In [5]:

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from plotly.offline import download_plotlyjs, init_notebook_mode, plot, iplo
t
import cufflinks as cf
import warnings
warnings.filterwarnings("ignore")
```

In [10]:

```
len(df)
```

Out[10]:

```
200
```

In [11]:

```
df.head()
```

Out[11]:

	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

In [12]:

```
df.isnull()
```

Out[12]:

	CustomerID	Gender	Age	Annual Income (k$)	Spending Score (1-100)
0	False	False	False	False	False
1	False	False	False	False	False
2	False	False	False	False	False
3	False	False	False	False	False
4	False	False	False	False	False
...	...	...	...	...	...
195	False	False	False	False	False
196	False	False	False	False	False
197	False	False	False	False	False
198	False	False	False	False	False
199	False	False	False	False	False

200 rows × 5 columns

In [13]:

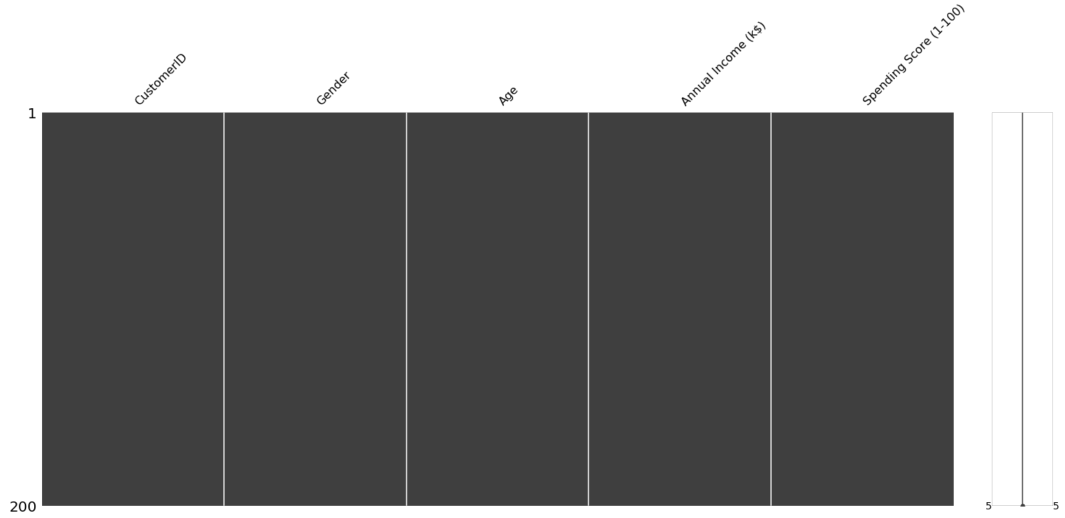
```
df.isnull().sum()
```

Out[13]:

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

In [14]:
```
import missingno as msno
msno.matrix(df)
```

Out[14]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7fd506161668>
```



In [15]:
```
df['Gender'].unique()
```

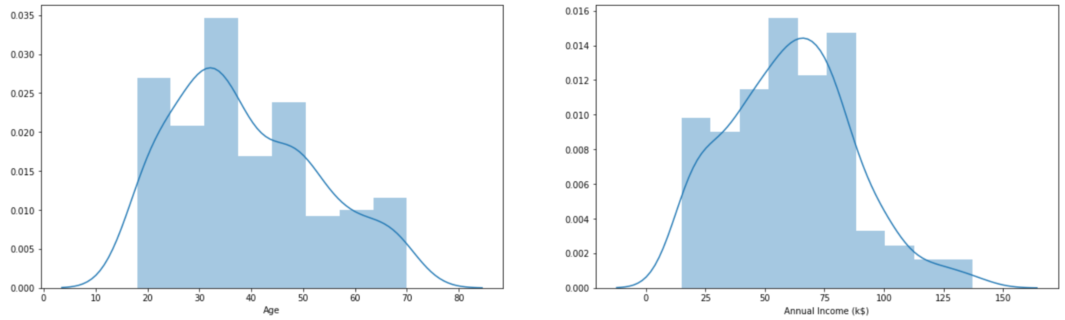
Out[15]:
```
array(['Male', 'Female'], dtype=object)
```

