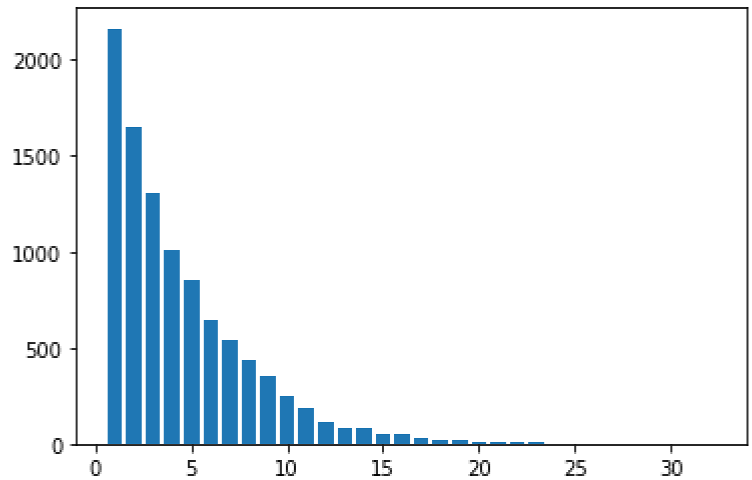
Q1 - a

In [32]:
```
import pandas as pd
import matplotlib.pyplot as plt
G = pd.read_csv('Groceries.csv',delimiter=',')
nItemPurchase = G.groupby('Customer').size()
unique_item = pd.Series.sort_index(pd.Series.value_counts(nItemPurchase))
plt.bar(unique_item.index.values,unique_item)
plt.show()
```



In [189]:
```
import numpy as np
#print(unique_item)
sum = np.sum(unique_item)
freq= unique_item.cumsum()
median = freq[freq>=sum/2].index[0]
q1 = freq[freq>=sum/4].index[0]
q3 = freq[freq>=3*(sum/4)].index[0]
print("Median",median)
print("25th percentile",q1)
print("75th percentile",q3)
```

```
Median 3
25th percentile 2
75th percentile 6
```

Q1 - b

In [20]:
```
pip install mlxtend
```

```
Requirement already satisfied: mlxtend in c:\users\segar\anaconda3\lib\site-p
ackages (0.17.1)
Requirement already satisfied: numpy>=1.16.2 in c:\users\segar\anaconda3\lib
\site-packages (from mlxtend) (1.16.5)
Requirement already satisfied: scikit-learn>=0.20.3 in c:\users\segar\anacond
a3\lib\site-packages (from mlxtend) (0.21.3)
Requirement already satisfied: scipy>=1.2.1 in c:\users\segar\anaconda3\lib\s
ite-packages (from mlxtend) (1.3.1)
Requirement already satisfied: pandas>=0.24.2 in c:\users\segar\anaconda3\lib
\site-packages (from mlxtend) (0.25.1)
Requirement already satisfied: setuptools in c:\users\segar\anaconda3\lib\sit
e-packages (from mlxtend) (41.4.0)
Requirement already satisfied: joblib>=0.13.2 in c:\users\segar\anaconda3\lib
\site-packages (from mlxtend) (0.13.2)
Requirement already satisfied: matplotlib>=3.0.0 in c:\users\segar\anaconda3
\lib\site-packages (from mlxtend) (3.1.1)
Requirement already satisfied: pytz>=2017.2 in c:\users\segar\anaconda3\lib\s
ite-packages (from pandas>=0.24.2->mlxtend) (2019.3)
Requirement already satisfied: python-dateutil>=2.6.1 in c:\users\segar\anaco
nda3\lib\site-packages (from pandas>=0.24.2->mlxtend) (2.8.0)
Requirement already satisfied: cycler>=0.10 in c:\users\segar\anaconda3\lib\s
ite-packages (from matplotlib>=3.0.0->mlxtend) (0.10.0)
Requirement already satisfied: kiwisolver>=1.0.1 in c:\users\segar\anaconda3
\lib\site-packages (from matplotlib>=3.0.0->mlxtend) (1.1.0)
Requirement already satisfied: pyparsing!=2.0.4,!=2.1.2,!=2.1.6,>=2.0.1 in
c:\users\segar\anaconda3\lib\site-packages (from matplotlib>=3.0.0->mlxtend)
(2.4.2)
Requirement already satisfied: six>=1.5 in c:\users\segar\anaconda3\lib\site-
packages (from python-dateutil>=2.6.1->pandas>=0.24.2->mlxtend) (1.12.0)
Note: you may need to restart the kernel to use updated packages.

WARNING: You are using pip version 19.3.1; however, version 20.0.2 is availab
le.
You should consider upgrading via the 'python -m pip install --upgrade pip' c
ommand.
```

In [24]:
```
import pandas
ListItem = G.groupby(['Customer'])['Item'].apply(list).values.tolist()
from mlxtend.preprocessing import TransactionEncoder
te = TransactionEncoder()
te_ary = te.fit(ListItem).transform(ListItem)
ItemIndicator = pandas.DataFrame(te_ary, columns=te.columns_)
from mlxtend.frequent_patterns import apriori

frequent_itemsets = apriori(ItemIndicator, min_support = (75/sum), max_len = 4
, use_colnames = True)
print(frequent_itemsets.count())
```

```
support     524
itemsets    524
dtype: int64
```

