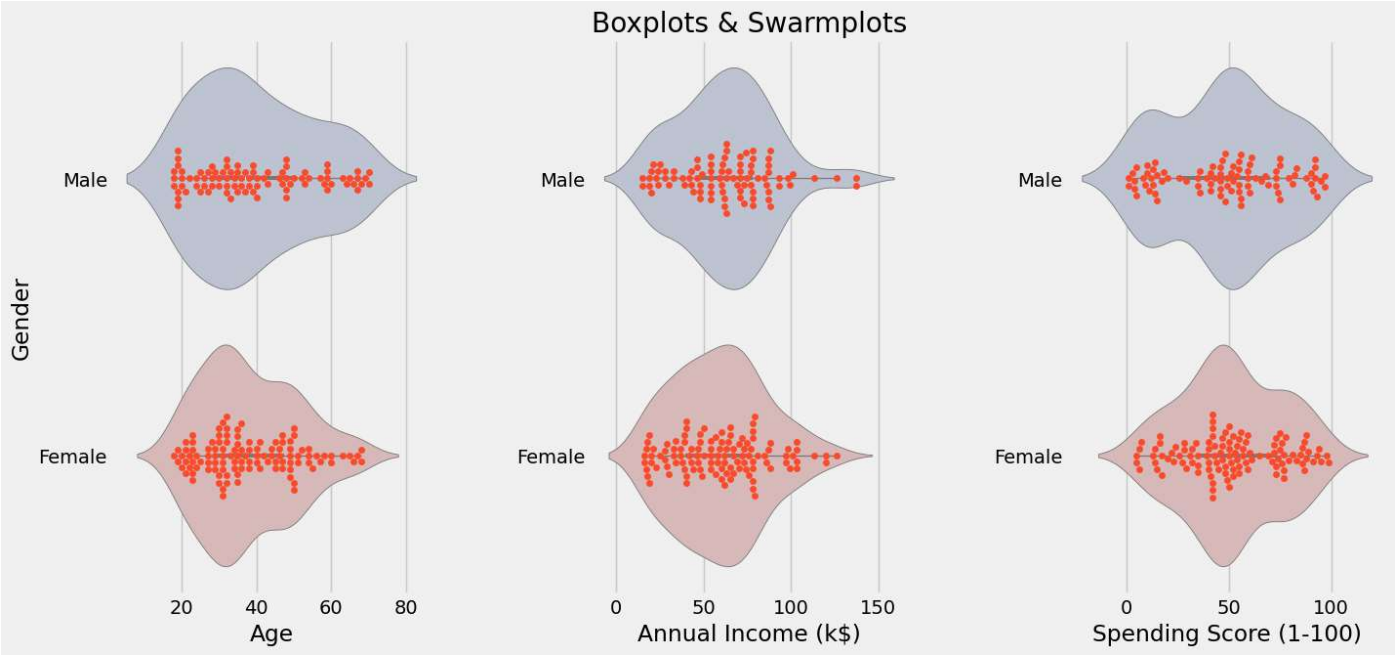
Age vs Annual Income with respect to gender

```
plt.figure(1, figsize=(15, 6))
for gender in ['Male', 'Female']:
  plt.scatter(x = 'Age', y = 'Annual Income (k$)', data = dataframe[dataframe['Gender'] == gender], s = 200, alpha=0.5, label=gender)
  plt.xlabel('Age')
  plt.ylabel('Annual Income (k$)')
  plt.title('Age vs Annual Income (k$) w.r.t Gender')
  plt.legend()
plt.show()
```



Distribution of values in Age , Annual Income and Spending Score according to Gender

```
plt.figure(1 , figsize = (15 , 7))
n = 0
for cols in ['Age' , 'Annual Income (k$)' , 'Spending Score (1-100)']:
    n += 1
    plt.subplot(1 , 3 , n)
    plt.subplots_adjust(hspace = 0.5 , wspace = 0.5)
    sns.violinplot(x = cols , y = 'Gender' , data = dataframe , palette = 'vlag')
    sns.swarmplot(x = cols , y = 'Gender' , data = dataframe)
    plt.ylabel('Gender' if n == 1 else '')
    plt.title('Boxplots & Swarmplots' if n == 2 else '')
plt.show()
```



