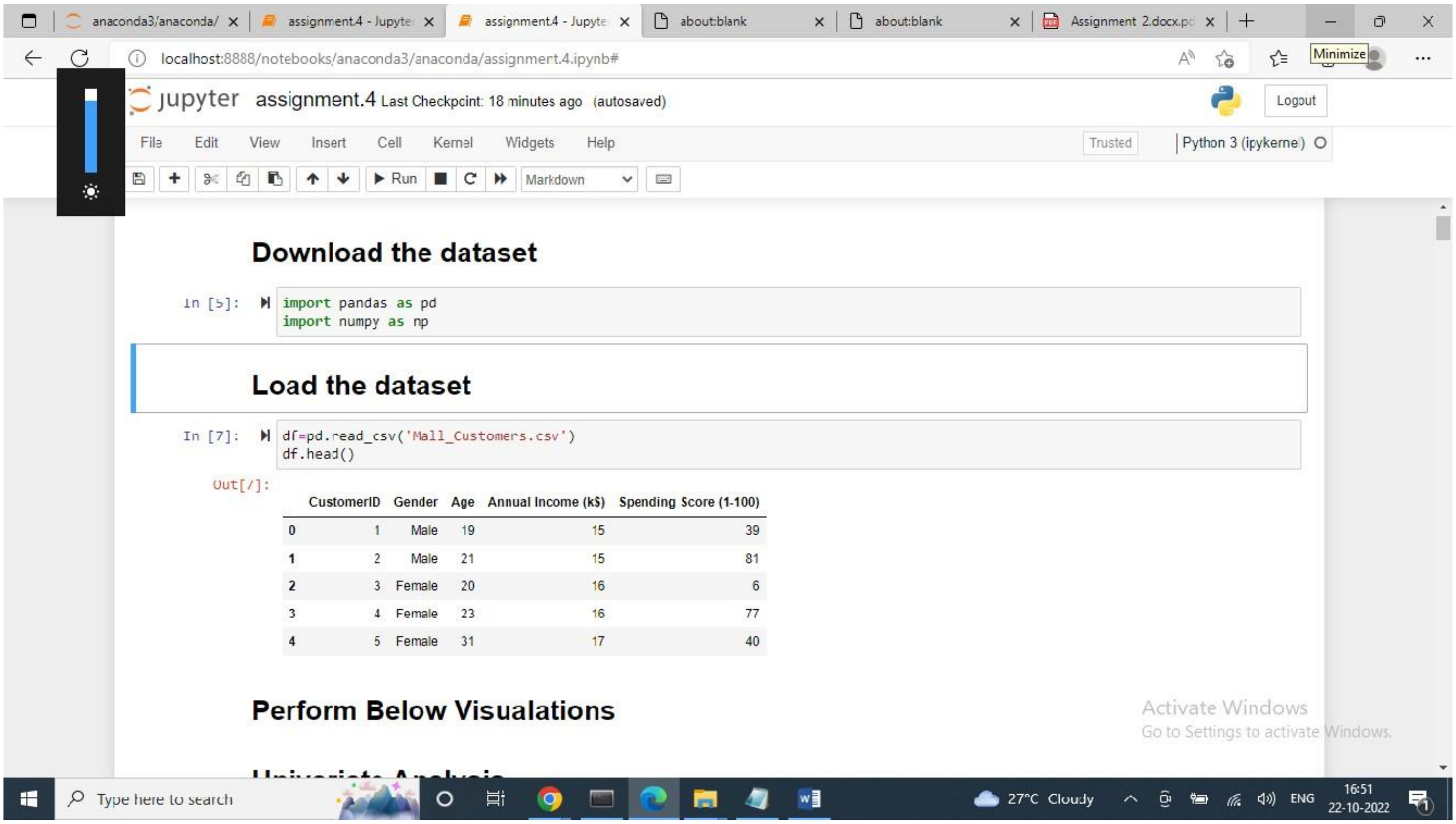
ASSIGNMENT-4

APPLIED DATA SCIENCE

Assignment date	22 October 2022
Student Name	**Harsh Kumar**
Student Roll Number	7309730919104036
Maximum Marks	2 Marks



Download the dataset

```
In [5]: import pandas as pd
        import numpy as np
```

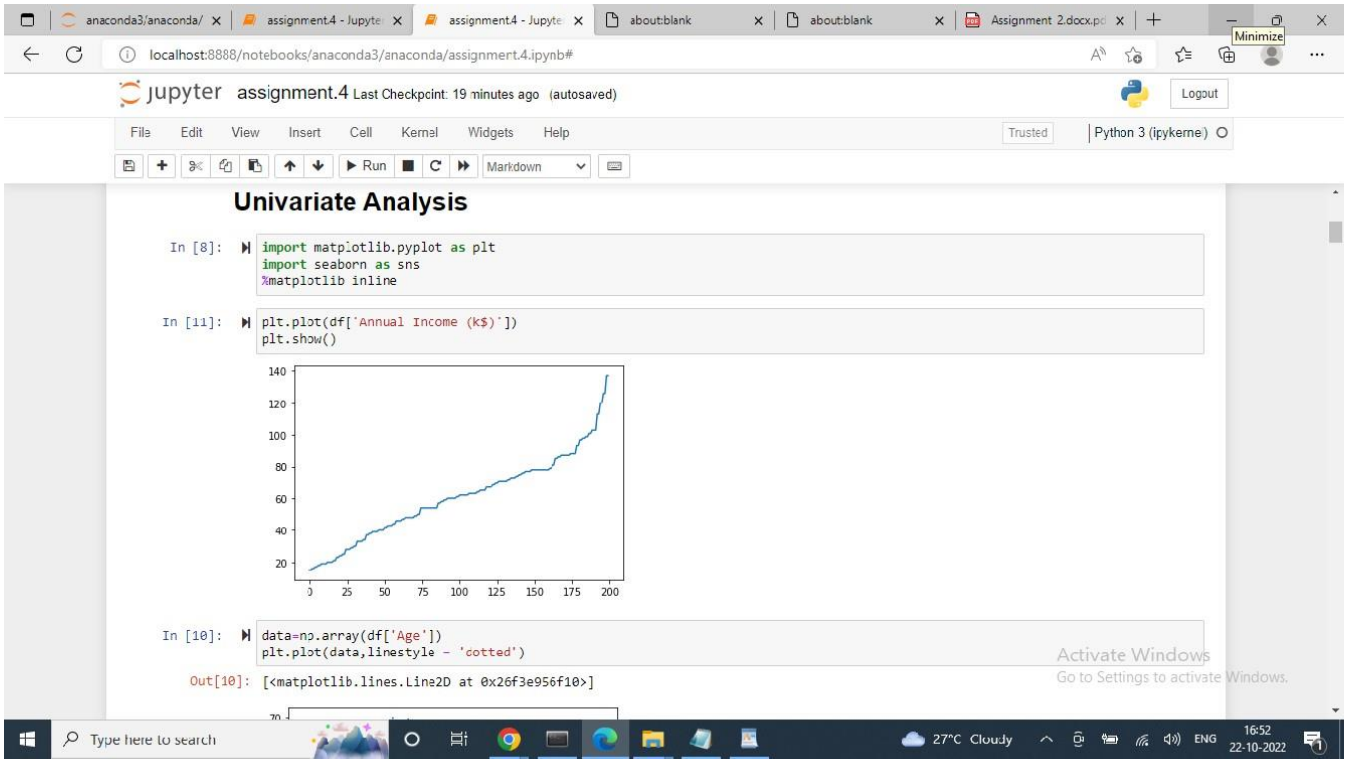
Load the dataset

```
In [7]: df=pd.read_csv('Mall_Customers.csv')
        df.head()
```

```
Out[7]:
   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
```