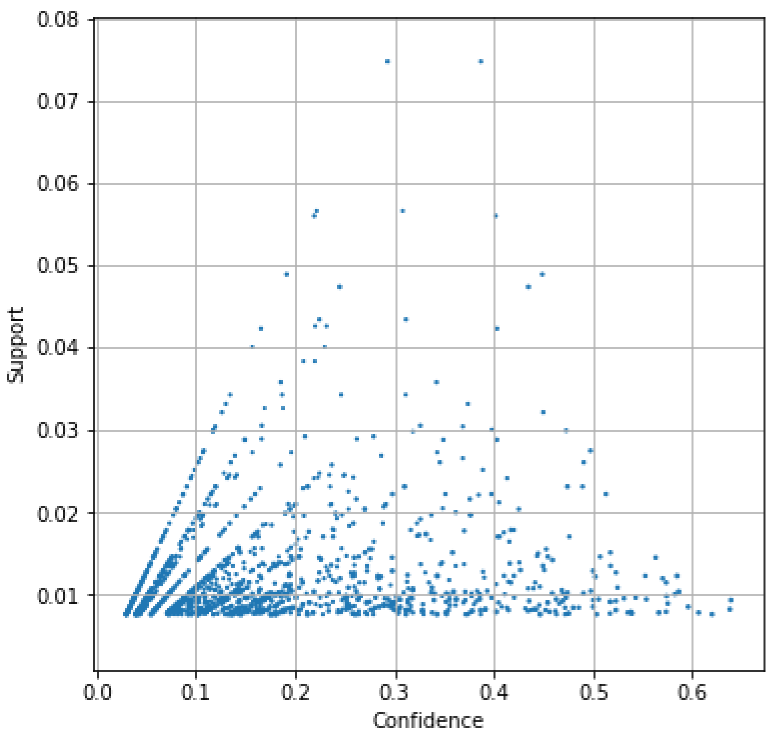
Q1 - c

In [31]:
```
from mlxtend.frequent_patterns import association_rules
assoc_rules = association_rules(frequent_itemsets, metric = "confidence", min_
threshold = 0.01)
print(assoc_rules.count()["antecedents"])
```

1228

Q1 - d

In [37]:
```
import matplotlib.pyplot as plt
plt.figure(figsize=(6,6))
plt.scatter(assoc_rules['confidence'], assoc_rules['support'], s = assoc_rules
['lift'])
plt.grid(True)
plt.xlabel("Confidence")
plt.ylabel("Support")
plt.show()
```



Q1 - e

In [54]:
```
pip install tabulate
```

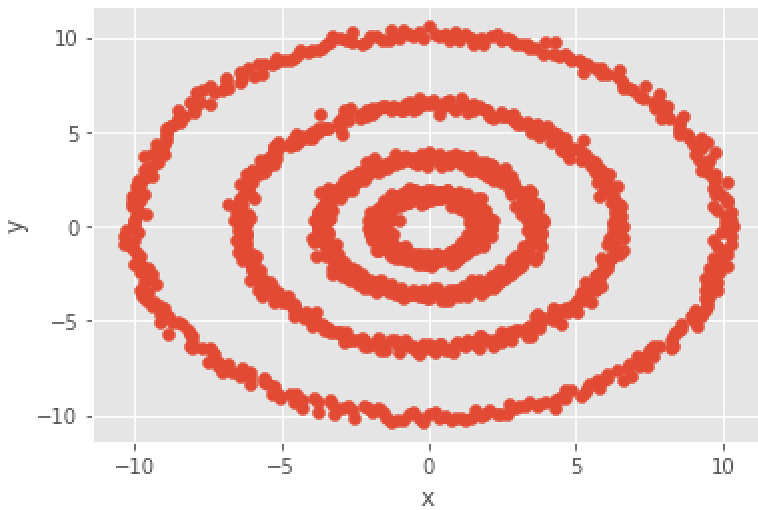
```
Collecting tabulate
  Using cached https://files.pythonhosted.org/packages/c4/41/523f6a05e6dc3329
a5660f6a81254c6cd87e5cfb5b7482bae3391d86ec3a/tabulate-0.8.6.tar.gz
Building wheels for collected packages: tabulate
  Building wheel for tabulate (setup.py): started
  Building wheel for tabulate (setup.py): finished with status 'done'
  Created wheel for tabulate: filename=tabulate-0.8.6-cp37-none-any.whl size=
23279 sha256=0ce769de776a3cb5297534c59bc3b0093130a03b927a560ac1c63d02569828c2
  Stored in directory: C:\Users\segar\AppData\Local\pip\Cache\wheels\9c\9b\f4
\eb243fdb89676ec00588e8c54bb54360724c06e7fafe95278e
Successfully built tabulate
Installing collected packages: tabulate
Successfully installed tabulate-0.8.6
Note: you may need to restart the kernel to use updated packages.

WARNING: You are using pip version 19.3.1; however, version 20.0.2 is availab
le.
You should consider upgrading via the 'python -m pip install --upgrade pip' c
ommand.
```

