In [1]:
```
import pandas as pd
import numpy as np
```

In [3]:
```
df = pd.read_csv('7431_sales_data_sample.csv', encoding='unicode_escape')
```

In [5]:
```
df.head()
```

Out[5]:

	ORDERNUMBER	QUANTITYORDERED	PRICEEACH	ORDERLINENUMBER	SALES	OR
0	10107	30	95.70	2	2871.00	
1	10121	34	81.35	5	2765.90	
2	10134	41	94.74	2	3884.34	
3	10145	45	83.26	6	3746.70	
4	10159	49	100.00	14	5205.27	1(

5 rows × 25 columns

In [7]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 2823 entries, 0 to 2822
Data columns (total 25 columns):
 #   Column            Non-Null Count  Dtype  
---  ------            --------------  -----  
 0   ORDERNUMBER       2823 non-null   int64  
 1   QUANTITYORDERED   2823 non-null   int64  
 2   PRICEEACH         2823 non-null   float64
 3   ORDERLINENUMBER   2823 non-null   int64  
 4   SALES             2823 non-null   float64
 5   ORDERDATE         2823 non-null   object 
 6   STATUS            2823 non-null   object 
 7   QTR_ID            2823 non-null   int64  
 8   MONTH_ID          2823 non-null   int64  
 9   YEAR_ID           2823 non-null   int64  
 10  PRODUCTLINE       2823 non-null   object 
 11  MSRP              2823 non-null   int64  
 12  PRODUCTCODE       2823 non-null   object 
 13  CUSTOMERNAME      2823 non-null   object 
 14  PHONE             2823 non-null   object 
 15  ADDRESSLINE1      2823 non-null   object 
 16  ADDRESSLINE2      302 non-null    object 
 17  CITY              2823 non-null   object 
 18  STATE             1337 non-null   object 
 19  POSTALCODE        2747 non-null   object 
 20  COUNTRY           2823 non-null   object 
 21  TERRITORY         1749 non-null   object 
 22  CONTACTLASTNAME   2823 non-null   object 
 23  CONTACTFIRSTNAME  2823 non-null   object 
 24  DEALSIZE          2823 non-null   object 
dtypes: float64(2), int64(7), object(16)
memory usage: 551.5+ KB
```

In [8]:

```
#Columns to Remove
to_drop = ['ADDRESSLINE1', 'ADDRESSLINE2', 'STATE', 'POSTALCODE', 'PHONE']
df = df.drop(to_drop, axis=1)
```

In [9]:

```
#Check for null values
df.isnull().sum()
```

Out[9]:
```
ORDERNUMBER             0
QUANTITYORDERED         0
PRICEEACH               0
ORDERLINENUMBER         0
SALES                   0
ORDERDATE               0
STATUS                  0
QTR_ID                  0
MONTH_ID                0
YEAR_ID                 0
PRODUCTLINE             0
MSRP                    0
PRODUCTCODE             0
CUSTOMERNAME            0
CITY                    0
COUNTRY                 0
TERRITORY            1074
CONTACTLASTNAME         0
CONTACTFIRSTNAME        0
DEALSIZE                0
dtype: int64
```

In [10]:
```
df.dtypes
```

Out[10]:
```
ORDERNUMBER             int64
QUANTITYORDERED         int64
PRICEEACH             float64
ORDERLINENUMBER         int64
SALES                 float64
ORDERDATE              object
STATUS                 object
QTR_ID                  int64
MONTH_ID                int64
YEAR_ID                 int64
PRODUCTLINE            object
MSRP                    int64
PRODUCTCODE            object
CUSTOMERNAME           object
CITY                   object
COUNTRY                object
TERRITORY              object
CONTACTLASTNAME        object
CONTACTFIRSTNAME       object
DEALSIZE               object
dtype: object
```

In [12]:
```
#ORDERDATE Should be in date time
df['ORDERDATE'] = pd.to_datetime(df['ORDERDATE'])
```

In [13]:
```
#We need to create some features in order to create cluseters
#Recency: Number of days between customer's latest order and today's date
#Frequency : Number of purchases by the customers
#MonetaryValue : Revenue generated by the customers
import datetime as dt
snapshot_date = df['ORDERDATE'].max() + dt.timedelta(days = 1)
df_RFM = df.groupby(['CUSTOMERNAME']).agg({
    'ORDERDATE' : lambda x : (snapshot_date - x.max()).days,
    'ORDERNUMBER' : 'count',
    'SALES' : 'sum'
```

```
})