Perform Below Visualations

Univariate Analysis

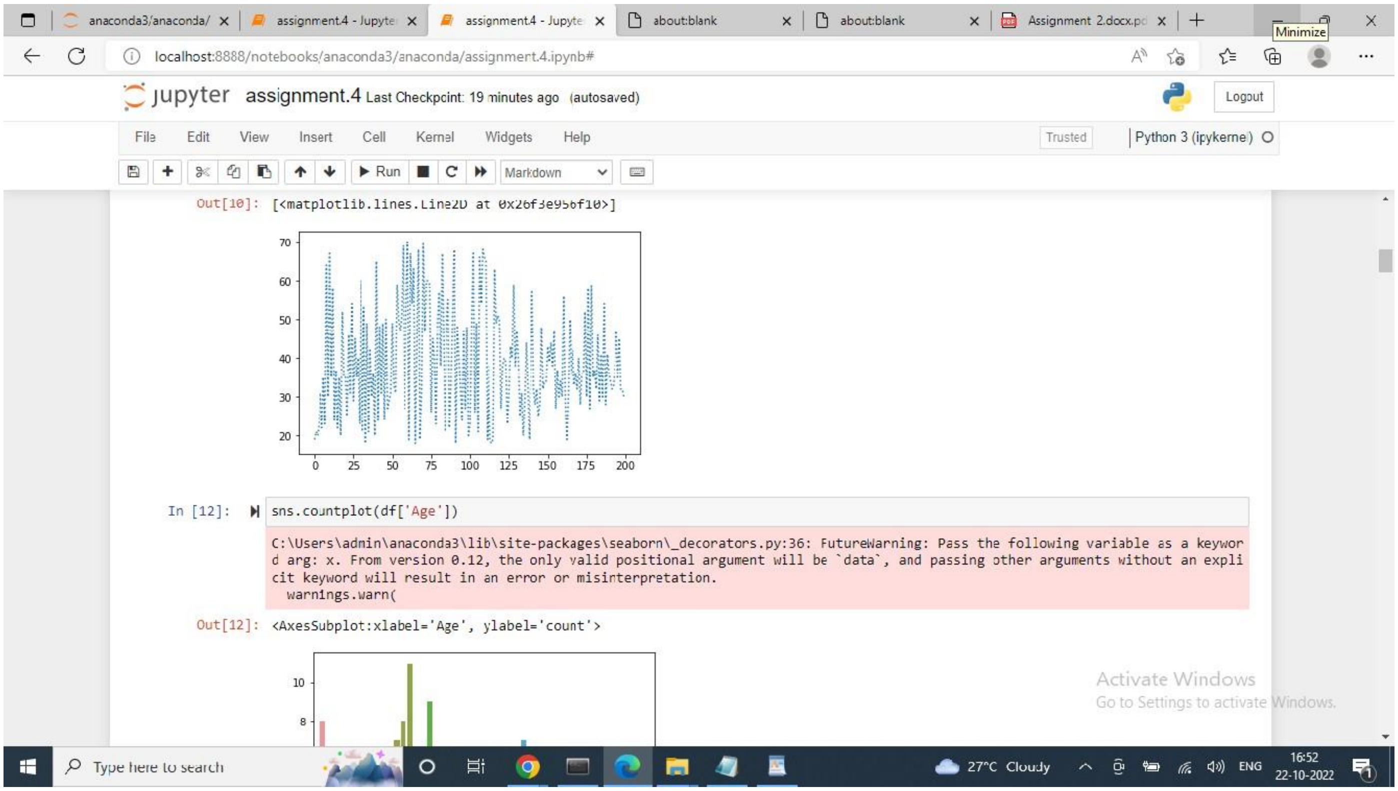


Univariate Analysis

```
In [8]:  import matplotlib.pyplot as plt
         import seaborn as sns
         %matplotlib inline
```

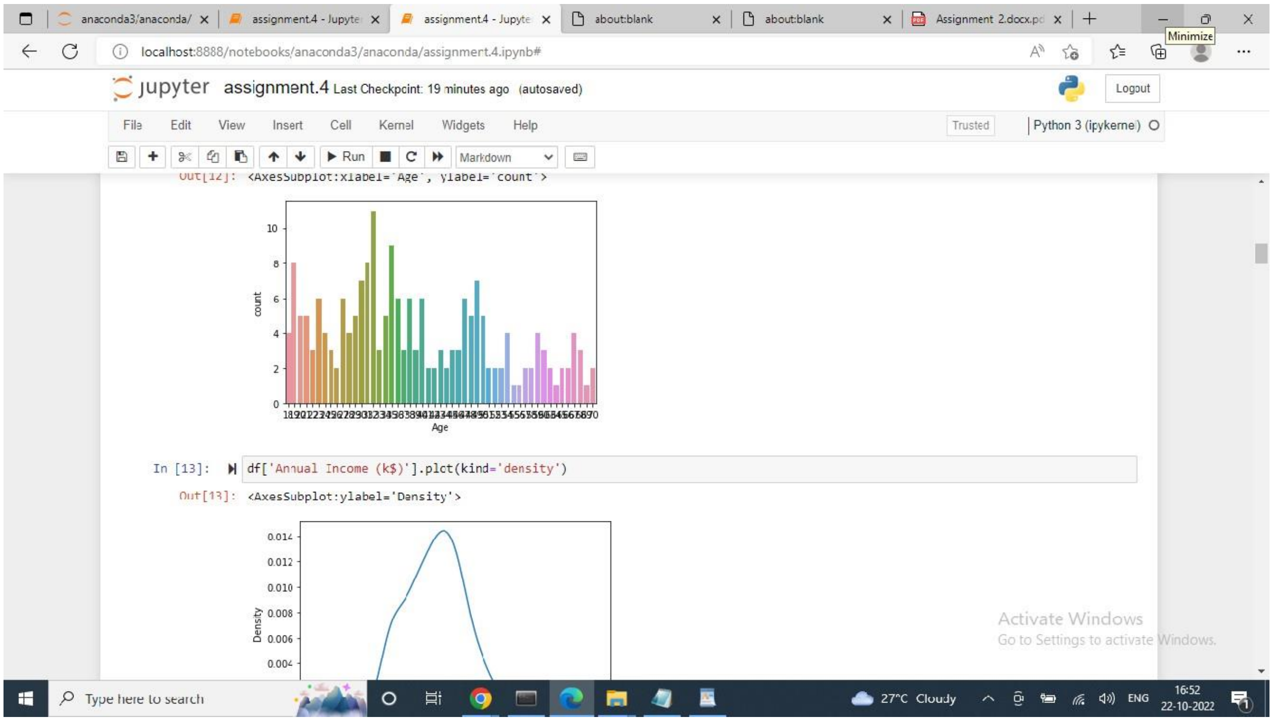
```
In [11]: plt.plot(df['Annual Income (k$)'])
         plt.show()
```

```
In [10]: data=np.array(df['Age'])
         plt.plot(data,linestyle = 'dotted')

Out[10]: [<matplotlib.lines.Line2D at 0x26f3e956f10>]
```

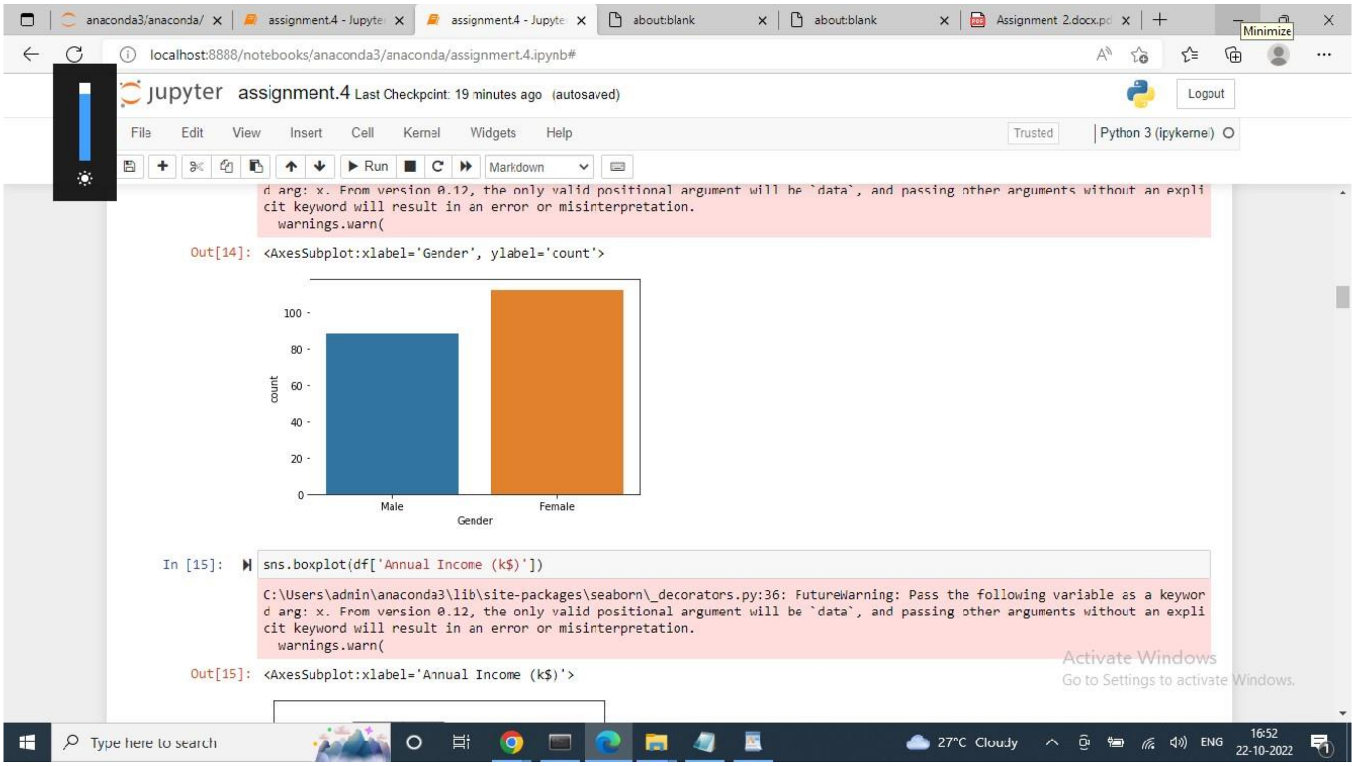


```
Out[10]: [<matplotlib.lines.Line2D at 0x26f3e956f10>]
```