In [17]:
```
print(sum(df.duplicated()))
```

```
0
```

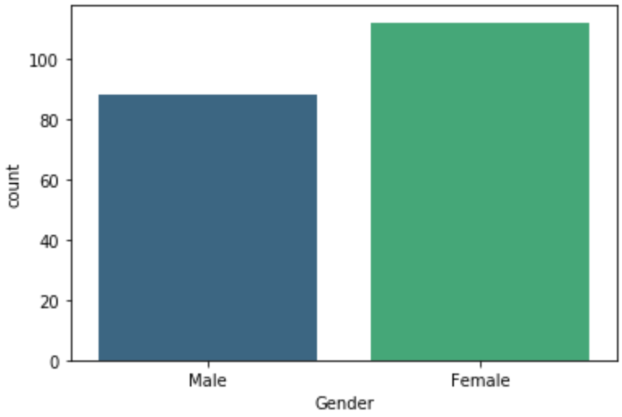
In [18]:
```
ig, axes = plt.subplots(1,2, figsize=(21,6))
sns.distplot(df['Age'], ax=axes[0])
sns.distplot(df['Annual Income (k$)'], ax=axes[1])
```

Out[18]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7fd50607bc18>
```



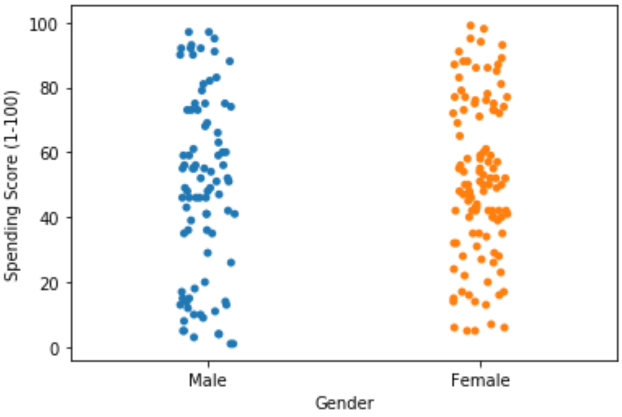
```
In [19]: sns.countplot(x='Gender',data=df,palette='viridis')
```

```
Out[19]: <matplotlib.axes._subplots.AxesSubplot at 0x7fd505e7ac50>
```



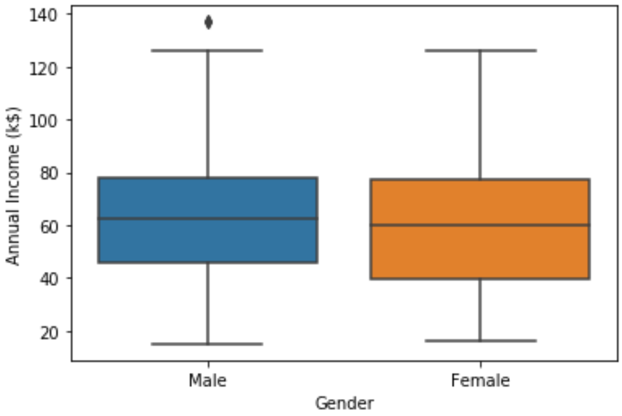
```
In [21]: sns.stripplot(x = 'Gender', y = 'Spending Score (1-100)',data = df)
```