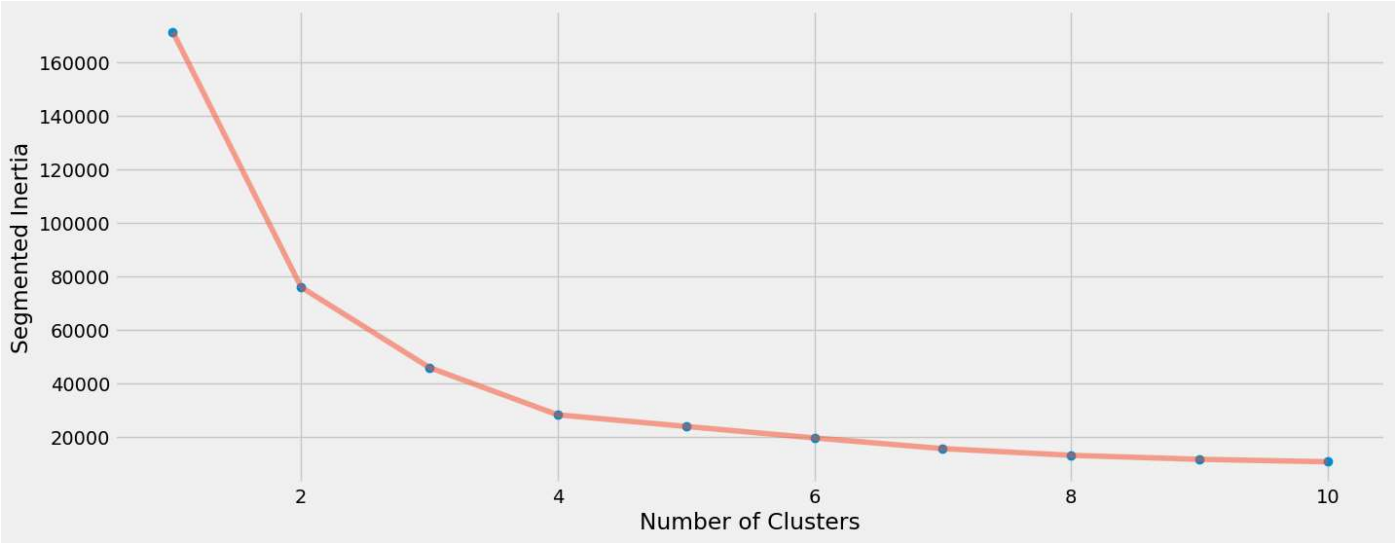
Clustering Using K-Means

Creating Segmentations using Age and Spending Score

```
Y1 = dataframe[['Age', 'Spending Score (1-100)']].iloc[:, :].values
segmented_inertia = []
for x in range(1, 11):
  algorithm = (KMeans(n_clusters = x, init = 'k-means++',n_init = 10, max_iter=300,
                      tol= 0.0001, random_state =111, algorithm='elkan'))
  algorithm.fit(Y1)
  segmented_inertia.append(algorithm.inertia_)
```

Selction of N number of clusters based on Squared Distance between Centroids and data points

```
plt.figure(1, figsize=(15, 6))
plt.plot(np.arange(1, 11), segmented_inertia, 'o')
plt.plot(np.arange(1, 11), segmented_inertia, '-', alpha=0.5)
plt.xlabel('Number of Clusters')
plt.ylabel('Segmented Inertia')
plt.show()
```