In [188]:
```
from mlxtend.frequent_patterns import association_rules
from tabulate import tabulate
assoc_rules_greater_than_60 = association_rules(frequent_itemsets, metric = "c
onfidence", min_threshold = 0.6)
print(assoc_rules_greater_than_60)
print(" ")
print(str(assoc_rules_greater_than_60['antecedents'][0]) + " -> " + str(assoc_
rules_greater_than_60['consequents'][0]))
print("Support: " + str(assoc_rules_greater_than_60['support'][0]))
print("Lift: " + str(assoc_rules_greater_than_60['lift'][0]) +"\n")
print(str(assoc_rules_greater_than_60['antecedents'][1]) + " -> " + str(assoc_
rules_greater_than_60['consequents'][1]))
print("Support: " + str(assoc_rules_greater_than_60['support'][1]))
print("Lift: " + str(assoc_rules_greater_than_60['lift'][1]) +"\n")
print(str(assoc_rules_greater_than_60['antecedents'][2]) + " -> " + str(assoc_
rules_greater_than_60['consequents'][2]))
print("Support: " + str(assoc_rules_greater_than_60['support'][2]))
print("Lift: " + str(assoc_rules_greater_than_60['lift'][2]) +"\n")
print(str(assoc_rules_greater_than_60['antecedents'][3]) + " -> " + str(assoc_
rules_greater_than_60['consequents'][3]))
print("Support: " + str(assoc_rules_greater_than_60['support'][3]))
print("Lift: " + str(assoc_rules_greater_than_60['lift'][3]) +"\n")
```

```
                                  antecedents   consequents  \
0                   (root vegetables, butter)  (whole milk)
1                            (butter, yogurt)  (whole milk)
2  (root vegetables, other vegetables, yogurt)  (whole milk)
3   (tropical fruit, other vegetables, yogurt)  (whole milk)

   antecedent support  consequent support   support  confidence      lift  \
0            0.012913            0.255516  0.008236    0.637795  2.496107
1            0.014642            0.255516  0.009354    0.638889  2.500387
2            0.012913            0.255516  0.007829    0.606299  2.372842
3            0.012303            0.255516  0.007626    0.619835  2.425816

   leverage  conviction
0  0.004936    2.055423
1  0.005613    2.061648
2  0.004530    1.890989
3  0.004482    1.958317

frozenset({'root vegetables', 'butter'}) -> frozenset({'whole milk'})
Support: 0.008235892221657347
Lift: 2.4961068585089814

frozenset({'butter', 'yogurt'}) -> frozenset({'whole milk'})
Support: 0.009354346720894764
Lift: 2.500386877127824

frozenset({'root vegetables', 'other vegetables', 'yogurt'}) -> frozenset({'w
hole milk'})
Support: 0.007829181494661922
Lift: 2.3728423222863158

frozenset({'tropical fruit', 'other vegetables', 'yogurt'}) -> frozenset({'wh
ole milk'})
Support: 0.007625826131164209
Lift: 2.4258155114068
```

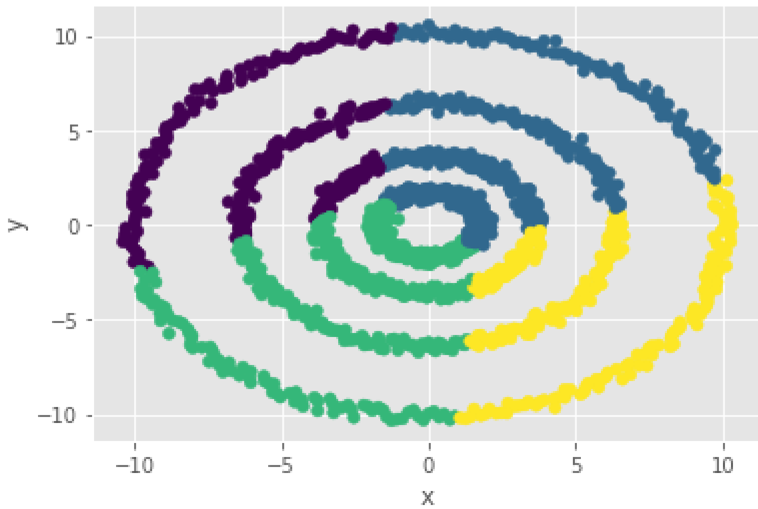
Q3 - a

In [61]:
```
import pandas as pd
import sklearn.cluster as cluster
import matplotlib.pyplot as plt
import numpy as np
import math
import sklearn.neighbors
from matplotlib import style
Four_Circle_Data = pd.read_csv('FourCircle.csv', delimiter=',')
plt.scatter(np.array(Four_Circle_Data['x']), np.array(Four_Circle_Data['y']))
plt.xlabel('x')
plt.ylabel('y')
plt.grid(True)
plt.show()
```



Q3 - b

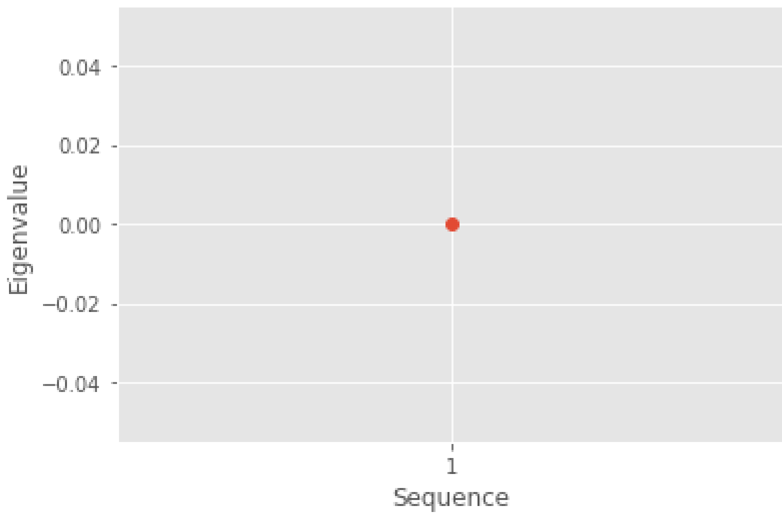
In [62]:
```
trainData = Four_Circle_Data[['x','y']]
kmeans = cluster.KMeans(n_clusters=4, random_state=60616).fit(trainData)
Four_Circle_Data['KMClusterLabel'] = kmeans.labels_
plt.scatter(Four_Circle_Data['x'], Four_Circle_Data['y'], c = Four_Circle_Data
['KMClusterLabel'])
plt.xlabel('x')
plt.ylabel('y')
plt.grid(True)
plt.show()
```



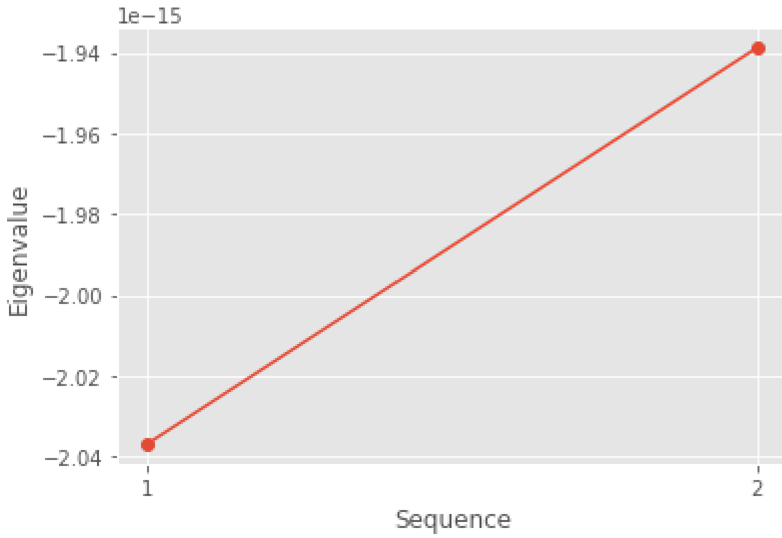
Q3 - c

In [68]:
```
import numpy
```

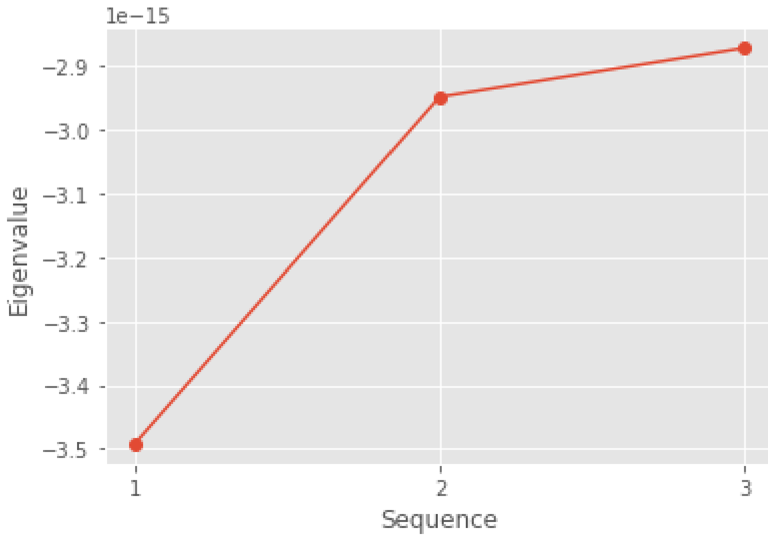
In [95]:
```
kNNSpec = neighbors.NearestNeighbors(n_neighbors = 1, algorithm = 'brute', met
ric = 'euclidean')
nbrs = kNNSpec.fit(trainData)
d3, i3 = nbrs.kneighbors(trainData)

# Retrieve the distances among the observations
distObject = neighbors.DistanceMetric.get_metric('euclidean')
distances = distObject.pairwise(trainData)

# Create the Adjacency matrix
Adjacency = numpy.zeros((nObs, nObs))
for i in range(nObs):
    for j in i3[i]:
        Adjacency[i,j] = math.exp(- (distances[i][j])**2 )

# Make the Adjacency matrix symmetric
Adjacency = 0.5 * (Adjacency + Adjacency.transpose())

# Create the Degree matrix
Degree = numpy.zeros((nObs, nObs))
for i in range(nObs):
    sum = 0
    for j in range(nObs):
        sum += Adjacency[i,j]
    Degree[i,i] = sum

# Create the Laplacian matrix
Lmatrix = Degree - Adjacency

# Obtain the eigenvalues and the eigenvectors of the Laplacian matrix
evals, evecs = linalg.eigh(Lmatrix)

# Series plot of the smallest five eigenvalues to determine the number of clus
ters
sequence = numpy.arange(1,2,1)
plt.plot(sequence, evals[0:1,], marker = "o")
plt.xlabel('Sequence')
plt.ylabel('Eigenvalue')
plt.xticks(sequence)
plt.grid("both")
plt.show()
```


0.04
0.02
0.00
−0.02
−0.04
Eigenvalue
1
Sequence

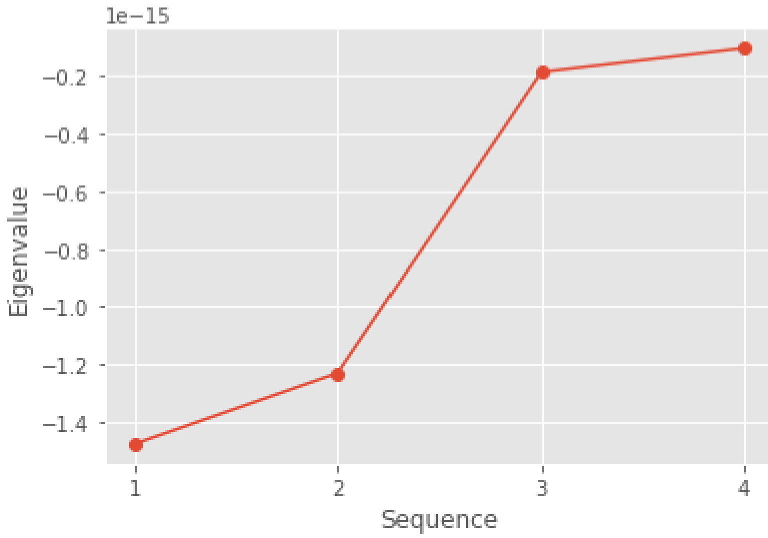
In [94]:
```
kNNSpec = neighbors.NearestNeighbors(n_neighbors = 2, algorithm = 'brute', met
ric = 'euclidean')
nbrs = kNNSpec.fit(trainData)
d3, i3 = nbrs.kneighbors(trainData)

# Retrieve the distances among the observations
distObject = neighbors.DistanceMetric.get_metric('euclidean')
distances = distObject.pairwise(trainData)

# Create the Adjacency matrix
Adjacency = numpy.zeros((nObs, nObs))
for i in range(nObs):
    for j in i3[i]:
        Adjacency[i,j] = math.exp(- (distances[i][j])**2 )

# Make the Adjacency matrix symmetric
Adjacency = 0.5 * (Adjacency + Adjacency.transpose())

# Create the Degree matrix
Degree = numpy.zeros((nObs, nObs))
for i in range(nObs):
    sum = 0
    for j in range(nObs):
        sum += Adjacency[i,j]
    Degree[i,i] = sum

# Create the Laplacian matrix
Lmatrix = Degree - Adjacency

# Obtain the eigenvalues and the eigenvectors of the Laplacian matrix
evals, evecs = linalg.eigh(Lmatrix)

# Series plot of the smallest five eigenvalues to determine the number of clus
ters
sequence = numpy.arange(1,3,1)
plt.plot(sequence, evals[0:2,], marker = "o")
plt.xlabel('Sequence')
plt.ylabel('Eigenvalue')
plt.xticks(sequence)
plt.grid("both")
plt.show()
```


1e−15
−1.94
−1.96
−1.98
−2.00
−2.02
−2.04
Eigenvalue
1
2
Sequence

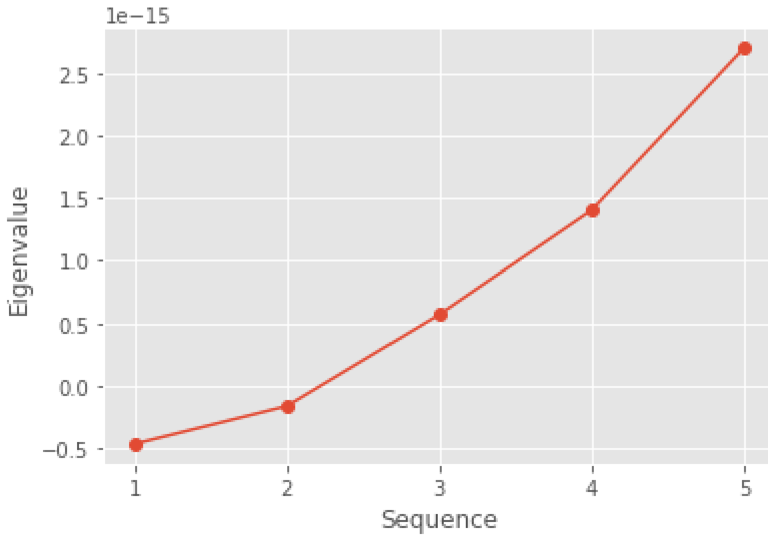
In [93]:
```
kNNSpec = neighbors.NearestNeighbors(n_neighbors = 3, algorithm = 'brute', met
ric = 'euclidean')
nbrs = kNNSpec.fit(trainData)
d3, i3 = nbrs.kneighbors(trainData)

# Retrieve the distances among the observations
distObject = neighbors.DistanceMetric.get_metric('euclidean')
distances = distObject.pairwise(trainData)

# Create the Adjacency matrix
Adjacency = numpy.zeros((nObs, nObs))
for i in range(nObs):
    for j in i3[i]:
        Adjacency[i,j] = math.exp(- (distances[i][j])**2 )

# Make the Adjacency matrix symmetric
Adjacency = 0.5 * (Adjacency + Adjacency.transpose())

# Create the Degree matrix
Degree = numpy.zeros((nObs, nObs))
for i in range(nObs):
    sum = 0
    for j in range(nObs):
        sum += Adjacency[i,j]
    Degree[i,i] = sum

# Create the Laplacian matrix
Lmatrix = Degree - Adjacency

# Obtain the eigenvalues and the eigenvectors of the Laplacian matrix
evals, evecs = linalg.eigh(Lmatrix)

# Series plot of the smallest five eigenvalues to determine the number of clus
ters
sequence = numpy.arange(1,4,1)
plt.plot(sequence, evals[0:3,], marker = "o")
plt.xlabel('Sequence')
plt.ylabel('Eigenvalue')
plt.xticks(sequence)
plt.grid("both")
plt.show()
```


1e−15
−2.9
−3.0
−3.1
−3.2
−3.3
−3.4
−3.5
Eigenvalue
1
2
3
Sequence

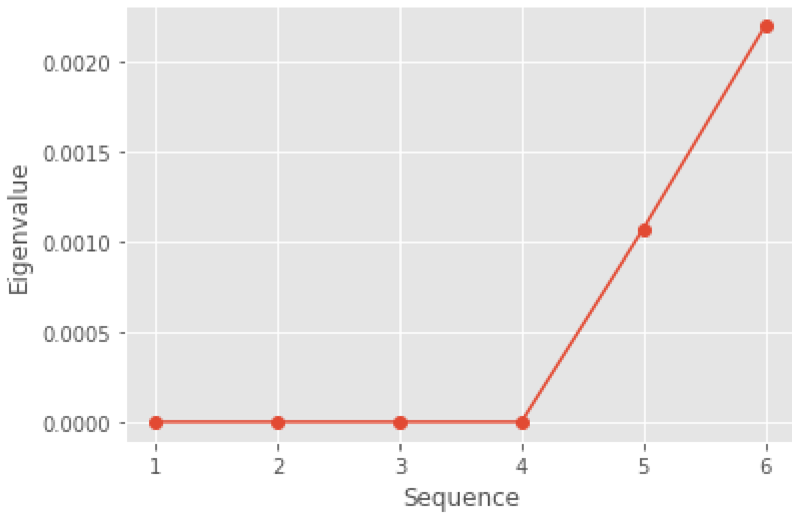
In [85]:
```
kNNSpec = neighbors.NearestNeighbors(n_neighbors = 4, algorithm = 'brute', met
ric = 'euclidean')
nbrs = kNNSpec.fit(trainData)
d3, i3 = nbrs.kneighbors(trainData)

# Retrieve the distances among the observations
distObject = neighbors.DistanceMetric.get_metric('euclidean')
distances = distObject.pairwise(trainData)

# Create the Adjacency matrix
Adjacency = numpy.zeros((nObs, nObs))
for i in range(nObs):
    for j in i3[i]:
        Adjacency[i,j] = math.exp(- (distances[i][j])**2 )

# Make the Adjacency matrix symmetric
Adjacency = 0.5 * (Adjacency + Adjacency.transpose())

# Create the Degree matrix
Degree = numpy.zeros((nObs, nObs))
for i in range(nObs):
    sum = 0
    for j in range(nObs):
        sum += Adjacency[i,j]
    Degree[i,i] = sum

# Create the Laplacian matrix
Lmatrix = Degree - Adjacency

# Obtain the eigenvalues and the eigenvectors of the Laplacian matrix
evals, evecs = linalg.eigh(Lmatrix)

# Series plot of the smallest five eigenvalues to determine the number of clus
ters
sequence = numpy.arange(1,5,1)
plt.plot(sequence, evals[0:4,], marker = "o")
plt.xlabel('Sequence')
plt.ylabel('Eigenvalue')
plt.xticks(sequence)
plt.grid("both")
plt.show()
```


1e−15
−0.2
−0.4
−0.6
−0.8
−1.0
−1.2
−1.4
Eigenvalue
1
2
3
4
Sequence

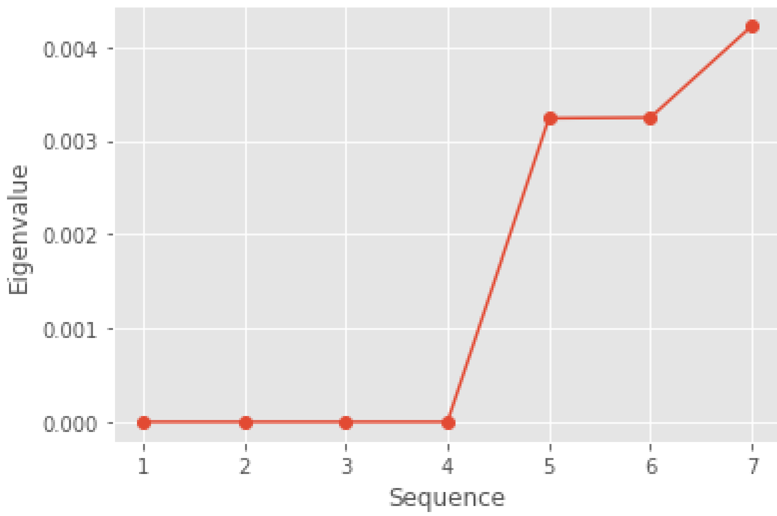
In [92]:
```
kNNSpec = neighbors.NearestNeighbors(n_neighbors = 5, algorithm = 'brute', met
ric = 'euclidean')
nbrs = kNNSpec.fit(trainData)
d3, i3 = nbrs.kneighbors(trainData)

# Retrieve the distances among the observations
distObject = neighbors.DistanceMetric.get_metric('euclidean')
distances = distObject.pairwise(trainData)

# Create the Adjacency matrix
Adjacency = numpy.zeros((nObs, nObs))
for i in range(nObs):
    for j in i3[i]:
        Adjacency[i,j] = math.exp(- (distances[i][j])**2 )

# Make the Adjacency matrix symmetric
Adjacency = 0.5 * (Adjacency + Adjacency.transpose())

# Create the Degree matrix
Degree = numpy.zeros((nObs, nObs))
for i in range(nObs):
    sum = 0
    for j in range(nObs):
        sum += Adjacency[i,j]
    Degree[i,i] = sum

# Create the Laplacian matrix
Lmatrix = Degree - Adjacency

# Obtain the eigenvalues and the eigenvectors of the Laplacian matrix
evals, evecs = linalg.eigh(Lmatrix)

# Series plot of the smallest five eigenvalues to determine the number of clus
ters
sequence = numpy.arange(1,6,1)
plt.plot(sequence, evals[0:5], marker = "o")
plt.xlabel('Sequence')
plt.ylabel('Eigenvalue')
plt.xticks(sequence)
plt.grid("both")
plt.show()
```


1e−15
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
Eigenvalue
1
2
3
4
5
Sequence

In [88]:
```
kNNSpec = neighbors.NearestNeighbors(n_neighbors = 6, algorithm = 'brute', met
ric = 'euclidean')
nbrs = kNNSpec.fit(trainData)
d3, i3 = nbrs.kneighbors(trainData)

# Retrieve the distances among the observations
distObject = neighbors.DistanceMetric.get_metric('euclidean')
distances = distObject.pairwise(trainData)

# Create the Adjacency matrix
Adjacency = numpy.zeros((nObs, nObs))
for i in range(nObs):
    for j in i3[i]:
        Adjacency[i,j] = math.exp(- (distances[i][j])**2 )

# Make the Adjacency matrix symmetric
Adjacency = 0.5 * (Adjacency + Adjacency.transpose())

# Create the Degree matrix
Degree = numpy.zeros((nObs, nObs))
for i in range(nObs):
    sum = 0
    for j in range(nObs):
        sum += Adjacency[i,j]
    Degree[i,i] = sum

# Create the Laplacian matrix
Lmatrix = Degree - Adjacency

# Obtain the eigenvalues and the eigenvectors of the Laplacian matrix
evals, evecs = linalg.eigh(Lmatrix)

# Series plot of the smallest five eigenvalues to determine the number of clus
ters
sequence = numpy.arange(1,7,1)
plt.plot(sequence, evals[0:6,], marker = "o")
plt.xlabel('Sequence')
plt.ylabel('Eigenvalue')
plt.xticks(sequence)
plt.grid("both")
plt.show()
```


0.0020
0.0015
0.0010
0.0005
0.0000
Eigenvalue
1
2
3
4
5
6
Sequence

In [97]:
```
kNNSpec = neighbors.NearestNeighbors(n_neighbors = 7, algorithm = 'brute', met
ric = 'euclidean')
nbrs = kNNSpec.fit(trainData)
d3, i3 = nbrs.kneighbors(trainData)

# Retrieve the distances among the observations
distObject = neighbors.DistanceMetric.get_metric('euclidean')
distances = distObject.pairwise(trainData)

# Create the Adjacency matrix
Adjacency = numpy.zeros((nObs, nObs))
for i in range(nObs):
    for j in i3[i]:
        Adjacency[i,j] = math.exp(- (distances[i][j])**2 )

# Make the Adjacency matrix symmetric
Adjacency = 0.5 * (Adjacency + Adjacency.transpose())

# Create the Degree matrix
Degree = numpy.zeros((nObs, nObs))
for i in range(nObs):
    sum = 0
    for j in range(nObs):
        sum += Adjacency[i,j]
    Degree[i,i] = sum

# Create the Laplacian matrix
Lmatrix = Degree - Adjacency

# Obtain the eigenvalues and the eigenvectors of the Laplacian matrix
evals, evecs = linalg.eigh(Lmatrix)

# Series plot of the smallest five eigenvalues to determine the number of clus
ters
sequence = numpy.arange(1,8,1)
plt.plot(sequence, evals[0:7,], marker = "o")
plt.xlabel('Sequence')
plt.ylabel('Eigenvalue')
plt.xticks(sequence)
plt.grid("both")
plt.show()
```



The least number of nearest neighbours is found to be 6

Q3 - d

In [128]:
```
kNNSpec = neighbors.NearestNeighbors(n_neighbors = 6, algorithm = 'brute', met
ric = 'euclidean')
nbrs = kNNSpec.fit(trainData)
d3, i3 = nbrs.kneighbors(trainData)

# Retrieve the distances among the observations
distObject = neighbors.DistanceMetric.get_metric('euclidean')
distances = distObject.pairwise(trainData)

# Create the Adjacency matrix
Adjacency = numpy.zeros((nObs, nObs))
for i in range(nObs):
    for j in i3[i]:
        Adjacency[i,j] = math.exp(- (distances[i][j])**2 )
Adjacency = 0.5 * (Adjacency + Adjacency.transpose())
print("Adjacency matrix: ",Adjacency)
Degree = numpy.zeros((nObs, nObs))
for i in range(nObs):
    sum = 0
    for j in range(nObs):
        sum += Adjacency[i,j]
    Degree[i,i] = sum
print("Degree matrix: ",Degree)
Lmatrix = Degree - Adjacency
print("Laplace matrix: ",Lmatrix)
evals, evecs = np.linalg.eigh(Lmatrix)
print("Eigen values: ",evals)
```

```
Adjacency matrix:  [[1.         0.         0.         ... 0.         0.
0.        ]
 [0.         1.         0.         ... 0.         0.         0.        ]
 [0.         0.         1.         ... 0.         0.96602229 0.        ]
 ...
 [0.         0.         0.         ... 1.         0.         0.        ]
 [0.         0.         0.96602229 ... 0.         1.         0.        ]
 [0.         0.         0.         ... 0.         0.         1.        ]]
Degree matrix:  [[4.80117773 0.         0.         ... 0.         0.
0.        ]
 [0.         4.29598338 0.         ... 0.         0.         0.        ]
 [0.         0.         5.55116784 ... 0.         0.         0.        ]
 ...
 [0.         0.         0.         ... 5.29371731 0.         0.        ]
 [0.         0.         0.         ... 0.         4.88916173 0.        ]
 [0.         0.         0.         ... 0.         0.         4.94116662]]
Laplace matrix:  [[ 3.80117773  0.          0.          ...  0.          0.
   0.        ]
 [ 0.          3.29598338  0.          ...  0.          0.
   0.        ]
 [ 0.          0.          4.55116784 ...  0.         -0.96602229
   0.        ]
 ...
 [ 0.          0.          0.          ...  4.29371731  0.
   0.        ]
 [ 0.          0.         -0.96602229 ...  0.          3.88916173
   0.        ]
 [ 0.          0.          0.          ...  0.          0.
   3.94116662]]
Eigen values:  [-2.71880199e-15 -7.54986321e-16  5.39494176e-16 ...  8.241883
50e+00
  8.30275009e+00  8.34644795e+00]
[-2.71880199e-15 -7.54986321e-16  5.39494176e-16  1.01317998e-15
  1.07168009e-03]
```

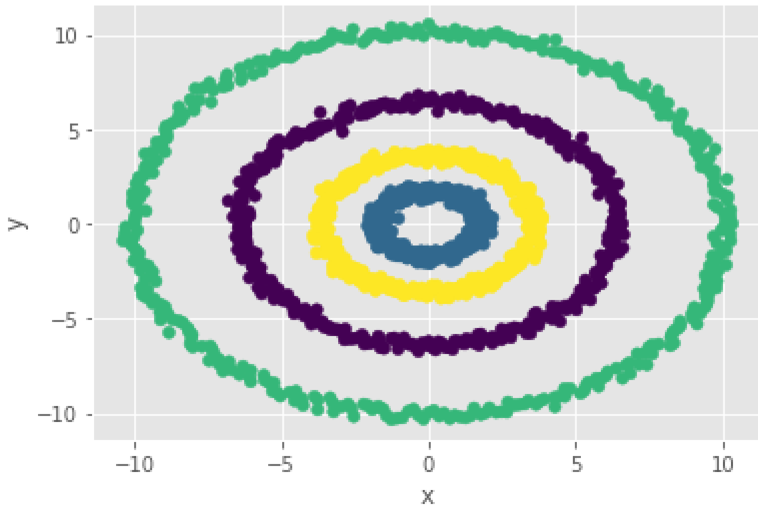
In [131]:
```
print(evals[0:5])
```

```
[-2.71880199e-15 -7.54986321e-16  5.39494176e-16  1.01317998e-15
  1.07168009e-03]
```

The eigev values from 1 to 4 seem to have approx zero values seen from both the print function and the graph.

Q3 - e

In [138]:
```
zero_eigen = evecs[:,[0,1,2,3,4]]
kmeans = cluster.KMeans(n_clusters=4, random_state=60616).fit(zero_eigen)
Four_Circle_Data['KMClusterLabel'] = kmeans.labels_
plt.scatter(Four_Circle_Data['x'], Four_Circle_Data['y'], c = Four_Circle_Data
['KMClusterLabel'])
plt.xlabel('x')
plt.ylabel('y')
plt.grid(True)
plt.show()
```



Q2 - a

In [157]:
```
car = pd.read_csv('cars.csv')
Type = car['Type'].values
Origin = car['Origin'].values
DriveTrain = car['DriveTrain'].values
Cylinders = car['Cylinders'].values
print(car['Type'].unique())
print(car['DriveTrain'].unique())
```

```
['SUV' 'Sedan' 'Sports' 'Wagon' 'Truck' 'Hybrid']
['AWD' 'FWD' 'RWD']
```

In [190]:
```
Suv =0
Sedan = 0
Sports = 0
Wagon = 0
Truck = 0
Hybrid = 0
for i in Type:
    if (i=="SUV"):
        Suv=Suv+1
    elif(i=="Sedan"):
        Sedan = Sedan + 1
    elif(i=="Sports"):
        Sports = Sports + 1
    elif(i=="Wagon"):
        Wagon = Wagon + 1
    elif(i=="Truck"):
        Truck = Truck + 1
    elif(i=="Hybrid"):
        Hybrid = Hybrid + 1
print("Frequency of Suv",Suv)
print("Frequency of Sedan",Sedan)
print("Frequency of Sports",Sports)
print("Frequency of Wagon",Wagon)
print("Frequency of Truck",Truck)
print("Frequency of Hybrid",Hybrid)
```

```
Frequency of Suv 60
Frequency of Sedan 262
Frequency of Sports 49
Frequency of Wagon 30
Frequency of Truck 24
Frequency of Hybrid 3
```

Q2 - b

In [191]:
```
AWD = 0
FWD = 0
RWD = 0
for i in DriveTrain:
    if (i=="AWD"):
        AWD=AWD+1
    elif(i=="FWD"):
        FWD = FWD + 1
    elif(i=="RWD"):
        RWD = RWD + 1
print("Frequency of AWD",AWD)
print("Frequency of FWD",FWD)
print("Frequency of RWD ",RWD)
```

```
Frequency of AWD 92
Frequency of FWD 226
Frequency of RWD  110
```

Q 2 - c

In [192]:
```
Asia = 0
Europe = 0
print(car['Origin'].unique())
for i in Origin:
    if (i=="Asia"):
        Asia=Asia+1
    elif(i=="Europe"):
        Europe = Europe + 1
print("Frequency of Asia",Asia)
print("Frequency of Europe",Europe)
Distance_metric = ((1/Asia) + (1/Europe))
print("Distance metric",Distance_metric)
```

```
['Asia' 'Europe' 'USA']
Frequency of Asia 158
Frequency of Europe 123
Distance metric 0.014459195224863643
```

Q2 - d

In [193]:
```
Five = 0
Missing = 0
print(car['Cylinders'].unique())
for i in Cylinders:
    if (i==5):
        Five=Five+1
    elif(np.isnan(i)):
        Missing = Missing + 1
print("Frequency of Five",Five)
print("Frequency of Missing numbers",Missing)
Distance_metric_cylinder = ((1/Five) + (1/Missing))
print("Distance metric",Distance_metric_cylinder)
```

```
[ 6.  4.  8. 10.  3. nan 12.  5.]
Frequency of Five 7
Frequency of Missing numbers 2
Distance metric 0.6428571428571428
```

The code for the questions 1 and 3 are referred to the code provided by Professor.