E-Commerce Data Analysis using RFM(K-mean clustering)

performing analysis on the reatil store dataset!

(following is the actual read data of a UK retailer store)

In [14]:

```
# importing the libraries
import pandas as pd
```

In [9]:

```
# for visualisation
import matplotlib.pyplot as plt
import seaborn as sns
%matplotlib inline
```

In [15]:

```
# to scale our data
from sklearn.preprocessing import scale

# to perform k-means clustering
from sklearn.cluster import KMeans
```

During this case study we will try to findout weather the customers could be segmented into different categories or not!

In [16]:

```
help(KMeans)
```

```
 |      Method for initialization:
 |
 |      'k-means++' : selects initial cluster centers for k-mean
 |      clustering in a smart way to speed up convergence. See section
 |      Notes in k_init for more details.
 |
 |      'random': choose `n_clusters` observations (rows) at random fr
om data
 |      for the initial centroids.
 |
 |      If an array is passed, it should be of shape (n_clusters, n_fe
atures)
 |      and gives the initial centers.
 |
 |      If a callable is passed, it should take arguments X, n_cluster
s and a
 |      random state and return an initialization.
 |
 |  n_init : int, default=10
 |      Number of time the k-means algorithm will be run with differen
```

Reading the dataset

In [23]:

```
#reading the dataset
retail = pd.read_excel("RetailPulseAssignmentData.xlsx")
```

Out[23]:

	Invoice	StockCode	Description	Quantity	InvoiceDate	Price	Customer ID	Countr
0	489434	85048	15CM CHRISTMAS GLASS BALL 20 LIGHTS	12	2009-12-01 07:45:00	6.95	13085.0	Unite Kingdor
1	489434	79323P	PINK CHERRY LIGHTS	12	2009-12-01 07:45:00	6.75	13085.0	Unite Kingdor
2	489434	79323W	WHITE CHERRY LIGHTS	12	2009-12-01 07:45:00	6.75	13085.0	Unite Kingdor
3	489434	22041	RECORD FRAME 7" SINGLE SIZE	48	2009-12-01 07:45:00	2.10	13085.0	Unite Kingdor
4	489434	21232	STRAWBERRY CERAMIC TRINKET BOX	24	2009-12-01 07:45:00	1.25	13085.0	Unite Kingdor
...	...	...	...	...	...	...	...	.
525456	538171	22271	FELTCRAFT DOLL ROSIE	2	2010-12-09 20:01:00	2.95	17530.0	Unite Kingdor
525457	538171	22750	FELTCRAFT PRINCESS LOLA DOLL	1	2010-12-09 20:01:00	3.75	17530.0	Unite Kingdor
525458	538171	22751	FELTCRAFT PRINCESS OLIVIA DOLL	1	2010-12-09 20:01:00	3.75	17530.0	Unite Kingdor
525459	538171	20970	PINK FLORAL FELTCRAFT SHOULDER BAG	2	2010-12-09 20:01:00	3.75	17530.0	Unite Kingdor
525460	538171	21931	JUMBO STORAGE BAG SUKI	2	2010-12-09 20:01:00	1.95	17530.0	Unite Kingdor

525461 rows × 8 columns

In [33]:

```
retail.head(10)
```

Out[33]:

	Invoice	StockCode	Description	Quantity	InvoiceDate	Price	Customer ID	Country
0	489434	85048	15CM CHRISTMAS GLASS BALL 20 LIGHTS	12	2009-12-01 07:45:00	6.95	13085.0	United Kingdom
1	489434	79323P	PINK CHERRY LIGHTS	12	2009-12-01 07:45:00	6.75	13085.0	United Kingdom
2	489434	79323W	WHITE CHERRY LIGHTS	12	2009-12-01 07:45:00	6.75	13085.0	United Kingdom
3	489434	22041	RECORD FRAME 7" SINGLE SIZE	48	2009-12-01 07:45:00	2.10	13085.0	United Kingdom
4	489434	21232	STRAWBERRY CERAMIC TRINKET BOX	24	2009-12-01 07:45:00	1.25	13085.0	United Kingdom
5	489434	22064	PINK DOUGHNUT TRINKET POT	24	2009-12-01 07:45:00	1.65	13085.0	United Kingdom
6	489434	21871	SAVE THE PLANET MUG	24	2009-12-01 07:45:00	1.25	13085.0	United Kingdom
7	489434	21523	FANCY FONT HOME SWEET HOME DOORMAT	10	2009-12-01 07:45:00	5.95	13085.0	United Kingdom
8	489435	22350	CAT BOWL	12	2009-12-01 07:46:00	2.55	13085.0	United Kingdom
9	489435	22349	DOG BOWL , CHASING BALL DESIGN	12	2009-12-01 07:46:00	3.75	13085.0	United Kingdom

In [26]:

```
retail.columns
```

Out[26]:

```
Index(['Invoice', 'StockCode', 'Description', 'Quantity', 'InvoiceDate',
       'Price', 'Customer ID', 'Country'],
      dtype='object')
```

In [37]:

```
retail.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 525461 entries, 0 to 525460
Data columns (total 8 columns):
 #   Column       Non-Null Count   Dtype         
---  ------       --------------   -----         
 0   Invoice      525461 non-null  object        
 1   StockCode    525461 non-null  object        
 2   Description  522533 non-null  object        
 3   Quantity     525461 non-null  int64         
 4   InvoiceDate  525461 non-null  datetime64[ns]
 5   Price        525461 non-null  float64       
 6   Customer ID  417534 non-null  float64       
 7   Country      525461 non-null  object        
dtypes: datetime64[ns](1), float64(2), int64(1), object(4)
memory usage: 32.1+ MB
```

removing the missing values

In [38]:

```
retail_1 = retail.dropna()
```

In [39]:

```
retail_1.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 417534 entries, 0 to 525460
Data columns (total 8 columns):
 #   Column       Non-Null Count   Dtype         
---  ------       --------------   -----         
 0   Invoice      417534 non-null  object        
 1   StockCode    417534 non-null  object        
 2   Description  417534 non-null  object        
 3   Quantity     417534 non-null  int64         
 4   InvoiceDate  417534 non-null  datetime64[ns]
 5   Price        417534 non-null  float64       
 6   Customer ID  417534 non-null  float64       
 7   Country      417534 non-null  object        
dtypes: datetime64[ns](1), float64(2), int64(1), object(4)
memory usage: 28.7+ MB
```