```
Out[21]: <matplotlib.axes._subplots.AxesSubplot at 0x7fd502e05c50>
```



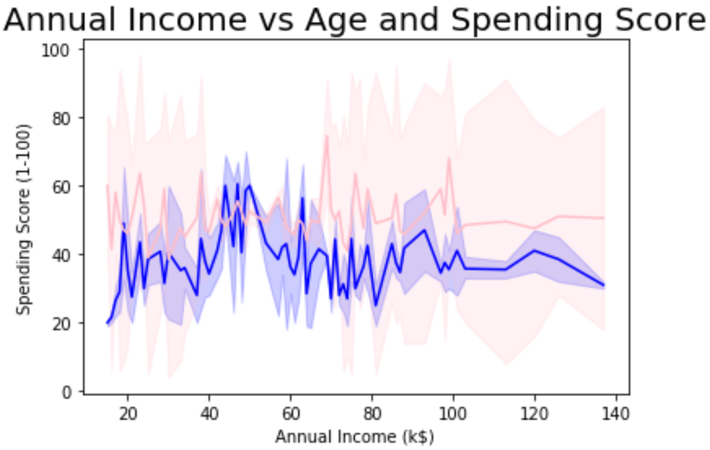
```
In [22]: sns.boxplot(x='Gender',y='Annual Income (k$)',data=df)
```

```
Out[22]: <matplotlib.axes._subplots.AxesSubplot at 0x7fd502c69dd8>
```



In [25]:
```
x = df['Annual Income (k$)']
y = df['Age']
z = df['Spending Score (1-100)']

sns.lineplot(x, y, color = 'blue')
sns.lineplot(x, z, color = 'pink')
plt.title('Annual Income vs Age and Spending Score', fontsize = 20)
plt.show()
```



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

Out[29]:

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

In [31]:
```
df.drop('CustomerID',axis=1,inplace=True)
```

```
---------------------------------------------------------------------------
KeyError                                  Traceback (most recent call last)
<ipython-input-31-57491add0442> in <module>
----> 1 df.drop('CustomerID',axis=1,inplace=True)

/home/tarun/snap/jupyter/common/lib/python3.7/site-packages/pandas/core/fram
e.py in drop(self, labels, axis, index, columns, level, inplace, errors)
   4115             level=level,
   4116             inplace=inplace,
-> 4117             errors=errors,
   4118         )
   4119 

/home/tarun/snap/jupyter/common/lib/python3.7/site-packages/pandas/core/gener
ic.py in drop(self, labels, axis, index, columns, level, inplace, errors)
   3912         for axis, labels in axes.items():
   3913             if labels is not None:
-> 3914                 obj = obj._drop_axis(labels, axis, level=level, error
s=errors)
   3915 
   3916         if inplace:

/home/tarun/snap/jupyter/common/lib/python3.7/site-packages/pandas/core/gener
ic.py in _drop_axis(self, labels, axis, level, errors)
   3944                 new_axis = axis.drop(labels, level=level, errors=erro
rs)
   3945             else:
-> 3946                 new_axis = axis.drop(labels, errors=errors)
   3947             result = self.reindex(**{axis_name: new_axis})
   3948 

/home/tarun/snap/jupyter/common/lib/python3.7/site-packages/pandas/core/index
es/base.py in drop(self, labels, errors)
   5338         if mask.any():
   5339             if errors != "ignore":
-> 5340                 raise KeyError("{} not found in axis".format(labels[m
ask]))
   5341             indexer = indexer[~mask]
   5342         return self.delete(indexer)