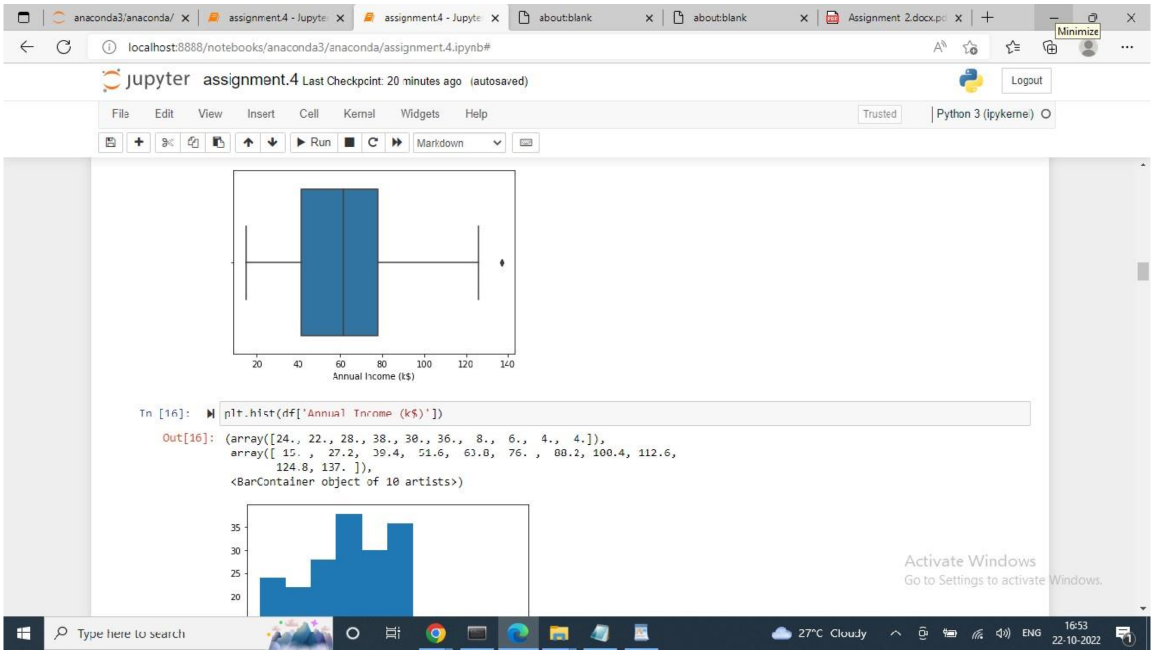
```
In [12]: sns.countplot(df['Age'])

C:\Users\admin\anaconda3\lib\site-packages\seaborn\_decorators.py:36: FutureWarning: Pass the following variable as a keywor
d arg: x. From version 0.12, the only valid positional argument will be `data`, and passing other arguments without an expli
cit keyword will result in an error or misinterpretation.
  warnings.warn(

Out[12]: <AxesSubplot:xlabel='Age', ylabel='count'>
```



```
Out[12]: <AxesSubplot:xlabel='Age', ylabel='count'>

In [13]:  df['Annual Income (k$)'].plct(kind='density')

Out[13]: <AxesSubplot:ylabel='Density'>
```



```
d arg: x. From version 0.12, the only valid positional argument will be `data`, and passing other arguments without an expli
cit keyword will result in an error or misinterpretation.
  warnings.warn(

Out[14]: <AxesSubplot:xlabel='Gender', ylabel='count'>

In [15]:  sns.boxplot(df['Annual Income (k$)'])

C:\Users\admin\anaconda3\lib\site-packages\seaborn\_decorators.py:36: FutureWarning: Pass the following variable as a keywor
d arg: x. From version 0.12, the only valid positional argument will be `data`, and passing other arguments without an expli
cit keyword will result in an error or misinterpretation.
  warnings.warn(

Out[15]: <AxesSubplot:xlabel='Annual Income (k$)'>
```


localhost:8888/notebooks/anaconda3/anaconda/assignment.4.ipynb#
jupyter assignment.4 Last Checkpoint: 20 minutes ago (autosaved)
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Python 3 (ipykernel)
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20
40
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100
120
140
Annual Income (k$)
35
30
25
20
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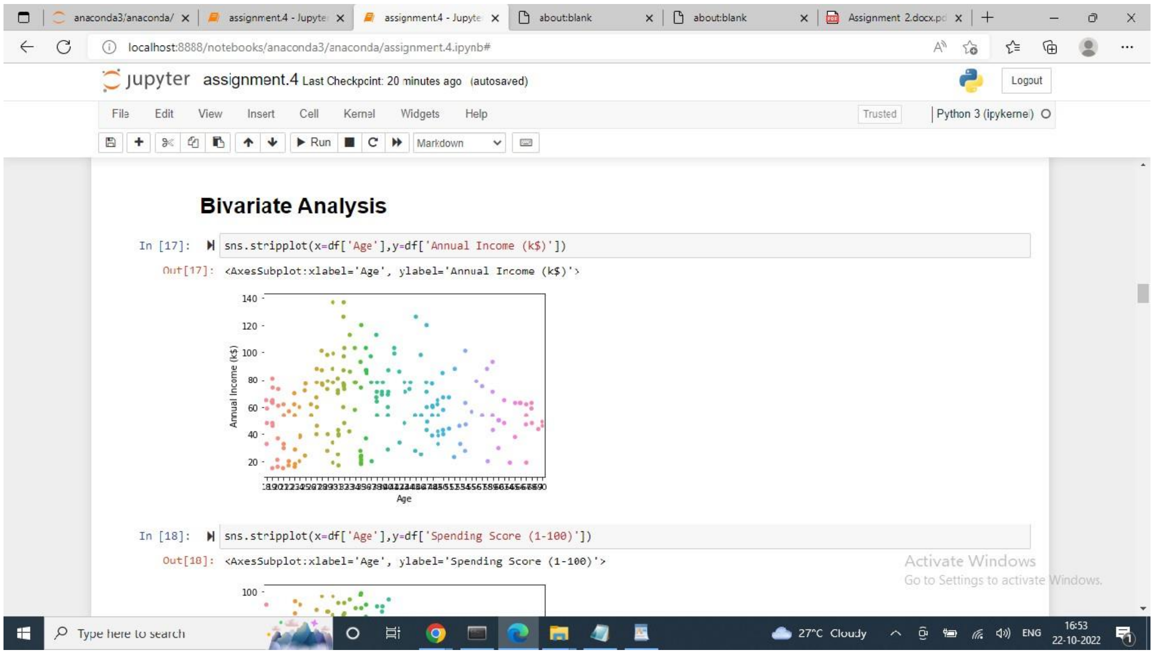
16:53
22-10-2022

```
In [16]:  plt.hist(df['Annual Income (k$)'])

Out[16]:  (array([24., 22., 28., 38., 30., 36.,  8.,  6.,  4.,  4.]),
           array([ 15. ,  27.2,  39.4,  51.6,  63.8,  76. ,  88.2, 100.4, 112.6,
                  124.8, 137. ]),
           <BarContainer object of 10 artists>)
```


localhost:8888/notebooks/anaconda3/anaconda/assignment.4.ipynb#
jupyter assignment.4 Last Checkpoint: 20 minutes ago (autosaved)
Logout
File Edit View Insert Cell Kernel Widgets Help
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Python 3 (ipykernel)
Run
Markdown
140
120
100
80
60
40
20
Annual Income (k$)
Age
100
Activate Windows
Go to Settings to activate Windows.
Type here to search
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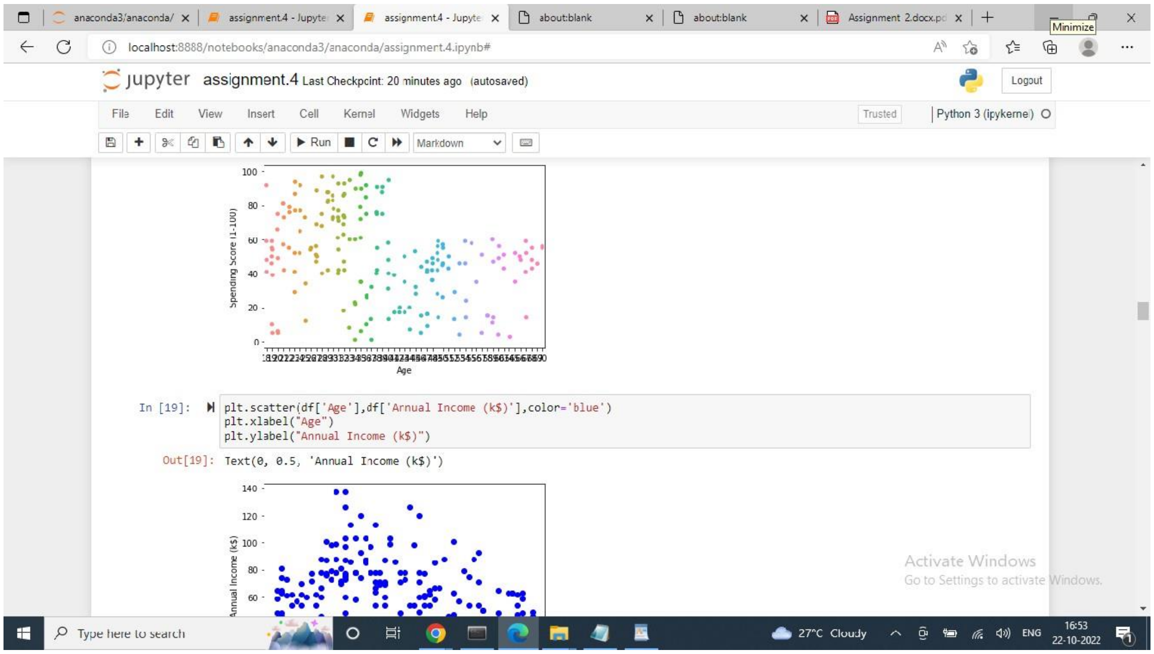
22-10-2022