In [40]:

```
retail
```

Out[40]:

	Invoice	StockCode	Description	Quantity	InvoiceDate	Price	Customer ID	Countr
0	489434	85048	15CM CHRISTMAS GLASS BALL 20 LIGHTS	12	2009-12-01 07:45:00	6.95	13085.0	Unite Kingdor
1	489434	79323P	PINK CHERRY LIGHTS	12	2009-12-01 07:45:00	6.75	13085.0	Unite Kingdor
2	489434	79323W	WHITE CHERRY LIGHTS	12	2009-12-01 07:45:00	6.75	13085.0	Unite Kingdor
3	489434	22041	RECORD FRAME 7" SINGLE SIZE	48	2009-12-01 07:45:00	2.10	13085.0	Unite Kingdor
4	489434	21232	STRAWBERRY CERAMIC TRINKET BOX	24	2009-12-01 07:45:00	1.25	13085.0	Unite Kingdor
...	...	...	...	...	...	...	...	.
525456	538171	22271	FELTCRAFT DOLL ROSIE	2	2010-12-09 20:01:00	2.95	17530.0	Unite Kingdor
525457	538171	22750	FELTCRAFT PRINCESS LOLA DOLL	1	2010-12-09 20:01:00	3.75	17530.0	Unite Kingdor
525458	538171	22751	FELTCRAFT PRINCESS OLIVIA DOLL	1	2010-12-09 20:01:00	3.75	17530.0	Unite Kingdor
525459	538171	20970	PINK FLORAL FELTCRAFT SHOULDER BAG	2	2010-12-09 20:01:00	3.75	17530.0	Unite Kingdor
525460	538171	21931	JUMBO STORAGE BAG SUKI	2	2010-12-09 20:01:00	1.95	17530.0	Unite Kingdor

525461 rows × 8 columns

In [43]:

```
# no of unique customers
retail_1.Country.unique()
```

Out[43]:

```
array(['United Kingdom', 'France', 'USA', 'Belgium', 'Australia', 'EIRE',
       'Germany', 'Portugal', 'Japan', 'Denmark', 'Netherlands', 'Polan
d',
       'Spain', 'Channel Islands', 'Italy', 'Cyprus', 'Greece', 'Norway',
       'Austria', 'Sweden', 'United Arab Emirates', 'Finland',
       'Switzerland', 'Unspecified', 'Nigeria', 'Malta', 'RSA',
       'Singapore', 'Bahrain', 'Thailand', 'Israel', 'Lithuania',
       'West Indies', 'Korea', 'Brazil', 'Canada', 'Iceland'],
      dtype=object)
```

In [51]:

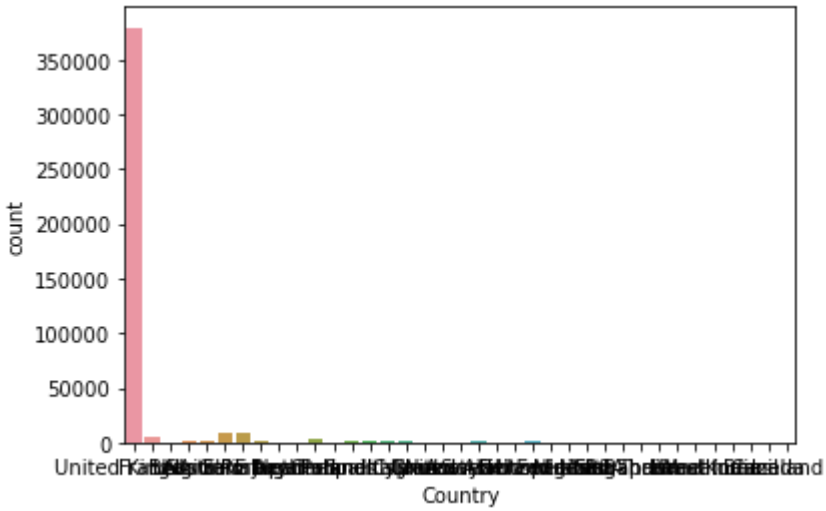
```
import warnings
warnings.filterwarnings("ignore")
```

In [52]:

```
sns.countplot(retail_1.Country)
```

Out[52]:

```
<AxesSubplot:xlabel='Country', ylabel='count'>
```



mainly we have the data of uk let's consider dropping out the other contries

In [55]:

```
retail_2 = retail_1[retail_1.Country == 'United Kingdom']
retail_2.head()
```

Out[55]:

	Invoice	StockCode	Description	Quantity	InvoiceDate	Price	Customer ID	Country
0	489434	85048	15CM CHRISTMAS GLASS BALL 20 LIGHTS	12	2009-12-01 07:45:00	6.95	13085.0	United Kingdom
1	489434	79323P	PINK CHERRY LIGHTS	12	2009-12-01 07:45:00	6.75	13085.0	United Kingdom
2	489434	79323W	WHITE CHERRY LIGHTS	12	2009-12-01 07:45:00	6.75	13085.0	United Kingdom
3	489434	22041	RECORD FRAME 7" SINGLE SIZE	48	2009-12-01 07:45:00	2.10	13085.0	United Kingdom
4	489434	21232	STRAWBERRY CERAMIC TRINKET BOX	24	2009-12-01 07:45:00	1.25	13085.0	United Kingdom

In [57]:

```
retail_2.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 379423 entries, 0 to 525460
Data columns (total 8 columns):
 #   Column       Non-Null Count   Dtype         
---  ------       --------------   -----         
 0   Invoice      379423 non-null  object        
 1   StockCode    379423 non-null  object        
 2   Description  379423 non-null  object        
 3   Quantity     379423 non-null  int64         
 4   InvoiceDate  379423 non-null  datetime64[ns]
 5   Price        379423 non-null  float64       
 6   Customer ID  379423 non-null  float64       
 7   Country      379423 non-null  object        
dtypes: datetime64[ns](1), float64(2), int64(1), object(4)
memory usage: 26.1+ MB
```