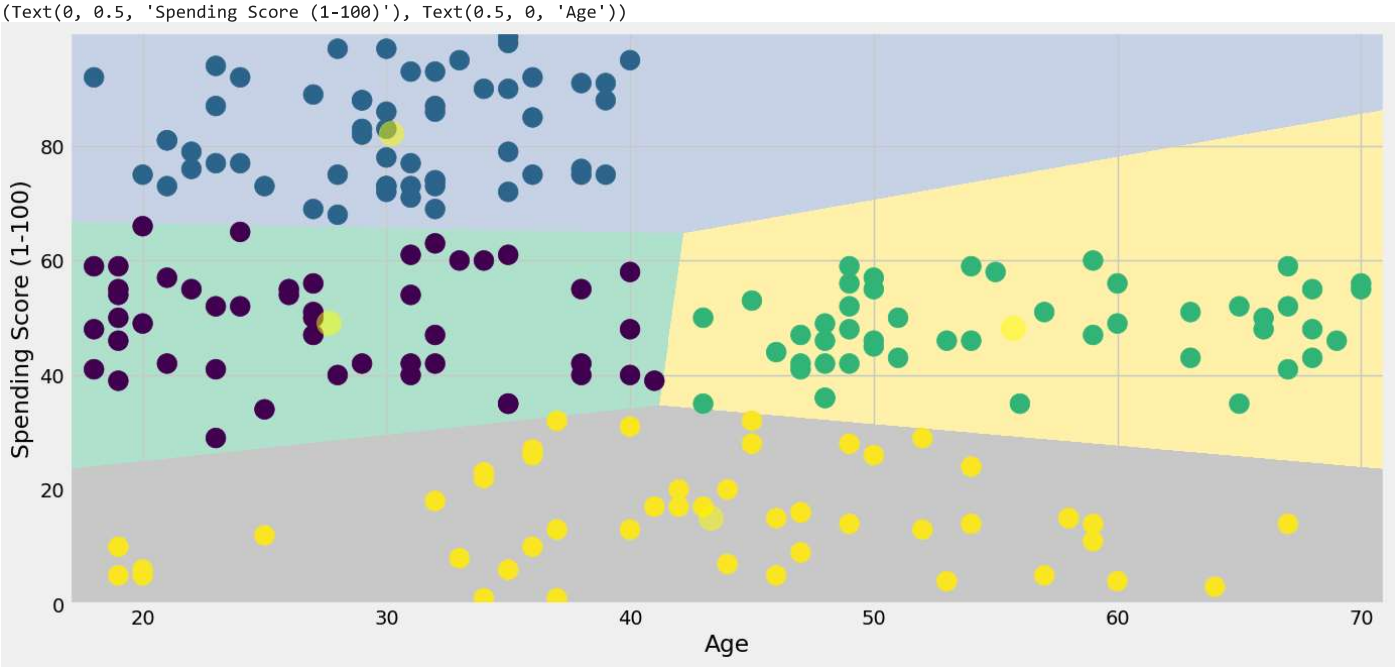

```
algorithm = (KMeans(n_clusters = 4 ,init='k-means++', n_init = 10 ,max_iter=300,
                    tol=0.0001,  random_state= 111  , algorithm='elkan') )
algorithm.fit(Y1)
labels1 = algorithm.labels_
centroids1 = algorithm.cluster_centers_


h = 0.02
x_min, x_max = Y1[:, 0].min() - 1, Y1[:, 0].max() + 1
y_min, y_max = Y1[:, 1].min() - 1, Y1[:, 1].max() + 1
xx, yy = np.meshgrid(np.arange(x_min, x_max, h), np.arange(y_min, y_max, h))
Z = algorithm.predict(np.c_[xx.ravel(), yy.ravel()])


plt.figure(1 , figsize = (15 , 7) )
plt.clf()
Z = Z.reshape(xx.shape)
plt.imshow(Z , interpolation='nearest',
           extent=(xx.min(), xx.max(), yy.min(), yy.max()),
           cmap = plt.cm.Pastel2, aspect = 'auto', origin='lower')

plt.scatter( x = 'Age' ,y = 'Spending Score (1-100)' , data = dataframe , c = labels1 ,
            s = 200 )
plt.scatter(x = centroids1[: , 0] , y =  centroids1[: , 1] , s = 300 , c = 'yellow' , alpha = 0.5)
plt.ylabel('Spending Score (1-100)') , plt.xlabel('Age')
```

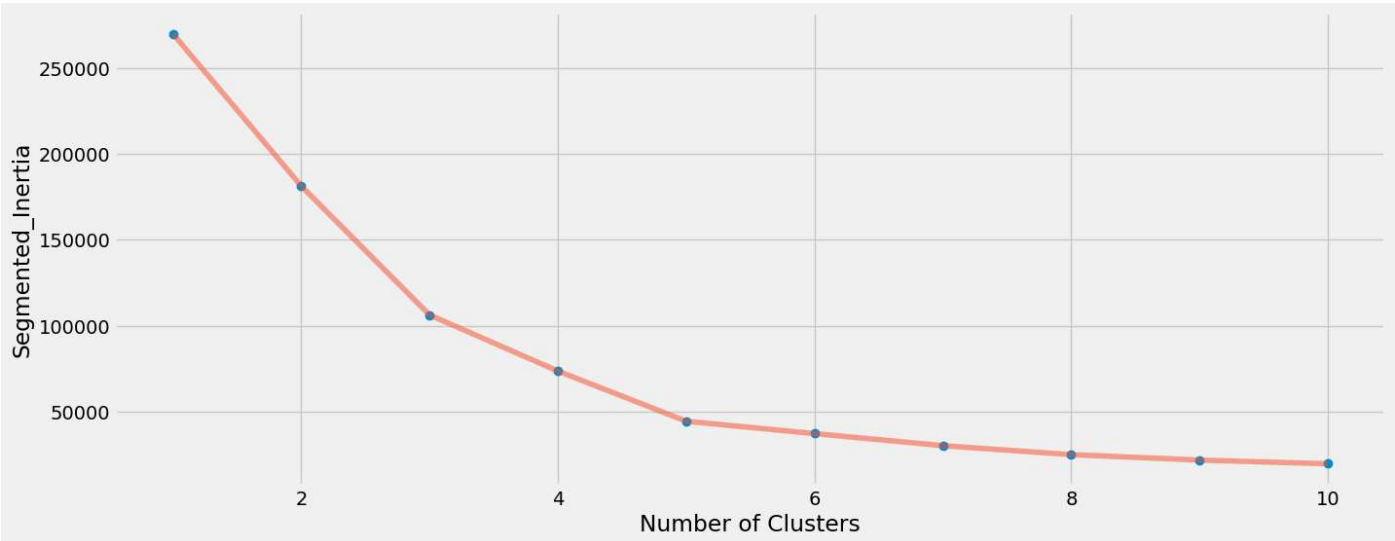
```
(Text(0, 0.5, 'Spending Score (1-100)'), Text(0.5, 0, 'Age'))
```



Segmentation using Annual Income and Spending Score

```
Y2 = dataframe[['Annual Income (k$)' , 'Spending Score (1-100)']].iloc[: , :].values
segmented_inertia = []
for x in range(1 , 11):
    algorithm = (KMeans(n_clusters = x ,init='k-means++', n_init = 10 ,max_iter=300,
                        tol=0.0001,  random_state= 111  , algorithm='elkan') )
    algorithm.fit(Y2)
    segmented_inertia.append(algorithm.inertia_)
```

```
plt.figure(1 , figsize = (15 ,6))
plt.plot(np.arange(1 , 11) , segmented_inertia , 'o')
plt.plot(np.arange(1 , 11) , segmented_inertia , '-' , alpha = 0.5)
plt.xlabel('Number of Clusters') , plt.ylabel('Segmented_Inertia')
plt.show()
```

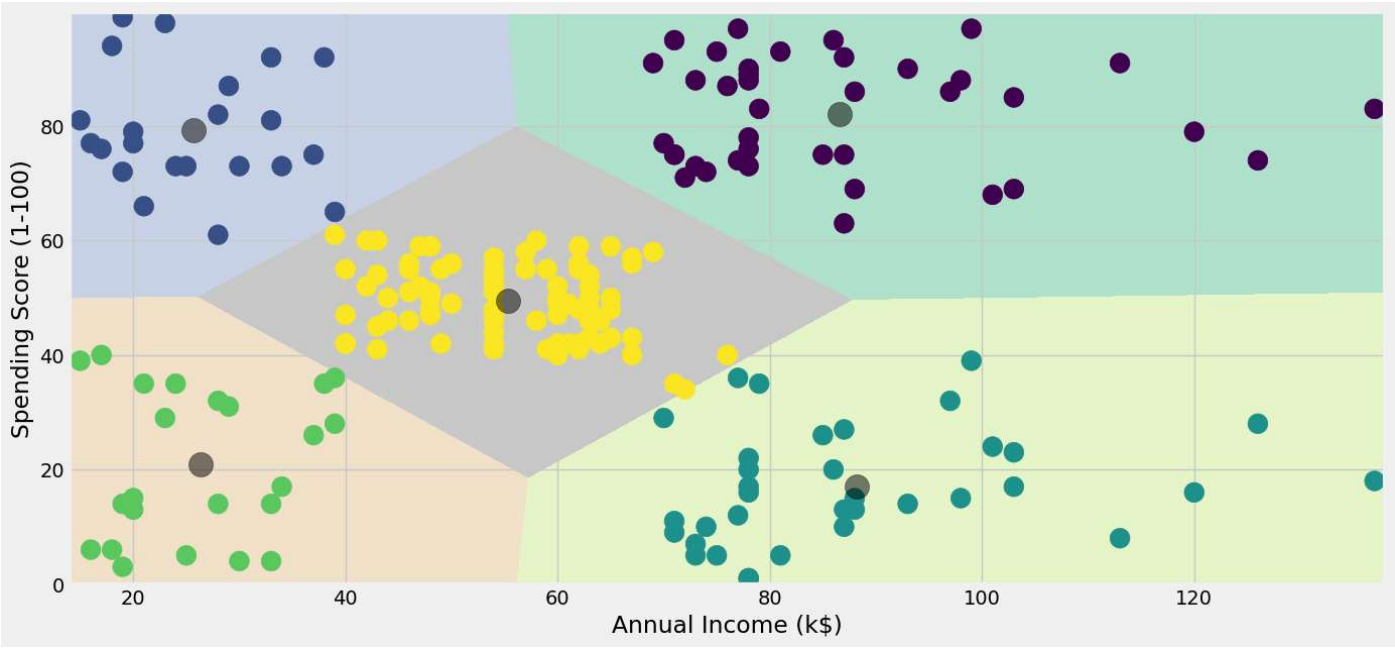


```
algorithm = (KMeans(n_clusters = 5 ,init='k-means++', n_init = 10 ,max_iter=300,
                    tol=0.0001,  random_state= 111  , algorithm='elkan') )
algorithm.fit(Y2)
labels2 = algorithm.labels_
centroids2 = algorithm.cluster_centers_


h = 0.02
x_min, x_max = Y2[:, 0].min() - 1, Y2[:, 0].max() + 1
y_min, y_max = Y2[:, 1].min() - 1, Y2[:, 1].max() + 1
xx, yy = np.meshgrid(np.arange(x_min, x_max, h), np.arange(y_min, y_max, h))
Z2 = algorithm.predict(np.c_[xx.ravel(), yy.ravel()])


plt.figure(1 , figsize = (15 , 7) )
plt.clf()
Z2 = Z2.reshape(xx.shape)
plt.imshow(Z2 , interpolation='nearest',
           extent=(xx.min(), xx.max(), yy.min(), yy.max()),
           cmap = plt.cm.Pastel2, aspect = 'auto', origin='lower')

plt.scatter( x = 'Annual Income (k$)' ,y = 'Spending Score (1-100)' , data = dataframe , c = labels2 ,
            s = 200 )
plt.scatter(x = centroids2[: , 0] , y =  centroids2[: , 1] , s = 300 , c = 'black' , alpha = 0.5)
plt.ylabel('Spending Score (1-100)') , plt.xlabel('Annual Income (k$)')
plt.show()
```



Selecting the Features for Model

```
dataframe.head(15)
```

	CustomerID	Gender	Age	Annual Income (k$)	Spending Score (1-100)
0	1	Male	19	15	39
1	2	Male	21	15	81
2	3	Female	20	16	6
3	4	Female	23	16	77
4	5	Female	31	17	40
5	6	Female	22	17	76
6	7	Female	35	18	6
7	8	Female	23	18	94

Next Generate code with dataframe View recommended plots New interactive sheet

```
X = dataframe.iloc[:, [3, 4]].values
```

Buliding a Model

Using K-Means Algorithm to decide the optimum Cluster

```
from sklearn.cluster import KMeans
w_clist=[]

for i in range(1,11):
    kmeans = KMeans(n_clusters= i, init='k-means++', random_state=0)
    kmeans.fit(X)
    w_clist.append(kmeans.inertia_)


plt.plot(range(1,11), w_clist)
plt.title('The Elbow Method')
plt.xlabel('No of clusters')
plt.ylabel('wcss')
plt.show()
```