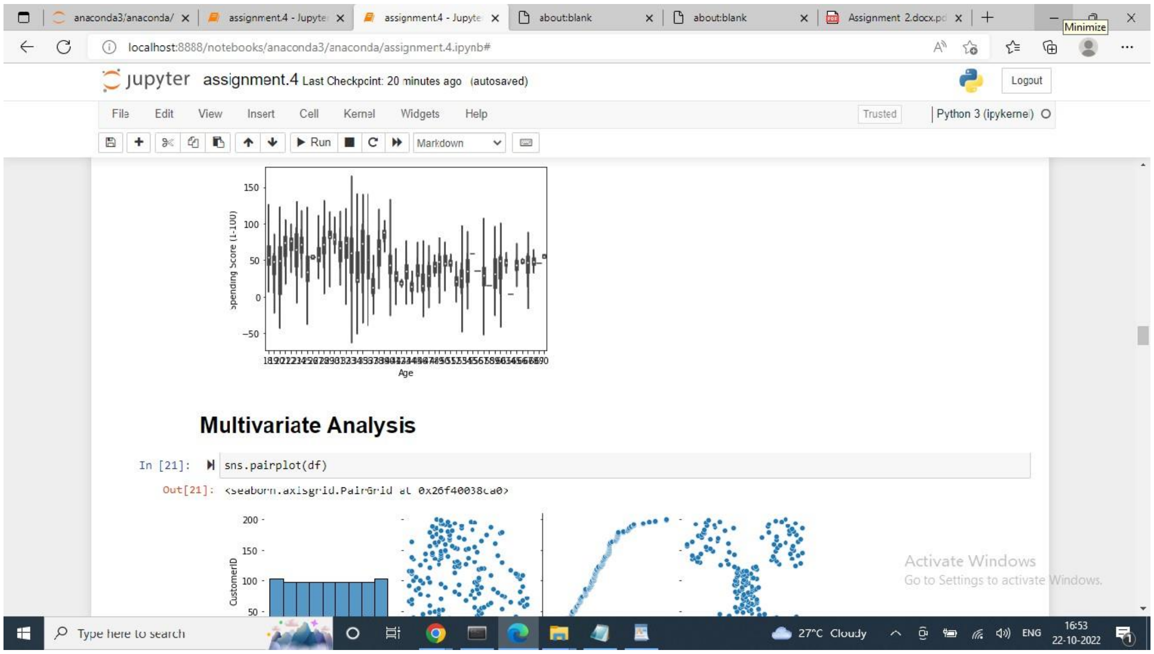
Bivariate Analysis

```
In [17]:  sns.stripplot(x=df['Age'],y=df['Annual Income (k$)'])

Out[17]:  <AxesSubplot:xlabel='Age', ylabel='Annual Income (k$)'>
```

```
In [18]:  sns.stripplot(x=df['Age'],y=df['Spending Score (1-100)'])

Out[18]:  <AxesSubplot:xlabel='Age', ylabel='Spending Score (1-100)'>
```

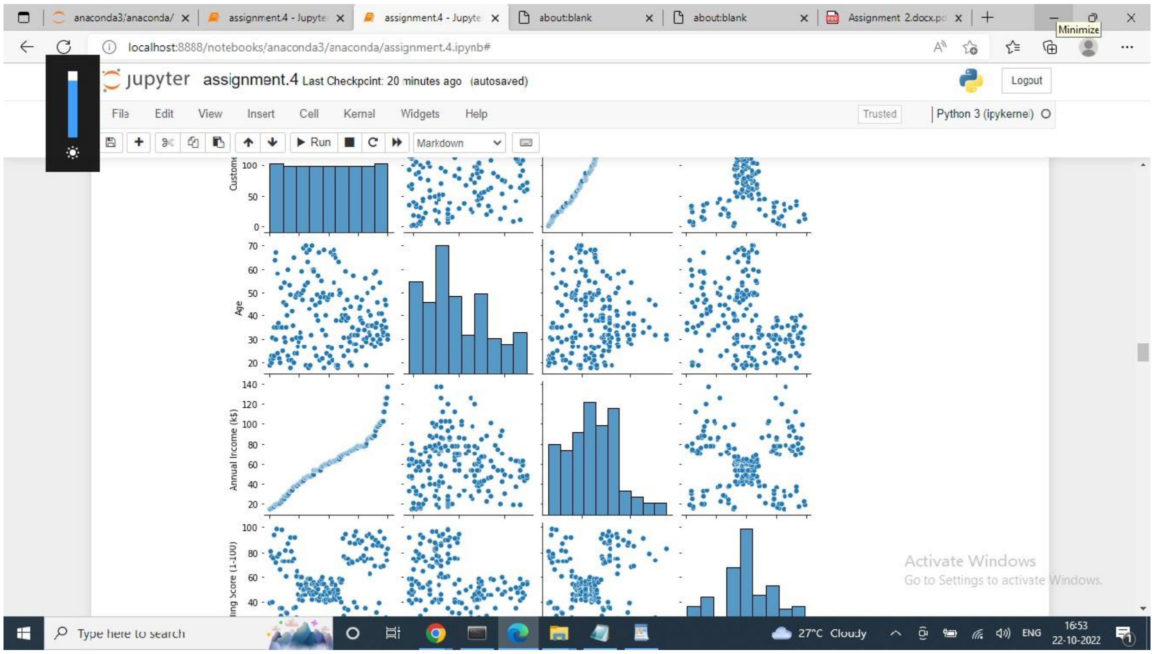


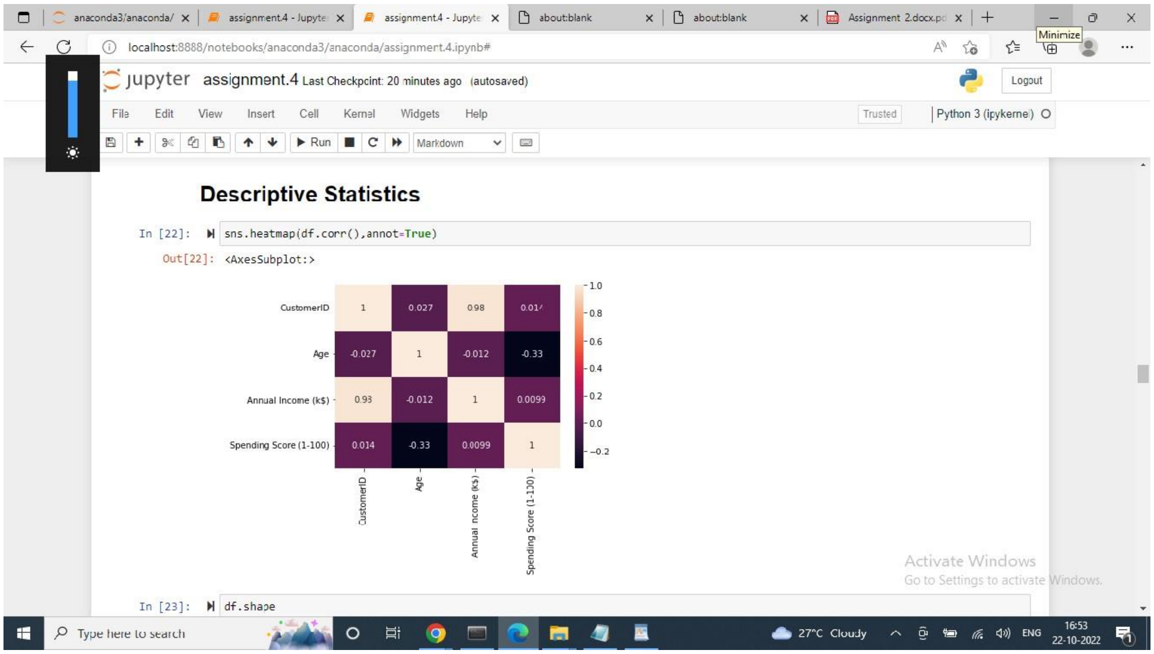
```
In [19]: plt.scatter(df['Age'],df['Annual Income (k$)'],color='blue')
         plt.xlabel("Age")
         plt.ylabel("Annual Income (k$)")

Out[19]: Text(0, 0.5, 'Annual Income (k$)')
```



Multivariate Analysis

```
In [21]: sns.pairplot(df)

Out[21]: <seaborn.axisgrid.PairGrid at 0x26f40038ca0>
```



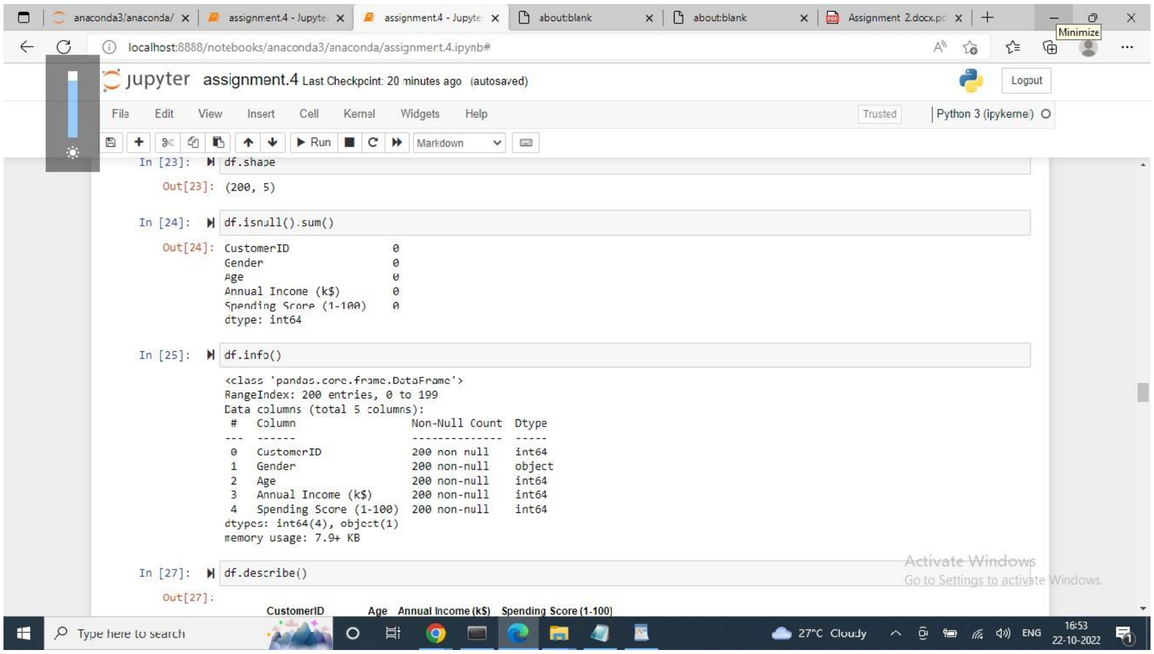


Descriptive Statistics

```
In [22]:  sns.heatmap(df.corr(),annot=True)
Out[22]:  <AxesSubplot:>
```

	CustomerID	Age	Annual Income (k$)	Spending Score (1-100)
CustomerID	1	0.027	0.98	0.01⁄
Age	-0.027	1	-0.012	-0.33
Annual Income (k$)	0.93	-0.012	1	0.0099
Spending Score (1-100)	0.014	-0.33	0.0099	1

```
In [23]:  df.shape
```

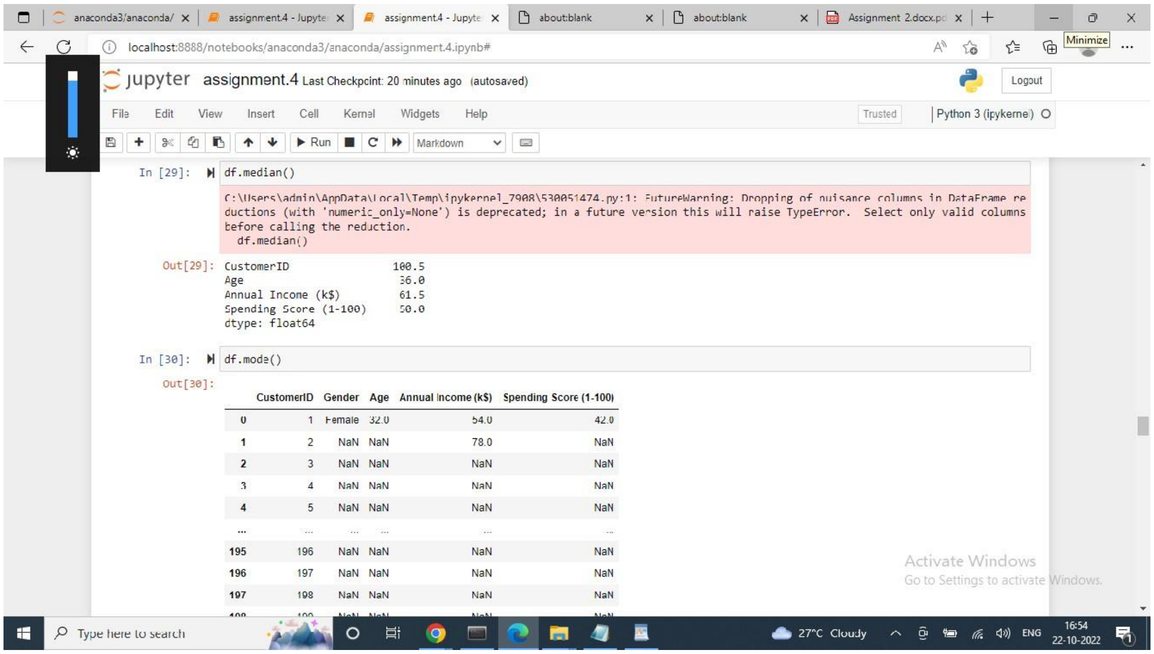


```
In [23]:  df.shape

Out[23]:  (200, 5)
```

```
In [24]:  df.isnull().sum()

Out[24]:  CustomerID                0
          Gender                    0
          Age                       0
          Annual Income (k$)        0
          Spending Score (1-100)    0
          dtype: int64
```

```
In [25]:  df.info()

          <class 'pandas.core.frame.DataFrame'>
          RangeIndex: 200 entries, 0 to 199
          Data columns (total 5 columns):
           #   Column                  Non-Null Count  Dtype
          ---  ------                  --------------  -----
           0   CustomerID              200 non null    int64
           1   Gender                  200 non-null    object
           2   Age                     200 non-null    int64
           3   Annual Income (k$)      200 non-null    int64
           4   Spending Score (1-100)  200 non-null    int64
          dtypes: int64(4), object(1)
          memory usage: 7.9+ KB
```

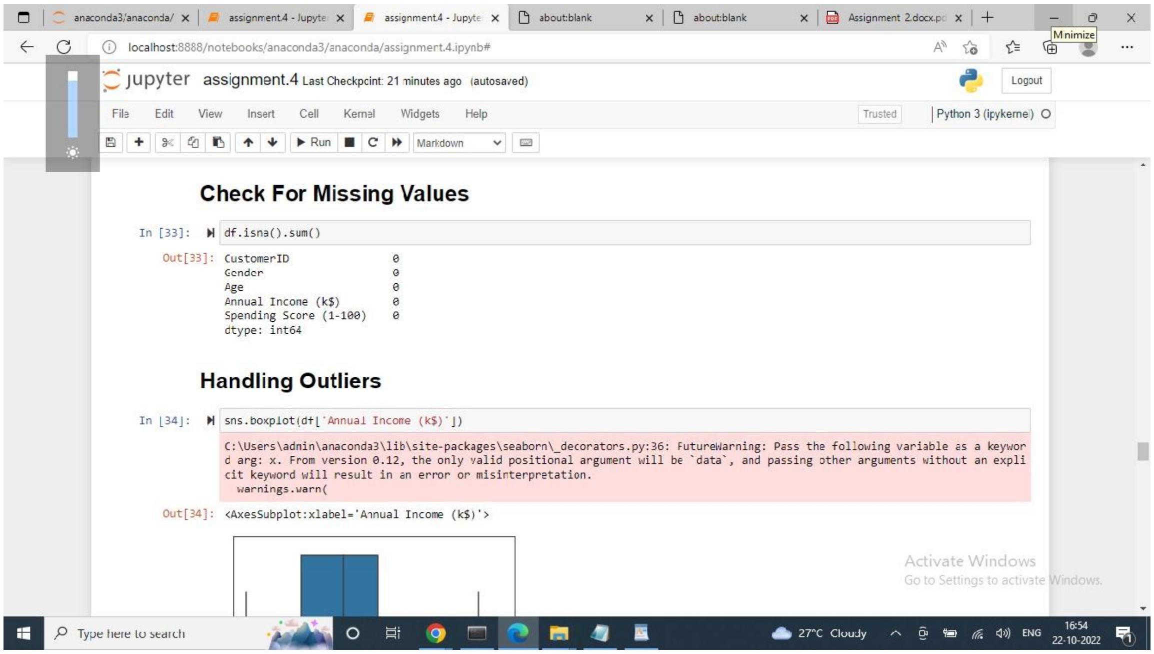
```
In [27]:  df.describe()

Out[27]:
                CustomerID      Age  Annual Income (k$)  Spending Score (1-100)
```



```
In [29]:  df.median()

          C:\Users\admin\AppData\Local\Temp\ipykernel_7908\530051474.py:1: FutureWarning: Dropping of nuisance columns in DataFrame re
          ductions (with 'numeric_only=None') is deprecated; in a future version this will raise TypeError.  Select only valid columns
          before calling the reduction.
            df.median()

Out[29]:  CustomerID                100.5
          Age                        36.0
          Annual Income (k$)         61.5
          Spending Score (1-100)     50.0
          dtype: float64
```

```
In [30]:  df.mode()

Out[30]:
```

	CustomerID	Gender	Age	Annual Income (k$)	Spending Score (1-100)
0	1	Female	32.0	54.0	42.0
1	2	NaN	NaN	78.0	NaN
2	3	NaN	NaN	NaN	NaN
3	4	NaN	NaN	NaN	NaN
4	5	NaN	NaN	NaN	NaN
...	...	...	...	...	...
195	196	NaN	NaN	NaN	NaN
196	197	NaN	NaN	NaN	NaN
197	198	NaN	NaN	NaN	NaN
198	199	NaN	NaN	NaN	NaN



Check For Missing Values

```
In [33]: df.isna().sum()
```

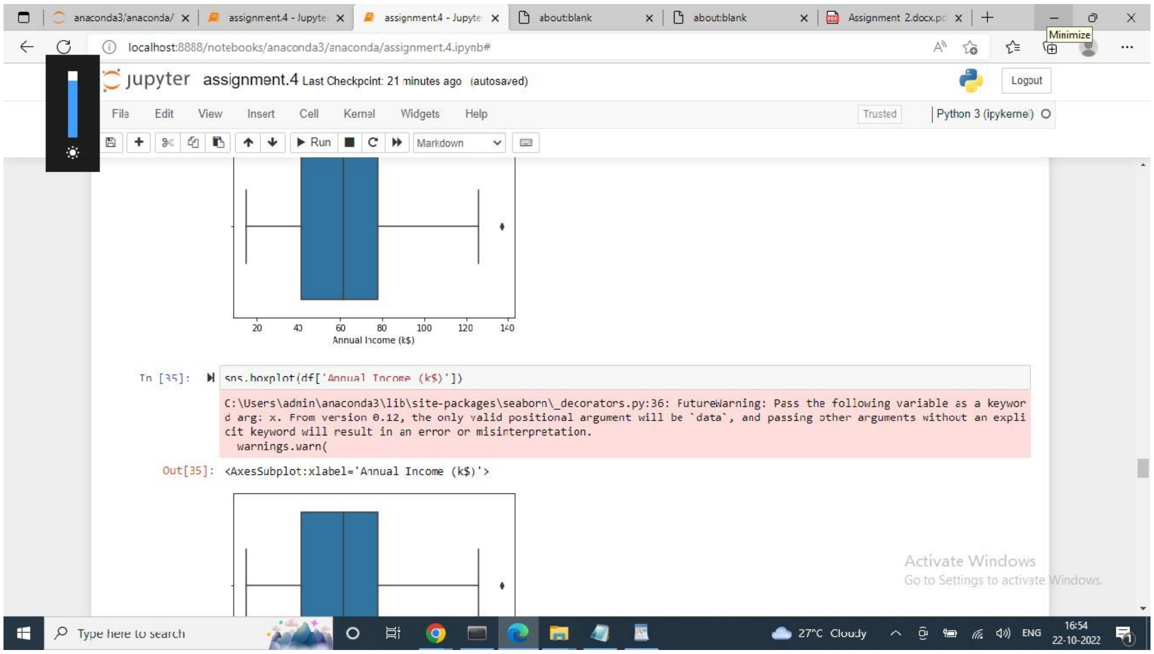
```
Out[33]: CustomerID                0
         Gender                    0
         Age                       0
         Annual Income (k$)        0
         Spending Score (1-100)    0
         dtype: int64
```

Handling Outliers

```
In [34]: sns.boxplot(df['Annual Income (k$)'])
```

```
C:\Users\admin\anaconda3\lib\site-packages\seaborn\_decorators.py:36: FutureWarning: Pass the following variable as a keywor
d arg: x. From version 0.12, the only valid positional argument will be `data`, and passing other arguments without an expli
cit keyword will result in an error or misinterpretation.
  warnings.warn(
```

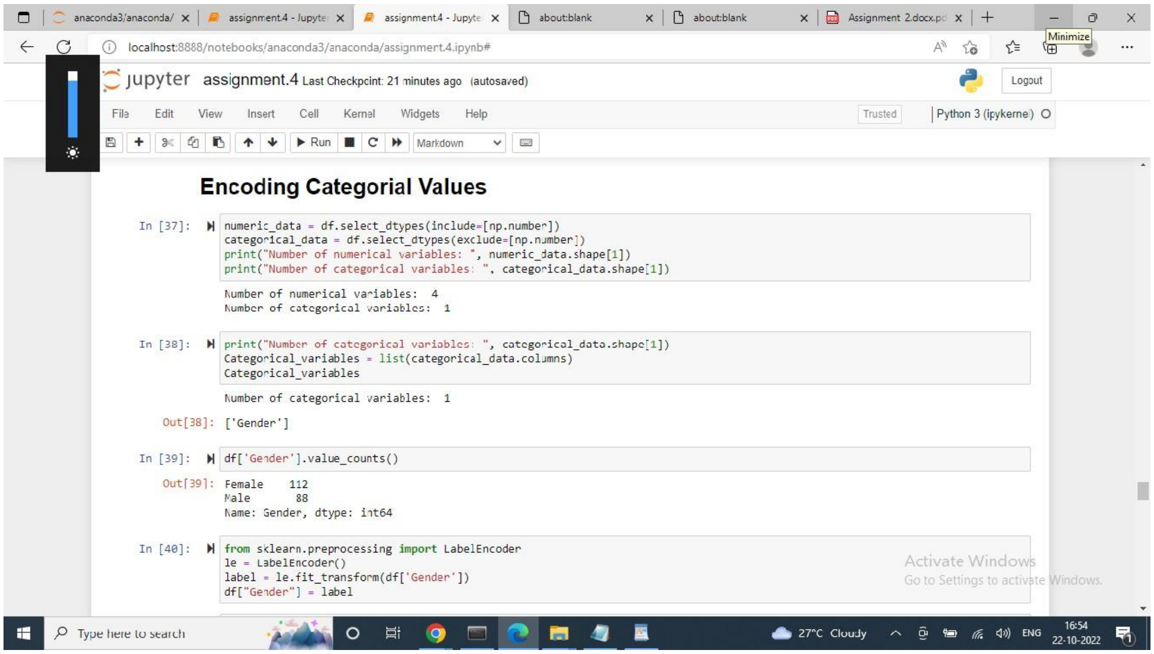
```
Out[34]: <AxesSubplot:xlabel='Annual Income (k$)'>
```



```
In [35]: sns.boxplot(df['Annual Income (k$)'])
```

```
C:\Users\admin\anaconda3\lib\site-packages\seaborn\_decorators.py:36: FutureWarning: Pass the following variable as a keywor
d arg: x. From version 0.12, the only valid positional argument will be `data`, and passing other arguments without an expli
cit keyword will result in an error or misinterpretation.
  warnings.warn(
```

```
Out[35]: <AxesSubplot:xlabel='Annual Income (k$)'>
```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Encoding Categorial Values

In [37]:
```
numeric_data = df.select_dtypes(include=[np.number])
categorical_data = df.select_dtypes(exclude=[np.number])
print("Number of numerical variables: ", numeric_data.shape[1])
print("Number of categorical variables: ", categorical_data.shape[1])
```

```
Number of numerical variables:  4
Number of categorical variables:  1
```

In [38]:
```
print("Number of categorical variables: ", categorical_data.shape[1])
Categorical_variables = list(categorical_data.columns)
Categorical_variables
```

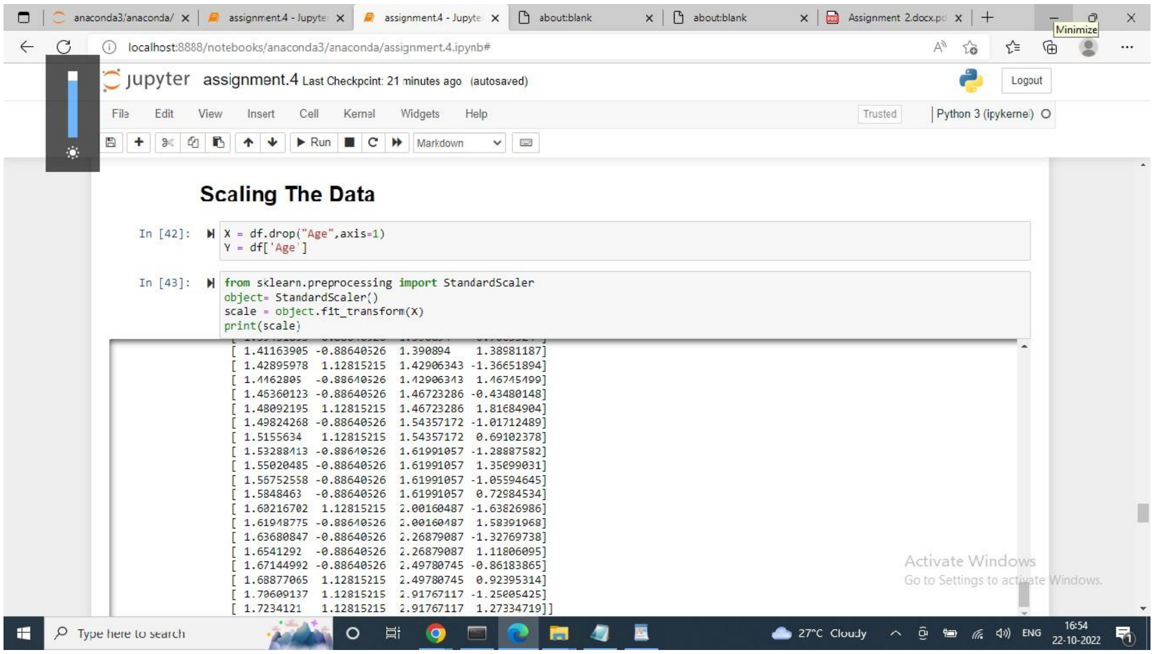
```
Number of categorical variables:  1
```

Out[38]:
```
['Gender']
```

In [39]:
```
df['Gender'].value_counts()
```

Out[39]:
```
Female    112
Male       88
Name: Gender, dtype: int64
```

In [40]:
```
from sklearn.preprocessing import LabelEncoder
le = LabelEncoder()
label = le.fit_transform(df['Gender'])
df["Gender"] = label
```


localhost:8888/notebooks/anaconda3/anaconda/assignment.4.ipynb#
jupyter assignment.4 Last Checkpoint: 21 minutes ago (autosaved)
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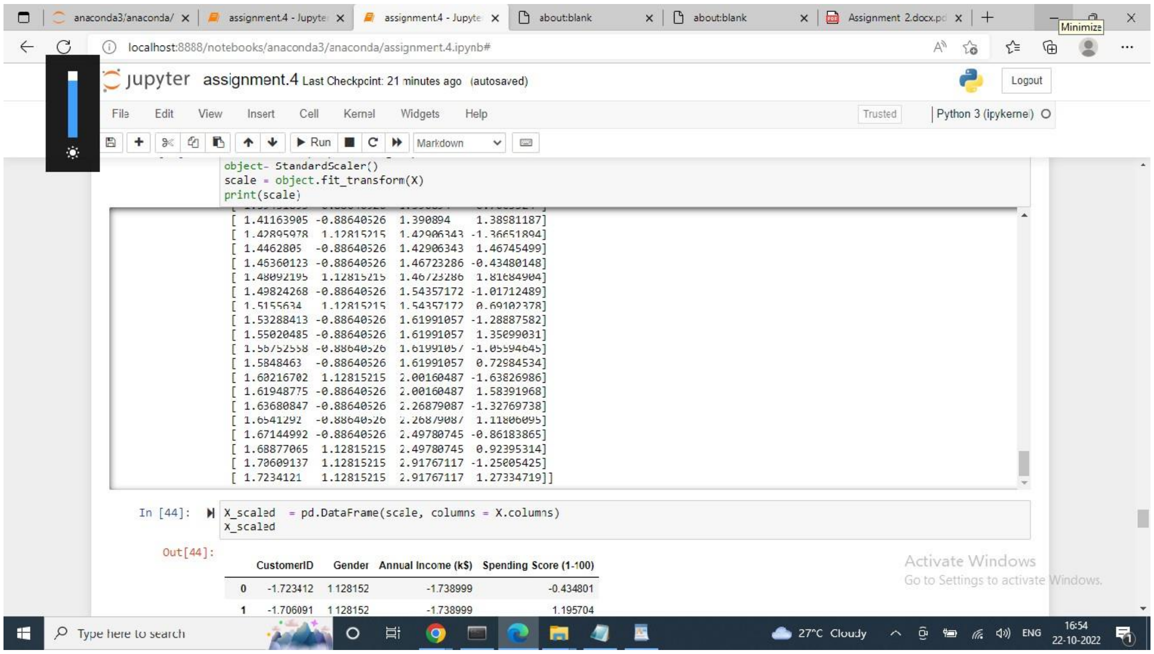
Scaling The Data

In [42]:
```
X = df.drop("Age",axis=1)
Y = df['Age']
```

In [43]:
```
from sklearn.preprocessing import StandardScaler
object= StandardScaler()
scale = object.fit_transform(X)
print(scale)
```

```
 [ 1.41163905 -0.88640526  1.390894    1.38981187]
 [ 1.42895978  1.12815215  1.42906343 -1.36651894]
 [ 1.4462805  -0.88640526  1.42906343  1.46745499]
 [ 1.46360123 -0.88640526  1.46723286 -0.43480148]
 [ 1.48092195  1.12815215  1.46723286  1.81684904]
 [ 1.49824268 -0.88640526  1.54357172 -1.01712489]
 [ 1.5155634   1.12815215  1.54357172  0.69102378]
 [ 1.53288413 -0.88640526  1.61991057 -1.28887582]
 [ 1.55020485 -0.88640526  1.61991057  1.35099031]
 [ 1.56752558 -0.88640526  1.61991057 -1.05594645]
 [ 1.5848463  -0.88640526  1.61991057  0.72984534]
 [ 1.60216702  1.12815215  2.00160487 -1.63826986]
 [ 1.61948775 -0.88640526  2.00160487  1.58391968]
 [ 1.63680847 -0.88640526  2.26879087 -1.32769738]
 [ 1.6541292  -0.88640526  2.26879087  1.11806095]
 [ 1.67144992 -0.88640526  2.49780745 -0.86183865]
 [ 1.68877065  1.12815215  2.49780745  0.92395314]
 [ 1.70609137  1.12815215  2.91767117 -1.25005425]
 [ 1.7234121   1.12815215  2.91767117  1.27334719]]
```


localhost:8888/notebooks/anaconda3/anaconda/assignment.4.ipynb#
jupyter assignment.4 Last Checkpoint: 21 minutes ago (autosaved)
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```
object= StandardScaler()
scale = object.fit_transform(X)
print(scale)
```

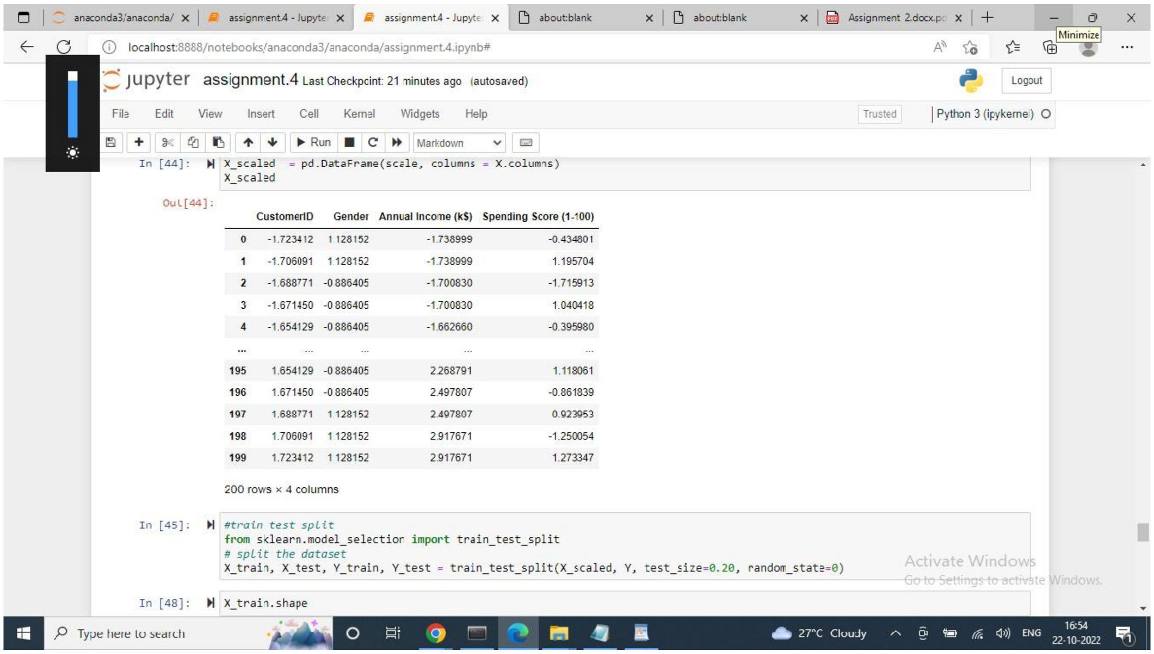
```
 [ 1.41163905 -0.88640526  1.390894    1.38981187]
 [ 1.42895978  1.12815215  1.42906343 -1.36651894]
 [ 1.4462805  -0.88640526  1.42906343  1.46745499]
 [ 1.46360123 -0.88640526  1.46723286 -0.43480148]
 [ 1.48092195  1.12815215  1.46723286  1.81684904]
 [ 1.49824268 -0.88640526  1.54357172 -1.01712489]
 [ 1.5155634   1.12815215  1.54357172  0.69102378]
 [ 1.53288413 -0.88640526  1.61991057 -1.28887582]
 [ 1.55020485 -0.88640526  1.61991057  1.35099031]
 [ 1.56752558 -0.88640526  1.61991057 -1.05594645]
 [ 1.5848463  -0.88640526  1.61991057  0.72984534]
 [ 1.60216702  1.12815215  2.00160487 -1.63826986]
 [ 1.61948775 -0.88640526  2.00160487  1.58391968]
 [ 1.63680847 -0.88640526  2.26879087 -1.32769738]
 [ 1.6541292  -0.88640526  2.26879087  1.11806095]
 [ 1.67144992 -0.88640526  2.49780745 -0.86183865]
 [ 1.68877065  1.12815215  2.49780745  0.92395314]
 [ 1.70609137  1.12815215  2.91767117 -1.25005425]
 [ 1.7234121   1.12815215  2.91767117  1.27334719]]
```

In [44]:

```
X_scaled  = pd.DataFrame(scale, columns = X.columns)
X_scaled
```

Out[44]:

	CustomerID	Gender	Annual Income (k$)	Spending Score (1-100)
0	-1.723412	1.128152	-1.738999	-0.434801
1	-1.706091	1.128152	-1.738999	1.195704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22-10-2022

In [44]:

```
X_scaled  = pd.DataFrame(scale, columns = X.columns)
X_scaled
```

Out[44]:

	CustomerID	Gender	Annual Income (k$)	Spending Score (1-100)
0	-1.723412	1.128152	-1.738999	-0.434801
1	-1.706091	1.128152	-1.738999	1.195704
2	-1.688771	-0.886405	-1.700830	-1.715913
3	-1.671450	-0.886405	-1.700830	1.040418
4	-1.654129	-0.886405	-1.662660	-0.395980
...	...	...	...	...
195	1.654129	-0.886405	2.268791	1.118061
196	1.671450	-0.886405	2.497807	-0.861839
197	1.688771	1.128152	2.497807	0.923953
198	1.706091	1.128152	2.917671	-1.250054
199	1.723412	1.128152	2.917671	1.273347

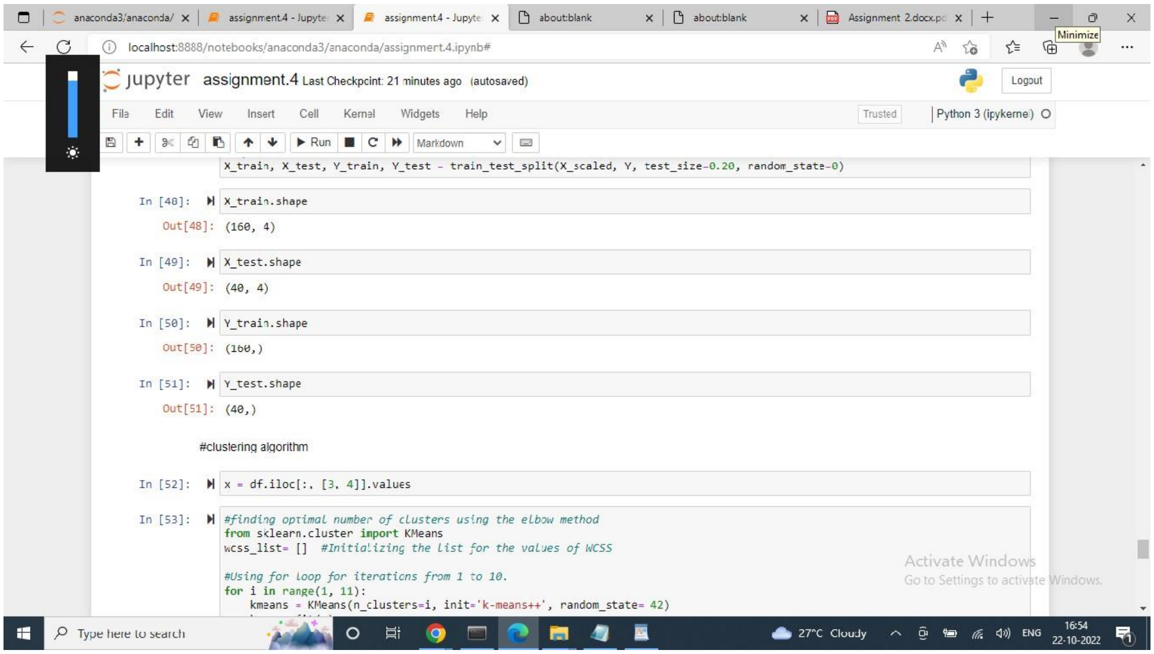
200 rows × 4 columns

In [45]:

```
#train test split
from sklearn.model_selection import train_test_split
# split the dataset
X_train, X_test, Y_train, Y_test = train_test_split(X_scaled, Y, test_size=0.20, random_state=0)
```

In [48]:

```
X_train.shape
```



```
X_train, X_test, Y_train, Y_test = train_test_split(X_scaled, Y, test_size=0.20, random_state=0)
```

In [48]:
```
X_train.shape
```

Out[48]:
```
(160, 4)
```

In [49]:
```
X_test.shape
```

Out[49]:
```
(40, 4)
```

In [50]:
```
Y_train.shape
```

Out[50]:
```
(160,)
```

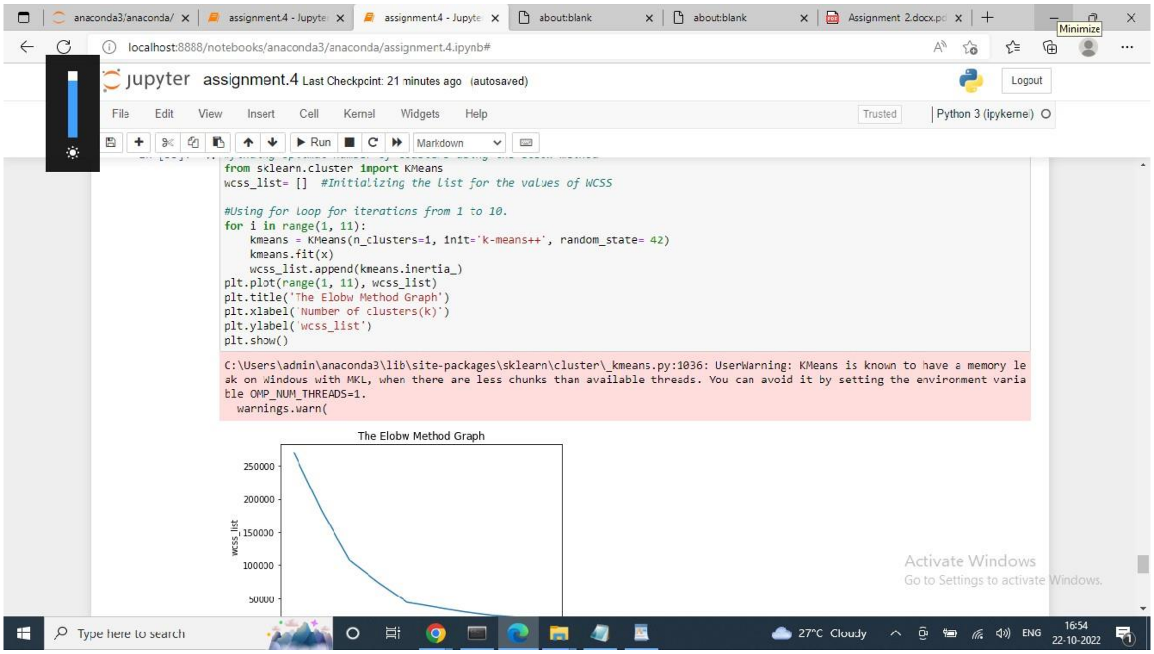
In [51]:
```
Y_test.shape
```

Out[51]:
```
(40,)
```

#clustering algorithm

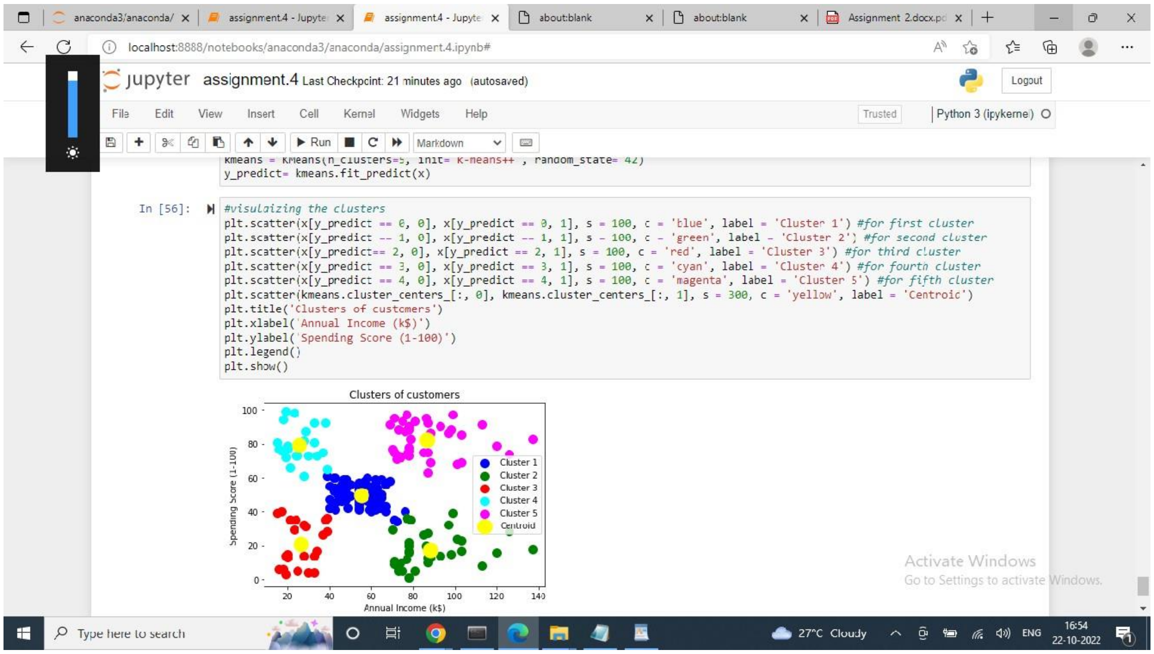
In [52]:
```
x = df.iloc[:, [3, 4]].values
```

In [53]:
```
#finding optimal number of clusters using the elbow method
from sklearn.cluster import KMeans
wcss_list= []  #Initializing the list for the values of WCSS

#Using for loop for iterations from 1 to 10.
for i in range(1, 11):
    kmeans = KMeans(n_clusters=i, init='k-means++', random_state= 42)
```



```
from sklearn.cluster import KMeans
wcss_list= []  #Initializing the list for the values of WCSS

#Using for loop for iterations from 1 to 10.
for i in range(1, 11):
    kmeans = KMeans(n_clusters=i, init='k-means++', random_state= 42)
    kmeans.fit(x)
    wcss_list.append(kmeans.inertia_)
plt.plot(range(1, 11), wcss_list)
plt.title('The Elobw Method Graph')
plt.xlabel('Number of clusters(k)')
plt.ylabel('wcss_list')
plt.show()
```

```
C:\Users\admin\anaconda3\lib\site-packages\sklearn\cluster\_kmeans.py:1036: UserWarning: KMeans is known to have a memory le
ak on Windows with MKL, when there are less chunks than available threads. You can avoid it by setting the environment varia
ble OMP_NUM_THREADS=1.
  warnings.warn(
```



```
kmeans = KMeans(n_clusters=5, init= 'k-means++', random_state= 42)
y_predict= kmeans.fit_predict(x)
```

In [56]:

```
#visulaizing the clusters
plt.scatter(x[y_predict == 0, 0], x[y_predict == 0, 1], s = 100, c = 'blue', label = 'Cluster 1') #for first cluster
plt.scatter(x[y_predict == 1, 0], x[y_predict == 1, 1], s = 100, c = 'green', label = 'Cluster 2') #for second cluster
plt.scatter(x[y_predict== 2, 0], x[y_predict == 2, 1], s = 100, c = 'red', label = 'Cluster 3') #for third cluster
plt.scatter(x[y_predict == 3, 0], x[y_predict == 3, 1], s = 100, c = 'cyan', label = 'Cluster 4') #for fourth cluster
plt.scatter(x[y_predict == 4, 0], x[y_predict == 4, 1], s = 100, c = 'magenta', label = 'Cluster 5') #for fifth cluster
plt.scatter(kmeans.cluster_centers_[:, 0], kmeans.cluster_centers_[:, 1], s = 300, c = 'yellow', label = 'Centroid')
plt.title('Clusters of customers')
plt.xlabel('Annual Income (k$)')
plt.ylabel('Spending Score (1-100)')
plt.legend()
plt.show()
```