KeyError: "['CustomerID'] not found in axis"
```

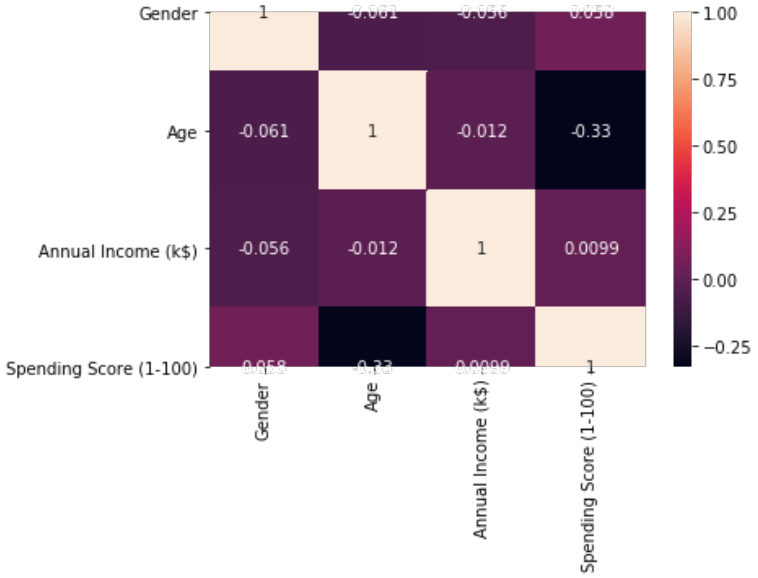
In [32]:
```
df.head()
```

Out[32]:

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

In [33]:
```
sns.heatmap(df.corr(),annot=True)
```

Out[33]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7fd5001bbe10>
```



In [35]:
```
def impute_age(cols):
    spend=cols
    if spend > 55:
        return 1
    else:
        return 0
df['Spending Score (1-100)'] = df['Spending Score (1-100)'].apply(impute_ag
e)
df.head()
```

Out[35]:

	Gender	Age	Annual Income (k$)	Spending Score (1-100)
0	0	19	15	0
1	0	21	15	1
2	1	20	16	0
3	1	23	16	1
4	1	31	17	0

In [36]:
```
df
```

Out[36]:

	Gender	Age	Annual Income (k$)	Spending Score (1-100)
0	0	19	15	0
1	0	21	15	1
2	1	20	16	0
3	1	23	16	1
4	1	31	17	0
...	...	...	...	...
195	1	35	120	1
196	1	45	126	0
197	0	32	126	1
198	0	32	137	0
199	0	30	137	1

200 rows × 4 columns

In [37]:
```
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test= train_test_split(df.drop('Spending Score (1-100)',axis=1), df['Spending Score (1-100)'], test_size=0.30, random_state=101)
from sklearn.linear_model import LogisticRegression
log=LogisticRegression()
log.fit(X_train,y_train)
pred=log.predict(X_test)
from sklearn.metrics import classification_report
print(classification_report(y_test, pred))
```

```
              precision    recall  f1-score   support

           0       0.63      0.86      0.73        36
           1       0.55      0.25      0.34        24

    accuracy                           0.62        60
   macro avg       0.59      0.56      0.54        60
weighted avg       0.60      0.62      0.57        60
```

In [38]:
```
from sklearn.preprocessing import StandardScaler
scaler = StandardScaler()
scaler.fit(df.drop('Spending Score (1-100)',axis=1))
scaled_features = scaler.transform(df.drop('Spending Score (1-100)',axis=1))
df_feat = pd.DataFrame(scaled_features,columns=df.columns[:-1])
df_feat.head()
```

Out[38]:

	Gender	Age	Annual Income (k$)
0	-1.128152	-1.424569	-1.738999
1	-1.128152	-1.281035	-1.738999
2	0.886405	-1.352802	-1.700830
3	0.886405	-1.137502	-1.700830
4	0.886405	-0.563369	-1.662660

In [39]:

```
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(scaled_features,df['Spending Score (1-100)'],
                                                               test_size=0.30)
from sklearn.neighbors import KNeighborsClassifier
knn = KNeighborsClassifier(n_neighbors=1)
knn.fit(X_train,y_train)
pred = knn.predict(X_test)
from sklearn.metrics import classification_report,confusion_matrix
print(confusion_matrix(y_test,pred))
print(classification_report(y_test,pred))
```

```
[[28 13]
 [ 6 13]]
              precision    recall  f1-score   support

           0       0.82      0.68      0.75        41
           1       0.50      0.68      0.58        19

    accuracy                           0.68        60
   macro avg       0.66      0.68      0.66        60
weighted avg       0.72      0.68      0.69        60
```