#Rename the columns
df_RFM.rename(columns = {
    'ORDERDATE' : 'Recency',
    'ORDERNUMBER' : 'Frequency',
    'SALES' : 'MonetaryValue'
}, inplace=True)
```

In [14]:
```
df_RFM.head()
```

Out[14]:

CUSTOMERNAME	Recency	Frequency	MonetaryValue
AV Stores, Co.	196	51	157807.81
Alpha Cognac	65	20	70488.44
Amica Models & Co.	265	26	94117.26
Anna's Decorations, Ltd	84	46	153996.13
Atelier graphique	188	7	24179.96

In [15]:
```
# Divide into segments
# We create 4 quartile ranges
df_RFM['M'] = pd.qcut(df_RFM['MonetaryValue'], q = 4, labels = range(1,5))
df_RFM['R'] = pd.qcut(df_RFM['Recency'], q = 4, labels = list(range(4,0,-1)))
df_RFM['F'] = pd.qcut(df_RFM['Frequency'], q = 4, labels = range(1,5))

df_RFM.head()
```

Out[15]:

CUSTOMERNAME	Recency	Frequency	MonetaryValue	M	R	F
AV Stores, Co.	196	51	157807.81	4	2	4
Alpha Cognac	65	20	70488.44	2	4	2
Amica Models & Co.	265	26	94117.26	3	1	2
Anna's Decorations, Ltd	84	46	153996.13	4	3	4
Atelier graphique	188	7	24179.96	1	2	1

In [16]:
```
#Create another column for RFM score
df_RFM['RFM_Score'] = df_RFM[['R', 'M', 'F']].sum(axis=1)
df_RFM.head()
```

Out[16]:

CUSTOMERNAME	Recency	Frequency	MonetaryValue	M	R	F	RFM_Score
AV Stores, Co.	196	51	157807.81	4	2	4	10
Alpha Cognac	65	20	70488.44	2	4	2	8
Amica Models & Co.	265	26	94117.26	3	1	2	6
Anna's Decorations, Ltd	84	46	153996.13	4	3	4	11
Atelier graphique	188	7	24179.96	1	2	1	4

In [17]:

```
def rfm_level(df):
    if bool(df['RFM_Score'] >= 10):
        return 'High Value Customer'

    elif bool(df['RFM_Score'] < 10) and bool(df['RFM_Score'] >= 6):
        return 'Mid Value Customer'
    else:
        return 'Low Value Customer'
df_RFM['RFM_Level'] = df_RFM.apply(rfm_level, axis = 1)
df_RFM.head()
```

Out[17]:

CUSTOMERNAME	Recency	Frequency	MonetaryValue	M	R	F	RFM_Score	RFM_Leve
AV Stores, Co.	196	51	157807.81	4	2	4	10	High Valu Custome
Alpha Cognac	65	20	70488.44	2	4	2	8	Mid Valu Custome
Amica Models & Co.	265	26	94117.26	3	1	2	6	Mid Valu Custome
Anna's Decorations, Ltd	84	46	153996.13	4	3	4	11	High Valu Custome
Atelier graphique	188	7	24179.96	1	2	1	4	Low Valu Custome

In [18]:

```
# Time to perform KMeans
data = df_RFM[['Recency', 'Frequency', 'MonetaryValue']]
data.head()
```

Out[18]:

CUSTOMERNAME	Recency	Frequency	MonetaryValue
AV Stores, Co.	196	51	157807.81
Alpha Cognac	65	20	70488.44
Amica Models & Co.	265	26	94117.26
Anna's Decorations, Ltd	84	46	153996.13
Atelier graphique	188	7	24179.96

In [19]:

```
# Our data is skewed we must remove it by performing log transformation
data_log = np.log(data)
data_log.head()
```

Out[19]:

CUSTOMERNAME	Recency	Frequency	MonetaryValue
AV Stores, Co.	5.278115	3.931826	11.969133
Alpha Cognac	4.174387	2.995732	11.163204
Amica Models & Co.	5.579730	3.258097	11.452297
Anna's Decorations, Ltd	4.430817	3.828641	11.944683
Atelier graphique	5.236442	1.945910	10.093279

In [20]:

```
#Standardization
from sklearn.preprocessing import StandardScaler
scaler = StandardScaler()
scaler.fit(data_log)
data_normalized = scaler.transform(data_log)
data_normalized = pd.DataFrame(data_normalized, index = data_log.index, columns=
data_normalized.describe().round(2)
```

Out[20]:

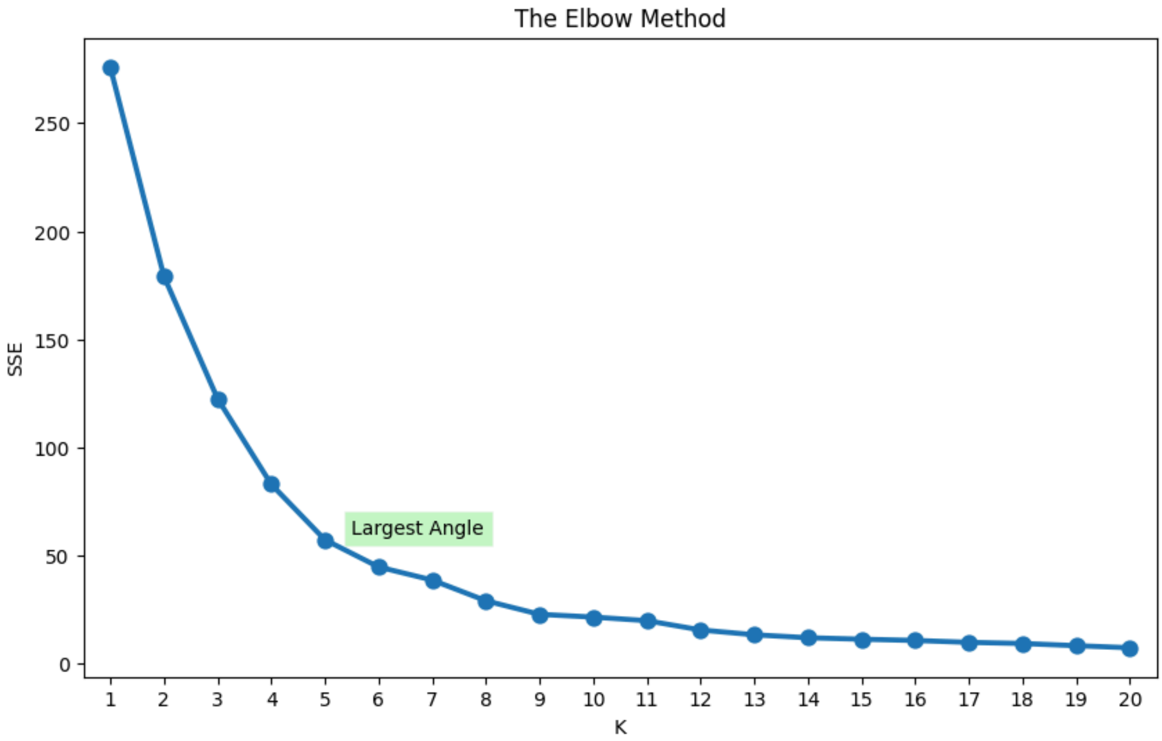
	Recency	Frequency	MonetaryValue
count	92.00	92.00	92.00
mean	0.00	-0.00	0.00
std	1.01	1.01	1.01
min	-3.51	-3.67	-3.82
25%	-0.24	-0.41	-0.39
50%	0.37	0.06	-0.04
75%	0.53	0.45	0.52
max	1.12	4.03	3.92

In [21]:

```
#Fit KMeans and use elbow method to choose the number of clusters
import matplotlib.pyplot as plt
import seaborn as sns
```

```
from sklearn.cluster import KMeans

sse = {}

for k in range(1, 21):
    kmeans = KMeans(n_clusters = k, random_state = 1)
    kmeans.fit(data_normalized)
    sse[k] = kmeans.inertia_
```

In [22]:
```
plt.figure(figsize=(10,6))
plt.title('The Elbow Method')

plt.xlabel('K')
plt.ylabel('SSE')
plt.style.use('ggplot')

sns.pointplot(x=list(sse.keys()), y = list(sse.values()))
plt.text(4.5, 60, "Largest Angle", bbox = dict(facecolor = 'lightgreen', alpha =
plt.show()
```



In [23]:
```
# 5 number of clusters seems good
kmeans = KMeans(n_clusters=5, random_state=1)
kmeans.fit(data_normalized)
cluster_labels = kmeans.labels_

data_rfm = data.assign(Cluster = cluster_labels)
data_rfm.head()
```

Out[23]:

CUSTOMERNAME	Recency	Frequency	MonetaryValue	Cluster
AV Stores, Co.	196	51	157807.81	4
Alpha Cognac	65	20	70488.44	2
Amica Models & Co.	265	26	94117.26	2
Anna's Decorations, Ltd	84	46	153996.13	4
Atelier graphique	188	7	24179.96	1