In [58]:

```
retail_2.describe()
```

Out[58]:

	Quantity	Price	Customer ID
count	379423.000000	379423.000000	379423.000000
mean	11.451517	3.653249	15559.935694
std	68.943709	68.743746	1593.744626
min	-9360.000000	0.000000	12346.000000
25%	2.000000	1.250000	14210.000000
50%	4.000000	1.950000	15581.000000
75%	12.000000	3.750000	16938.000000
max	10000.000000	25111.090000	18287.000000

RFM

Recency: since how long the customer has'nt appeared.
Frequency: how offen does the customer appear.
Monitory: how much customer invested

Recency:

In [162]:

```
retail_2.InvoiceDate.max() - retail_2.InvoiceDate.min()
```

Out[162]:

```
Timedelta('373 days 12:16:00')
```

In [163]:

```
# let's create a recency feature
min_date = retail_2.InvoiceDate.min()
retail_2['recency'] = retail_2.InvoiceDate - min_date
```

In [164]:

```
RECENCY = retail_2.groupby('Customer ID')['recency'].max().reset_index()
RECENCY.head()
```

Out[164]:

	Customer ID	recency
0	12346.0	307 days 08:48:00
1	12608.0	334 days 03:04:00
2	12745.0	252 days 02:29:00
3	12746.0	211 days 00:34:00
4	12747.0	369 days 07:53:00

Frequency:

In [165]:

```
retail_2.head()
```

Out[165]:

	Invoice	StockCode	Description	Quantity	InvoiceDate	Price	Customer ID	Country	rec
0	489434	85048	15CM CHRISTMAS GLASS BALL 20 LIGHTS	12	2009-12-01 07:45:00	6.95	13085.0	United Kingdom	0
1	489434	79323P	PINK CHERRY LIGHTS	12	2009-12-01 07:45:00	6.75	13085.0	United Kingdom	0
2	489434	79323W	WHITE CHERRY LIGHTS	12	2009-12-01 07:45:00	6.75	13085.0	United Kingdom	0
3	489434	22041	RECORD FRAME 7" SINGLE SIZE	48	2009-12-01 07:45:00	2.10	13085.0	United Kingdom	0
4	489434	21232	STRAWBERRY CERAMIC TRINKET BOX	24	2009-12-01 07:45:00	1.25	13085.0	United Kingdom	0

In [166]:

```
frequency = retail_2.groupby('Customer ID')['Invoice'].nunique().reset_index()
frequency.head()
```

Out[166]:

	Customer ID	Invoice
0	12346.0	15
1	12608.0	1
2	12745.0	2
3	12746.0	3
4	12747.0	22

Monitory:

In [167]:

```
retail_2.head()
```

Out[167]:

	Invoice	StockCode	Description	Quantity	InvoiceDate	Price	Customer ID	Country	rec
0	489434	85048	15CM CHRISTMAS GLASS BALL 20 LIGHTS	12	2009-12-01 07:45:00	6.95	13085.0	United Kingdom	0
1	489434	79323P	PINK CHERRY LIGHTS	12	2009-12-01 07:45:00	6.75	13085.0	United Kingdom	0
2	489434	79323W	WHITE CHERRY LIGHTS	12	2009-12-01 07:45:00	6.75	13085.0	United Kingdom	0
3	489434	22041	RECORD FRAME 7" SINGLE SIZE	48	2009-12-01 07:45:00	2.10	13085.0	United Kingdom	0
4	489434	21232	STRAWBERRY CERAMIC TRINKET BOX	24	2009-12-01 07:45:00	1.25	13085.0	United Kingdom	0

In [168]:

```
retail_2['amount'] = retail_2['Quantity']*retail_2['Price']
retail_2.head()
```

Out[168]:

	Invoice	StockCode	Description	Quantity	InvoiceDate	Price	Customer ID	Country	rec
0	489434	85048	15CM CHRISTMAS GLASS BALL 20 LIGHTS	12	2009-12-01 07:45:00	6.95	13085.0	United Kingdom	0
1	489434	79323P	PINK CHERRY LIGHTS	12	2009-12-01 07:45:00	6.75	13085.0	United Kingdom	0
2	489434	79323W	WHITE CHERRY LIGHTS	12	2009-12-01 07:45:00	6.75	13085.0	United Kingdom	0
3	489434	22041	RECORD FRAME 7" SINGLE SIZE	48	2009-12-01 07:45:00	2.10	13085.0	United Kingdom	0
4	489434	21232	STRAWBERRY CERAMIC TRINKET BOX	24	2009-12-01 07:45:00	1.25	13085.0	United Kingdom	0

In [169]:

```
monitory = retail_2.groupby('Customer ID').amount.sum().reset_index()
```

In [170]:

```
monitory.head()
```

Out[170]:

	Customer ID	amount
0	12346.0	-64.68
1	12608.0	415.79
2	12745.0	723.85
3	12746.0	230.85
4	12747.0	4968.58

In [171]:

```
rfm = RECENCY.merge(frequency, on='Customer ID', how = "left")
```

In [172]:

```
# correcting the invoice column name as frequency
rfm.rename(columns={'Invoice': 'frequency'}, inplace = True)
rfm
```

Out[172]:

	Customer ID	recency	frequency
0	12346.0	307 days 08:48:00	15
1	12608.0	334 days 03:04:00	1
2	12745.0	252 days 02:29:00	2
3	12746.0	211 days 00:34:00	3
4	12747.0	369 days 07:53:00	22
...	...	...	...
4030	18283.0	356 days 07:45:00	6
4031	18284.0	309 days 04:46:00	2
4032	18285.0	78 days 02:39:00	1
4033	18286.0	262 days 04:12:00	3
4034	18287.0	356 days 04:06:00	5

4035 rows × 3 columns

In [173]:

```
rfm.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 4035 entries, 0 to 4034
Data columns (total 3 columns):
 #   Column       Non-Null Count  Dtype          
---  ------       --------------  -----          
 0   Customer ID  4035 non-null   float64        
 1   recency      4035 non-null   timedelta64[ns]
 2   frequency    4035 non-null   int64          
dtypes: float64(1), int64(1), timedelta64[ns](1)
memory usage: 126.1 KB
```

In [174]:

```
# let's make a monitory column too
rfm = rfm.merge(monitory, on='Customer ID', how = "left")
```

In [175]:

```
rfm
```

Out[175]:

	Customer ID	recency	frequency	amount
0	12346.0	307 days 08:48:00	15	-64.68
1	12608.0	334 days 03:04:00	1	415.79
2	12745.0	252 days 02:29:00	2	723.85
3	12746.0	211 days 00:34:00	3	230.85
4	12747.0	369 days 07:53:00	22	4968.58
...	...	...	...	...
4030	18283.0	356 days 07:45:00	6	641.77
4031	18284.0	309 days 04:46:00	2	436.68
4032	18285.0	78 days 02:39:00	1	427.00
4033	18286.0	262 days 04:12:00	3	1188.43
4034	18287.0	356 days 04:06:00	5	2340.61

4035 rows × 4 columns

In [176]:

```
# let's takeout the days from recency
rfm['recency'] = rfm['recency'].dt.days
rfm
```

Out[176]:

	Customer ID	recency	frequency	amount
0	12346.0	307	15	-64.68
1	12608.0	334	1	415.79
2	12745.0	252	2	723.85
3	12746.0	211	3	230.85
4	12747.0	369	22	4968.58
...	...	...	...	...
4030	18283.0	356	6	641.77
4031	18284.0	309	2	436.68
4032	18285.0	78	1	427.00
4033	18286.0	262	3	1188.43
4034	18287.0	356	5	2340.61

4035 rows × 4 columns

In [180]:

```
rfm.head()
```

Out[180]:

	Customer ID	recency	frequency	amount
0	12346.0	307	15	-64.68
1	12608.0	334	1	415.79
2	12745.0	252	2	723.85
3	12746.0	211	3	230.85
4	12747.0	369	22	4968.58

In [181]:

```
rfm.info()
```

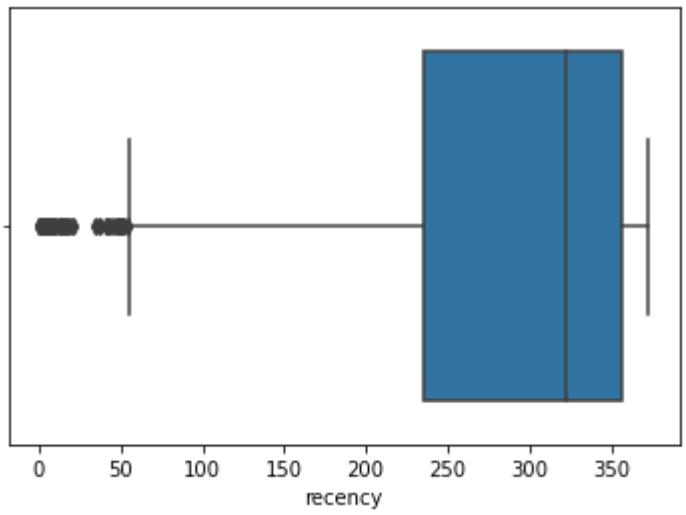
```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 4035 entries, 0 to 4034
Data columns (total 4 columns):
 #   Column       Non-Null Count  Dtype  
---  ------       --------------  -----  
 0   Customer ID  4035 non-null   float64
 1   recency      4035 non-null   int64  
 2   frequency    4035 non-null   int64  
 3   amount       4035 non-null   float64
dtypes: float64(2), int64(2)
memory usage: 126.2 KB
```

In [202]:

```
sns.boxplot(rfm['recency'])
```

Out[202]:

```
<AxesSubplot:xlabel='recency'>
```

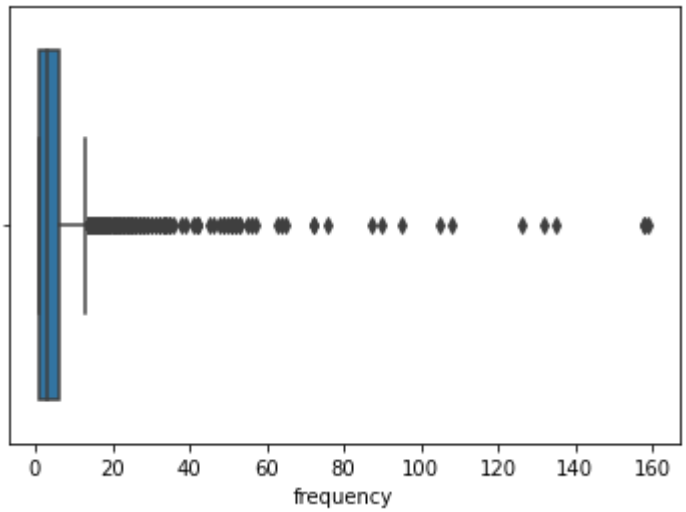


In [204]:

```
sns.boxplot(rfm['frequency']) # outliers need to be removed
```

Out[204]:

```
<AxesSubplot:xlabel='frequency'>
```

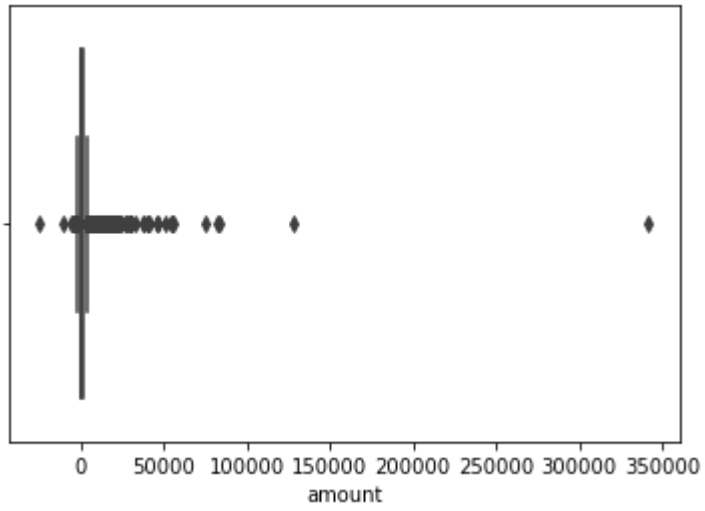


In [206]:

```
sns.boxplot(rfm['amount']) # outliers need to be taken care off
```

Out[206]:

```
<AxesSubplot:xlabel='amount'>
```



Outliers Treatment

In [224]:

```
import numpy as np
recency_25 = np.percentile(rfm['recency'], 25)
recency_75 = np.percentile(rfm['recency'], 75)
IQR = recency_75 - recency_25
print(recency_25, recency_75, IQR)
```

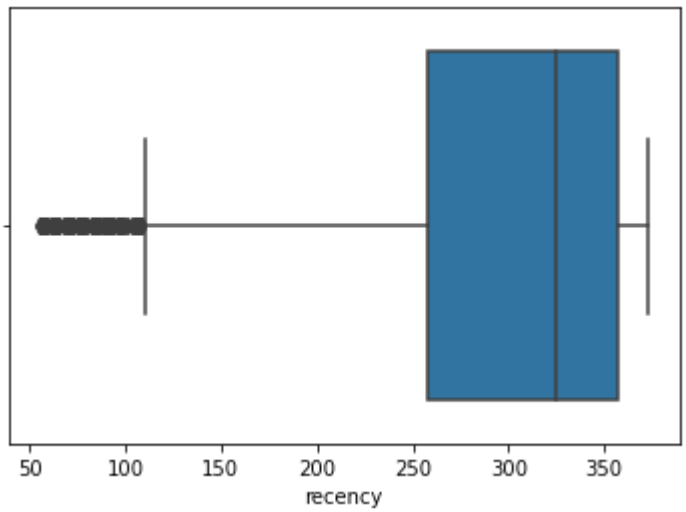
```
236.0 357.0 121.0
```

In [225]:

```
rfm_filtered = rfm[(rfm['recency'] < (recency_75 + 1.5 * IQR)) & (rfm['recency'] > (rece
sns.boxplot(rfm_filtered['recency'])
```

Out[225]:

```
<AxesSubplot:xlabel='recency'>
```



In [226]:

```
rfm = rfm_filtered
```

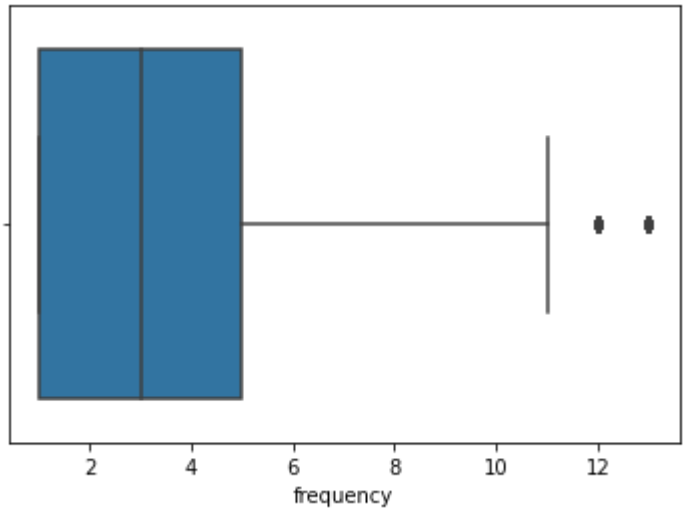
In [227]:

```
frequency_25 = np.percentile(rfm['frequency'], 25)
frequency_75 = np.percentile(rfm['frequency'], 75)
IQR = frequency_75 - frequency_25
print(frequency_25, frequency_75, IQR)
rfm_filtered = rfm[(rfm['frequency'] < (frequency_75 + 1.5 * IQR)) & (rfm['frequency'] >
sns.boxplot(rfm_filtered['frequency'])
```

```
1.0 6.0 5.0
```

Out[227]:

```
<AxesSubplot:xlabel='frequency'>
```



In [228]:

```
rfm = rfm_filtered
```

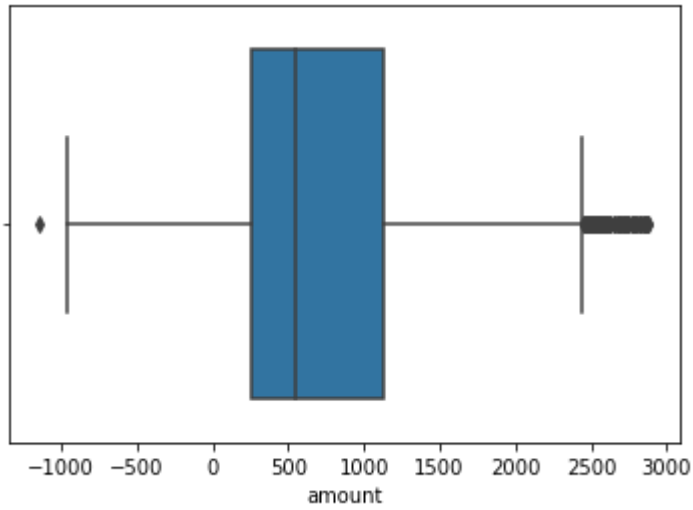
In [229]:

```
amount_25 = np.percentile(rfm['amount'], 25)
amount_75 = np.percentile(rfm['amount'], 75)
IQR = amount_75 - amount_25
print(amount_25, amount_75, IQR)
rfm_filtered = rfm[(rfm['amount'] < (amount_75 + 1.5 * IQR)) & (rfm['amount'] > (amount_
sns.boxplot(rfm_filtered['amount'])
```

```
274.47 1318.655 1044.185
```

Out[229]:

```
<AxesSubplot:xlabel='amount'>
```



In [230]:

```
rfm = rfm_filtered
```

In [237]:

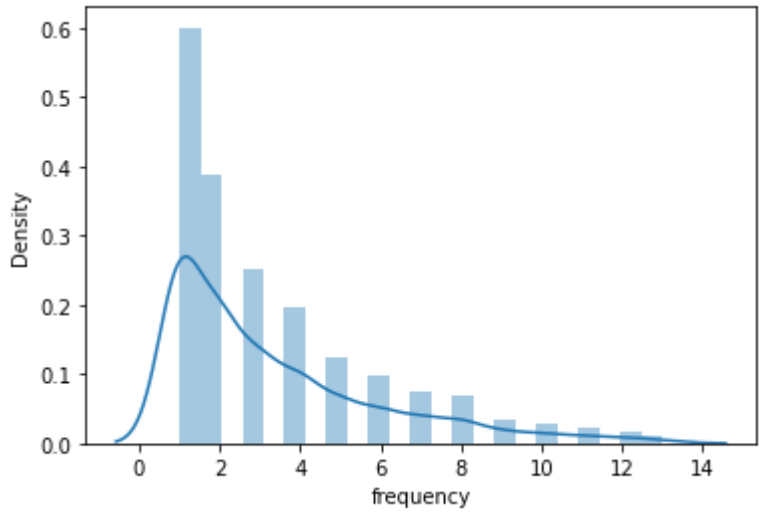
```
# now let's normalise the data
```

In [242]:

```
sns.distplot(rfm["frequency"])
```

Out[242]:

```
<AxesSubplot:xlabel='frequency', ylabel='Density'>
```

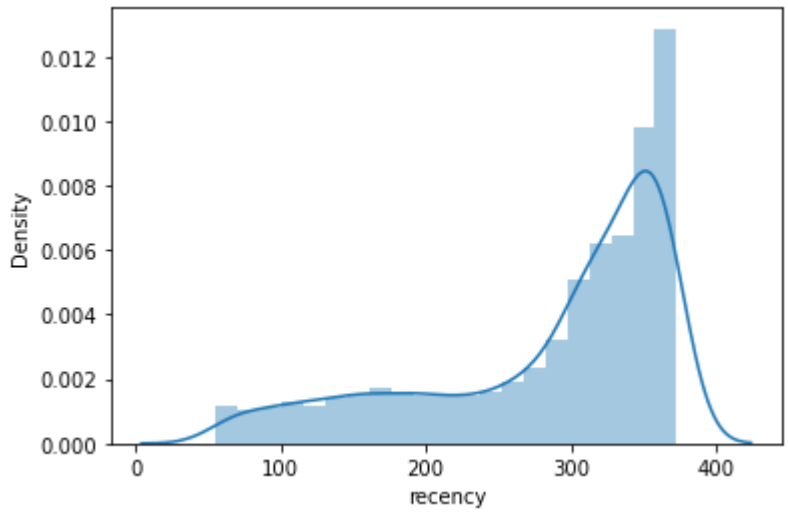


In [243]:

```
sns.distplot(rfm["recency"])
```

Out[243]:

```
<AxesSubplot:xlabel='recency', ylabel='Density'>
```

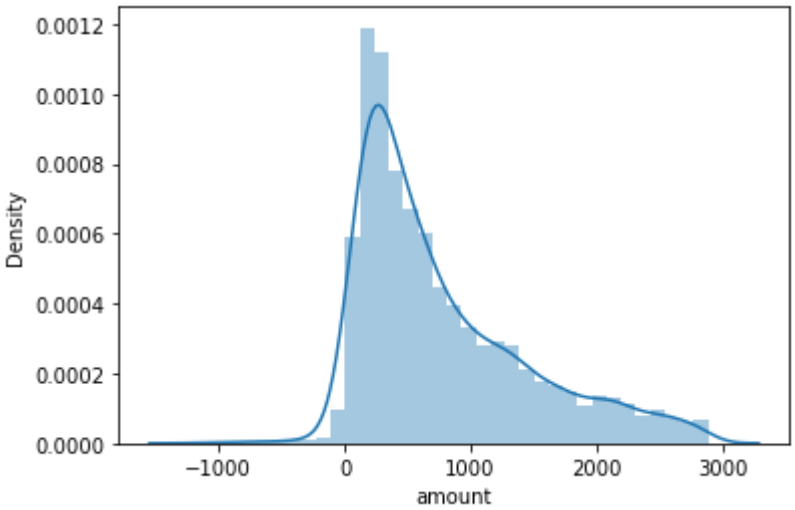


In [244]:

```
sns.distplot(rfm["amount"])
```

Out[244]:

```
<AxesSubplot:xlabel='amount', ylabel='Density'>
```



In [249]:

```
# let's standerize the data!
columns = rfm.columns
```

In [251]:

```
from sklearn.preprocessing import StandardScaler
scaler = StandardScaler()
scaled_data = scaler.fit_transform(rfm)
scaled_df = pd.DataFrame(scaled_data, columns=columns)
```

In [253]:

```
scaled_df.head()
```

Out[253]:

	Customer ID	recency	frequency	amount
0	-1.889664	0.567612	-0.878228	-0.526372
1	-1.802732	-0.380857	-0.502233	-0.072674
2	-1.802097	-0.855092	-0.126238	-0.798744
3	-1.800194	0.787379	1.753736	2.484685
4	-1.782426	-0.045423	-0.878228	-0.373706

In [ ]:

```

```

In [ ]:

```
```

In [254]:

```
help(KMeans)
```

```
Help on class KMeans in module sklearn.cluster._kmeans:

class KMeans(sklearn.base.TransformerMixin, sklearn.base.ClusterMixin,
sklearn.base.BaseEstimator)
 |  KMeans(n_clusters=8, *, init='k-means++', n_init=10, max_iter=300,
tol=0.0001, verbose=0, random_state=None, copy_x=True, algorithm='aut
o')
 |
 |  K-Means clustering.
 |
 |  Read more in the :ref:`User Guide <k_means>`.
 |
 |  Parameters
 |  ----------
 |
 |  n_clusters : int, default=8
 |      The number of clusters to form as well as the number of
 |      centroids to generate.
 |
 |  init : {'k-means++', 'random'}, callable or array-like of shape
```

In [264]:

```
obj=KMeans(n_clusters=3)
obj.fit(rfm)
```

Out[264]:

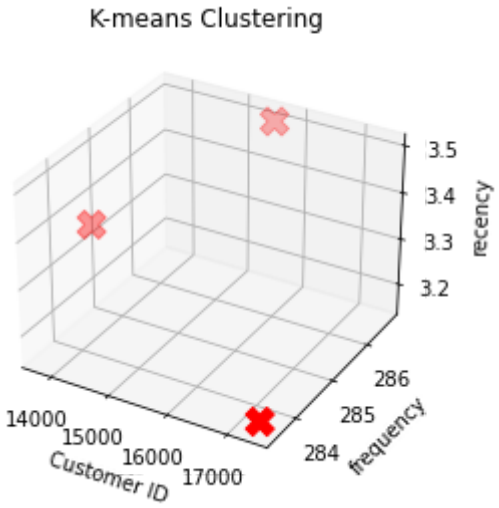
```
KMeans(n_clusters=3)
```

In [265]:

```
labels=obj.labels_
centers = obj.cluster_centers_
```

In [266]:

```
fig = plt.figure()
ax = fig.add_subplot(111, projection='3d')
# ax.scatter(rfm['Customer ID'], rfm['frequency'], rfm['recency'], c=labels, cmap='viria
ax.scatter(centers[:, 0], centers[:, 1], centers[:, 2], marker='X', color='red', s=200)
ax.set_xlabel('Customer ID')
ax.set_ylabel('frequency')
ax.set_zlabel('recency')
ax.set_title('K-means Clustering')
plt.show()
```



Silhouette Analysis

In [268]:

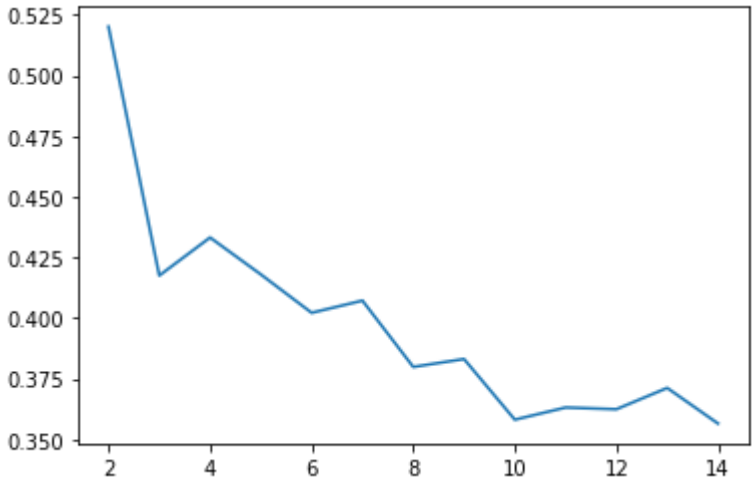
```
from sklearn.metrics import silhouette_score
from sklearn.cluster import KMeans

sse = []
for k in range(2, 15):
    kmeans = KMeans(n_clusters=k).fit(rfm)
    sse.append([k, silhouette_score(rfm, kmeans.labels_)])
```

In [270]:

```
plt.plot(pd.DataFrame(sse)[0], pd.DataFrame(sse)[1])
```

Out[270]:

```
[<matplotlib.lines.Line2D at 0x22f76ee4430>]
```



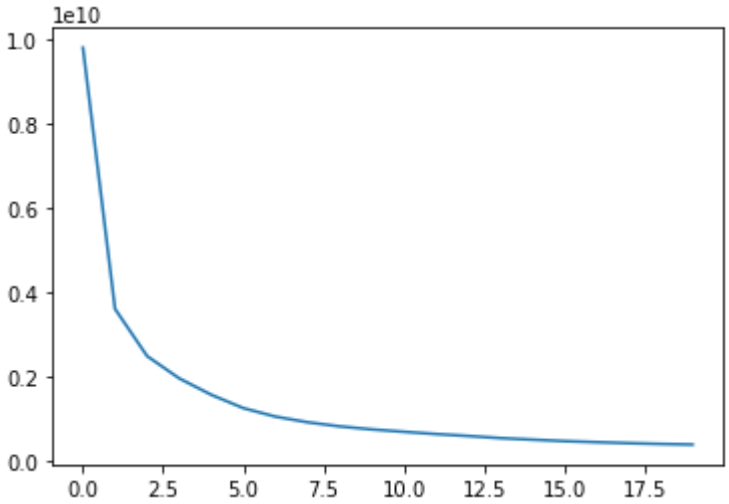
sum of squared distance

In [271]:

```
ssd = []
for num_clusters in list(range(1, 21)):
    model_clus = KMeans(n_clusters = num_clusters, max_iter = 50)
    model_clus.fit(rfm)
    ssd.append(model_clus.inertia_)

plt.plot(ssd)
```

Out[271]:

```
[<matplotlib.lines.Line2D at 0x22f75aa6430>]
```



In [324]:

```
model_clus5 = KMeans(n_clusters = 5)
model_clus5.fit(rfm)
```

Out[324]:

```
KMeans(n_clusters=5)
```

In [325]:

```
# analysis of the clusters formed
```

In [326]:

```
rfm.index = pd.RangeIndex(len(rfm.index))
rfm_km = pd.concat([rfm, pd.Series(model_clus5.labels_)], axis = 1)
```

In [327]:

```
rfm_km.head()
```

Out[327]:

	Customer ID	recency	frequency	amount	0
0	12608.0	334	1	415.79	3
1	12745.0	252	2	723.85	3
2	12746.0	211	3	230.85	3
3	12749.0	353	8	2460.29	0
4	12777.0	281	1	519.45	3

In [328]:

```
rfm_km.columns
```

Out[328]:

```
Index(['Customer ID', 'recency', 'frequency', 'amount', 0], dtype='objec
t')
```

In [329]:

```
# 0 is here the cluster id
rfm_km.cluster_amount = pd.DataFrame(rfm_km.groupby([0])['amount'].mean())
rfm_km.cluster_frequency = pd.DataFrame(rfm_km.groupby([0])['frequency'].mean())
rfm_km.cluster_recency = pd.DataFrame(rfm_km.groupby([0])['recency'].mean())
print(rfm_km.cluster_amount, rfm_km.cluster_frequency, rfm_km.cluster_recency)
```

```
        amount
0
0  1763.190503
1   473.534867
2   491.955970
3   445.650365
4  1839.480784    frequency
0
0   6.309896
1   2.501114
2   2.493072
3   2.375000
4   6.324324       recency
0
0  324.932292
1  275.230512
2  271.198614
3  271.721250
4  327.627027
```

In [330]:

```
final_mean = pd.concat([pd.Series([0,1,2,3,4]), rfm_km.cluster_amount, rfm_km.cluster_fr
```

In [331]:

```
final_mean.columns = ["cluster_id", "amount_mean", "frequency_mean", "recency_mean"]
final_mean
```

Out[331]:

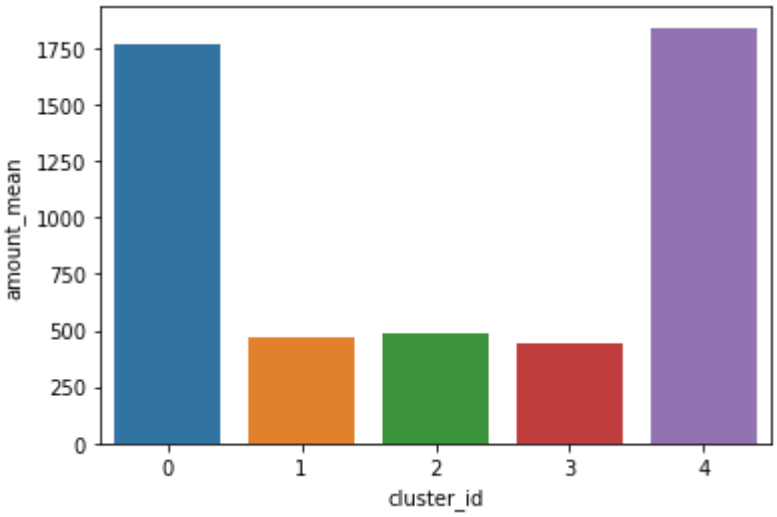
	cluster_id	amount_mean	frequency_mean	recency_mean
0	0	1763.190503	6.309896	324.932292
1	1	473.534867	2.501114	275.230512
2	2	491.955970	2.493072	271.198614
3	3	445.650365	2.375000	271.721250
4	4	1839.480784	6.324324	327.627027

In [332]:

```
sns.barplot(x=final_mean.cluster_id, y=final_mean.amount_mean)
```

Out[332]:

```
<AxesSubplot:xlabel='cluster_id', ylabel='amount_mean'>
```

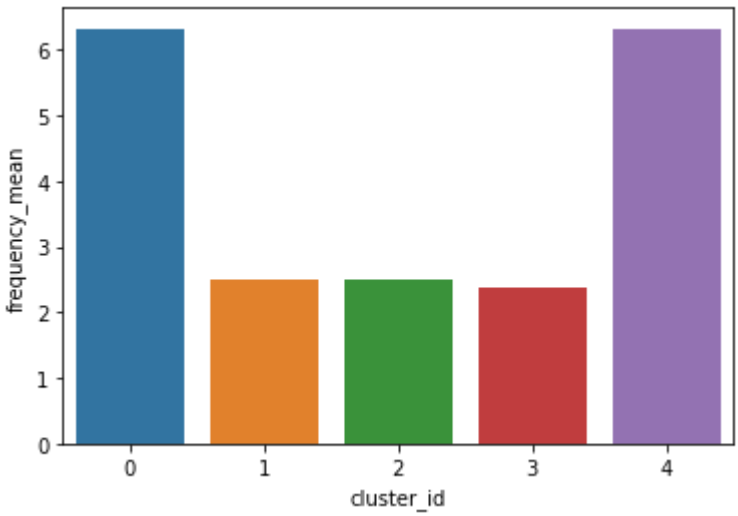


In [333]:

```
sns.barplot(x=final_mean.cluster_id, y=final_mean.frequency_mean)
```

Out[333]:

```
<AxesSubplot:xlabel='cluster_id', ylabel='frequency_mean'>
```

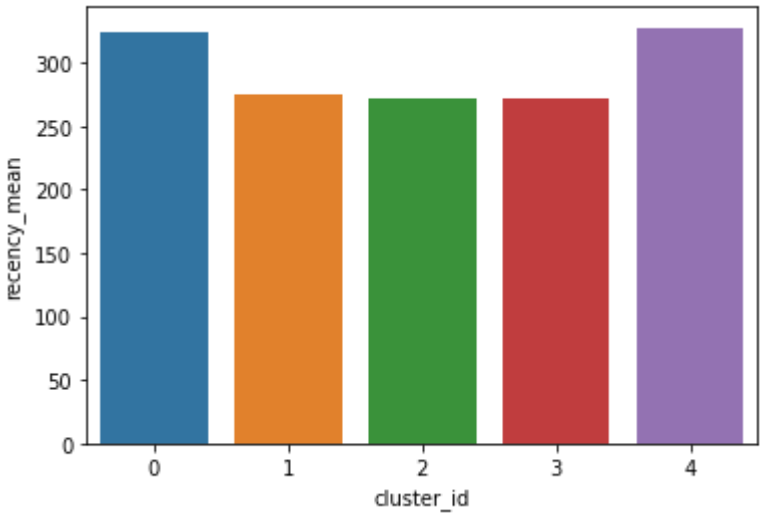


In [334]:

```
sns.barplot(x=final_mean.cluster_id, y=final_mean.recency_mean)
```

Out[334]:

```
<AxesSubplot:xlabel='cluster_id', ylabel='recency_mean'>
```



inference: as per the above analysis we could segment the customers in the categories...as we can see some peoples tend to spend little so we could provide some gift cards, or some extra offers to retain them

while some sements of peoples also tend to apper less so we can provide extra bonuses on frequent shopping!

ans as per the third plot all segments tend to appear with almost the same recency

In [ ]:

```

```