In [40]:

```
error_rate = []

for i in range(1,40):

    knn = KNeighborsClassifier(n_neighbors=i)
    knn.fit(X_train,y_train)
    pred_i = knn.predict(X_test)
    error_rate.append(np.mean(pred_i != y_test))
    plt.figure(figsize=(10,6))
plt.plot(range(1,40),error_rate,color='blue', linestyle='dashed', marker='o
',
         markerfacecolor='red', markersize=10)
plt.title('Error Rate vs. K Value')
plt.xlabel('K')
plt.ylabel('Error Rate')
```

```
Out[40]: Text(0, 0.5, 'Error Rate')
         <Figure size 720x432 with 0 Axes>
         <Figure size 720x432 with 0 Axes>
         <Figure size 720x432 with 0 Axes>
         <Figure size 720x432 with 0 Axes>
         <Figure size 720x432 with 0 Axes>
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         <Figure size 720x432 with 0 Axes>
         <Figure size 720x432 with 0 Axes>
         <Figure size 720x432 with 0 Axes>
         <Figure size 720x432 with 0 Axes>
```
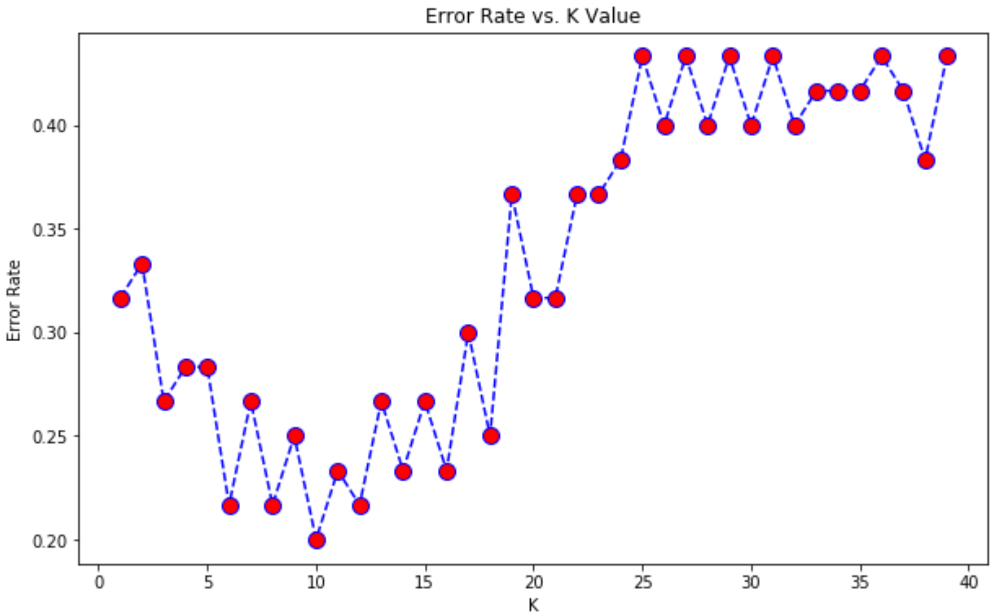

```
<Figure size 720x432 with 0 Axes>
```



In [41]:
```
knn = KNeighborsClassifier(n_neighbors=3)

knn.fit(X_train,y_train)
pred = knn.predict(X_test)
print('WITH K=3')
print('\n')
print(confusion_matrix(y_test,pred))
print('\n')
print(classification_report(y_test,pred))
```

```
WITH K=3


[[31 10]
 [ 6 13]]


              precision    recall  f1-score   support

           0       0.84      0.76      0.79        41
           1       0.57      0.68      0.62        19

    accuracy                           0.73        60
   macro avg       0.70      0.72      0.71        60
weighted avg       0.75      0.73      0.74        60
```

In [ ]: