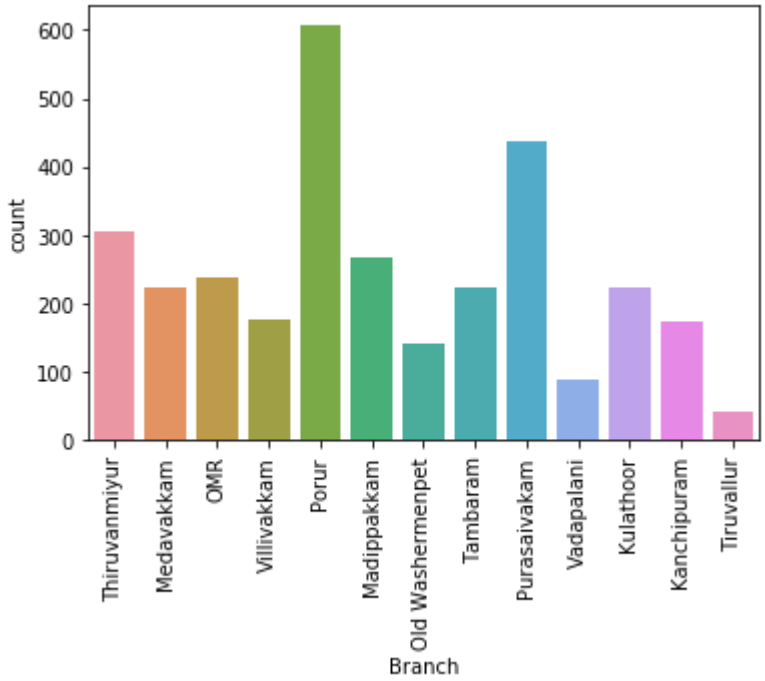
In [111]:
```
import numpy as np
import matplotlib.pyplot as plt
import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.neighbors import KNeighborsClassifier
import seaborn as sns
from sklearn.svm import SVC
from sklearn.naive_bayes import MultinomialNB
from sklearn.ensemble import BaggingClassifier
import warnings
warnings.filterwarnings('ignore')
from sklearn.ensemble import AdaBoostClassifier
from sklearn.ensemble import RandomForestClassifier
from sklearn.tree import DecisionTreeClassifier
from sklearn.metrics import classification_report,confusion_matrix ,accuracy_score
from sklearn.metrics import precision_recall_fscore_support,average_precision_score
from sklearn.metrics import precision_score,recall_score,f1_score,precision_recall_curve
```

In [112]:
```
data = pd.read_csv("data.csv")
data.count()
```

Out[112]:
```
Name                3152
Branch              3154
Date                3154
Brand               3154
Category            3154
Quantity            3154
Price               3154
TotalSales          3154
BranchProximity     3154
FestivalOffer       3154
ActualVisits        3154
ProductsPurchased   3154
Visitday            3154
VisitPossibleNot    3154
CustomerType        3154
dtype: int64
```

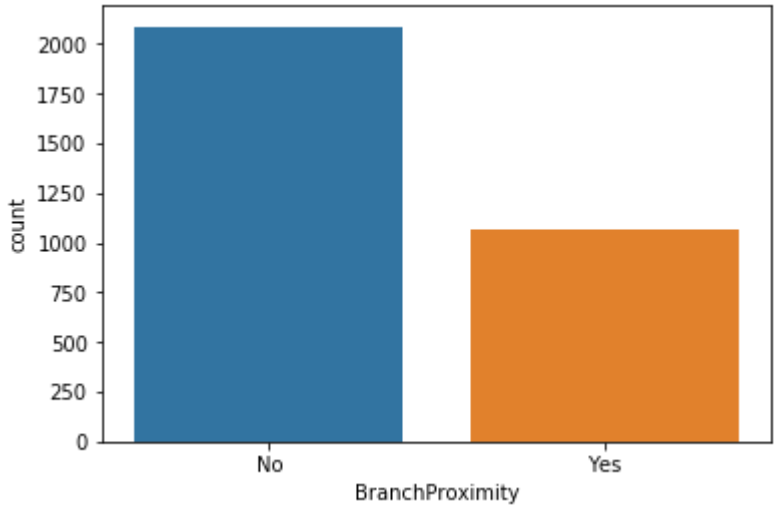
In [113]:
```
sns.countplot(data.Branch)
plt.xticks(rotation=90)
```

Out[113]:
```
(array([ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9, 10, 11, 12]),
 <a list of 13 Text xticklabel objects>)
```



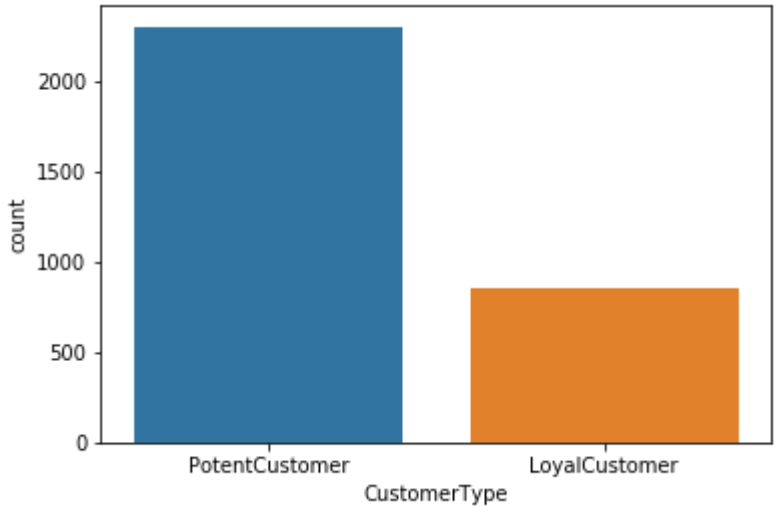
In [114]:
```
sns.countplot(data.BranchProximity)
```

Out[114]: <matplotlib.axes._subplots.AxesSubplot at 0x1a2470df28>



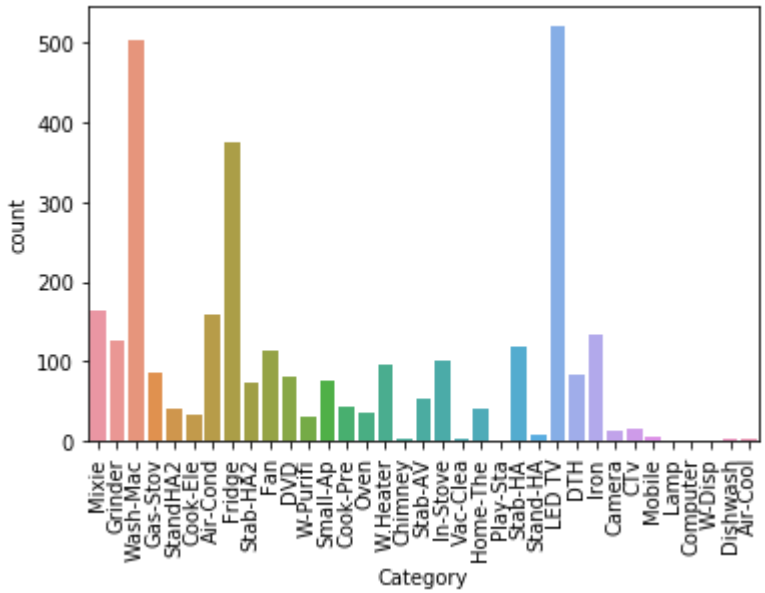
In [115]:
```
sns.countplot(data.CustomerType)
```

Out[115]: <matplotlib.axes._subplots.AxesSubplot at 0x1a2474c860>



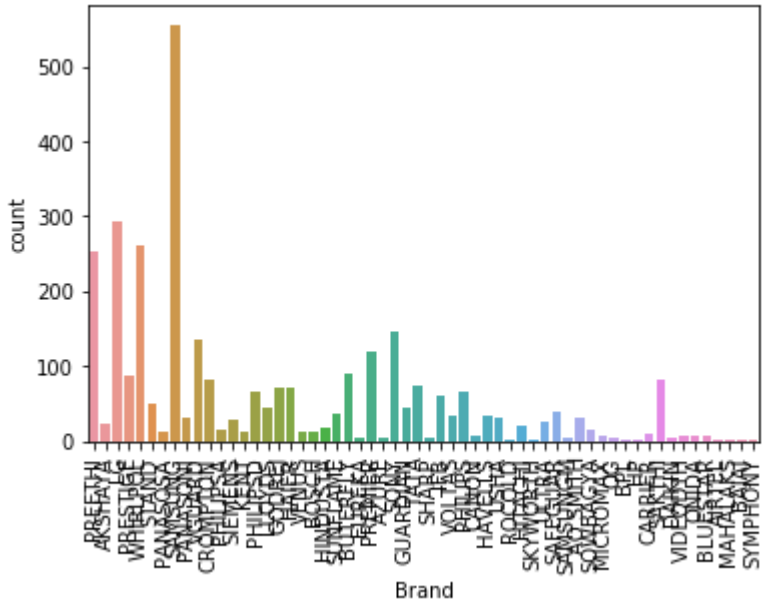
In [116]:
```
sns.countplot(data.Category)
plt.xticks(rotation=90)
```

Out[116]:
```
(array([ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9, 10, 11, 12, 13, 14, 15, 16,
        17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33,
        34]), <a list of 35 Text xticklabel objects>)
```



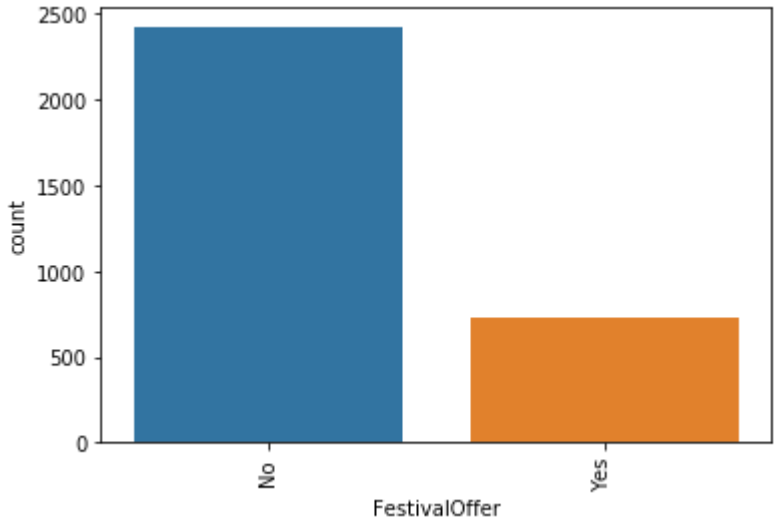
In [117]:
```
sns.countplot(data.Brand)
plt.xticks(rotation=90)
```

Out[117]:
```
(array([ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9, 10, 11, 12, 13, 14, 15, 16,
        17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33,
        34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50,
        51, 52, 53, 54, 55, 56, 57]), <a list of 58 Text xticklabel objects>)
```



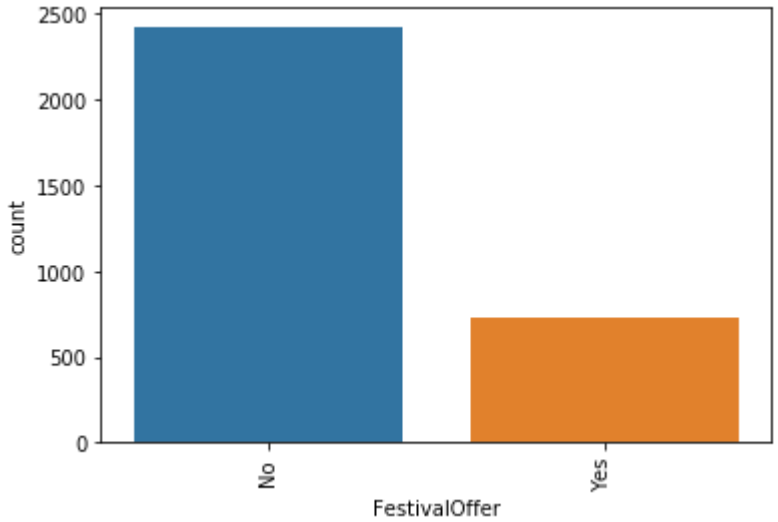
In [118]:
```
sns.countplot(data.FestivalOffer)
plt.xticks(rotation=90)
```

Out[118]:
```
(array([0, 1]), <a list of 2 Text xticklabel objects>)
```



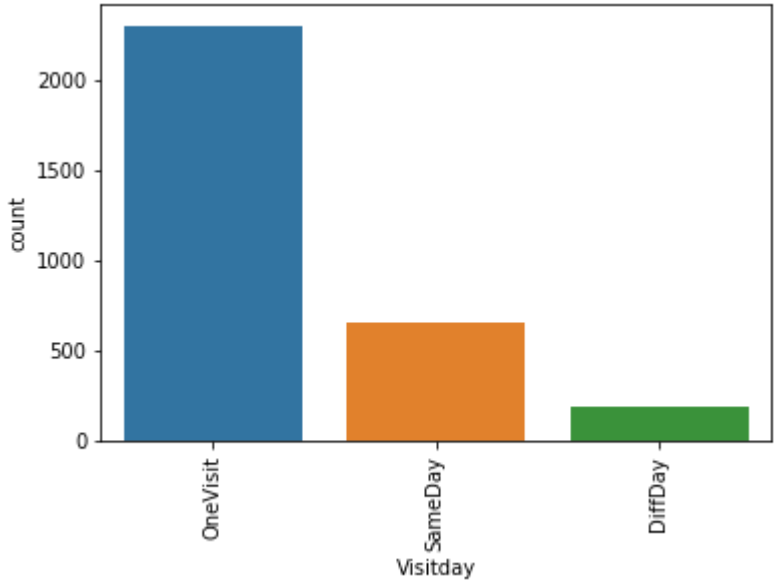
In [119]:
```
sns.countplot(data.FestivalOffer)
plt.xticks(rotation=90)
```

Out[119]:
```
(array([0, 1]), <a list of 2 Text xticklabel objects>)
```



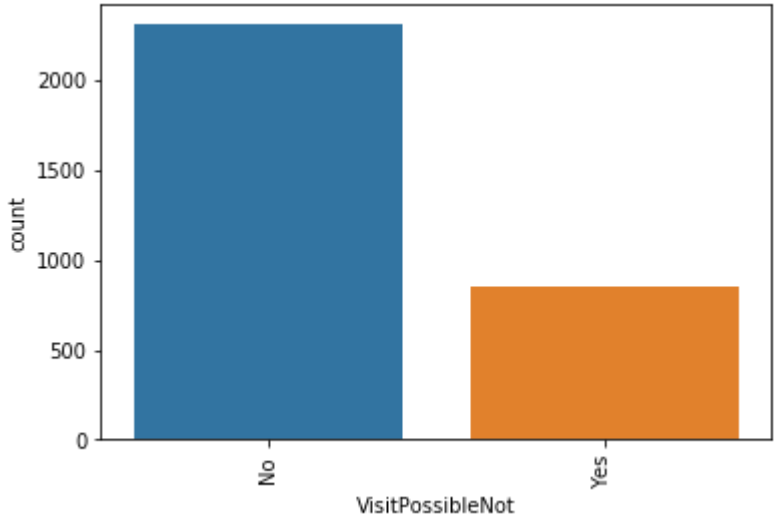
In [120]:
```
sns.countplot(data.Visitday)
plt.xticks(rotation=90)
```

Out[120]:
```
(array([0, 1, 2]), <a list of 3 Text xticklabel objects>)
```



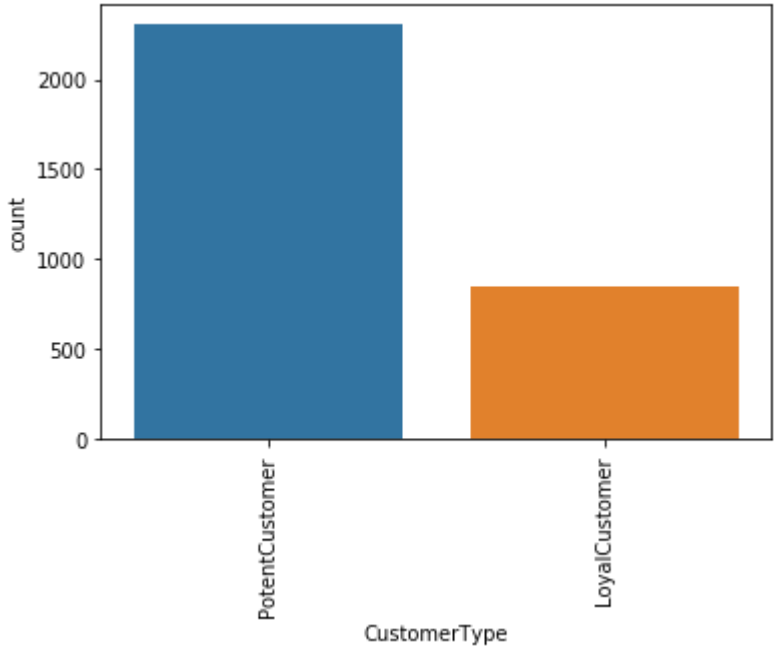
In [121]:
```
sns.countplot(data.VisitPossibleNot)
plt.xticks(rotation=90)
```

Out[121]:
```
(array([0, 1]), <a list of 2 Text xticklabel objects>)
```



In [122]:
```
sns.countplot(data.CustomerType)
plt.xticks(rotation=90)
```

Out[122]: (array([0, 1]), <a list of 2 Text xticklabel objects>)



In [123]:
```
data.head(10)
```

Out[123]:

	Name	Branch	Date	Brand	Category	Quantity	Price	TotalSales	BranchProximity	FestivalOffer	ActualVisits	Pr
0	KUMARESAN.T	Thiruvanmiyur	28-Jan-14	PREETHI	Mixie	1	4,344	4,344	No	No	1	
1	KARTHIKEYAN	Medavakkam	28-Jan-14	AKSHAYA	Grinder	1	2380.95	2380.95	No	No	1	
2	S.RAJMOHAN	OMR	29-Jan-14	PREETHI	Mixie	1	2620.09	2620.09	No	No	1	
3	VENKATARAMANI.M.S	Villivakkam	29-Jan-14	LG	Wash-Mac	1	16157.21	16157.21	No	No	1	
4	ARUNKUMAR	Porur	29-Jan-14	PREETHI	Mixie	1	3100.44	3100.44	Yes	No	1	
5	JEYACHANTRAN AR	Madippakkam	30-Jan-14	PRESTIGE	Gas-Stov	1	5109.17	5109.17	Yes	No	2	
6	PRASANA PRABHU	Medavakkam	30-Jan-14	WHIRLPOL	Wash-Mac	1	14192.14	14192.14	No	No	1	
7	GEETHA.N	Old Washermenpet	30-Jan-14	PREETHI	Mixie	1	3100.44	3100.44	Yes	No	1	
8	PARTHA SARATHI	Tambaram	31-Jan-14	STAND	StandHA2	1	285.71	285.71	No	No	1	
9	MUTHU RAMALINGAM	Porur	31-Jan-14	LG	Wash-Mac	1	13580.79	13580.79	Yes	No	1	

In [124]:
```
print ("Dataset Length: ", len(data))
print ("Dataset Shape: ", data.shape)
```

```
Dataset Length:  3154
Dataset Shape:  (3154, 15)
```

In [125]:
```
data.describe()
```

Out[125]:

	Quantity	ActualVisits	ProductsPurchased
count	3154.000000	3154.000000	3154.000000
mean	14.690869	1.071021	1.429296
std	147.831055	0.313605	0.933693
min	1.000000	1.000000	1.000000
25%	1.000000	1.000000	1.000000
50%	1.000000	1.000000	1.000000
75%	1.000000	1.000000	2.000000
max	4940.000000	6.000000	14.000000

In [126]:
```
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 3154 entries, 0 to 3153
Data columns (total 15 columns):
Name                 3152 non-null object
Branch               3154 non-null object
Date                 3154 non-null object
Brand                3154 non-null object
Category             3154 non-null object
Quantity             3154 non-null int64
Price                3154 non-null object
TotalSales           3154 non-null object
BranchProximity      3154 non-null object
FestivalOffer        3154 non-null object
ActualVisits         3154 non-null int64
ProductsPurchased    3154 non-null int64
Visitday             3154 non-null object
VisitPossibleNot     3154 non-null object
CustomerType         3154 non-null object
dtypes: int64(3), object(12)
memory usage: 369.7+ KB
```

In [127]:
```
X= data[['Branch','Quantity','BranchProximity','FestivalOffer','ActualVisits','ProductsPurchased','Visitday',
'CustomerType']]
```

In [128]:
```
X.head()
```

Out[128]:

	Branch	Quantity	BranchProximity	FestivalOffer	ActualVisits	ProductsPurchased	Visitday	CustomerType
0	Thiruvanmiyur	1	No	No	1	1	OneVisit	PotentCustomer
1	Medavakkam	1	No	No	1	2	SameDay	LoyalCustomer
2	OMR	1	No	No	1	1	OneVisit	PotentCustomer
3	Villivakkam	1	No	No	1	1	OneVisit	PotentCustomer
4	Porur	1	Yes	No	1	1	OneVisit	PotentCustomer

In [129]:
```
y=data[['VisitPossibleNot']]
```

In [130]:
```
y.head()
```

Out[130]:

	VisitPossibleNot
0	No
1	Yes
2	No
3	No
4	No

In [131]:
```
X_train,X_test,y_train,y_test=train_test_split(X,y,test_size=0.3,random_state=32)
```

In [132]:
```
X_train.head()
```

Out[132]:

	Branch	Quantity	BranchProximity	FestivalOffer	ActualVisits	ProductsPurchased	Visitday	CustomerType
1875	Madippakkam	1	Yes	Yes	1	2	SameDay	LoyalCustomer
3123	Kulathoor	1	No	No	1	1	OneVisit	PotentCustomer
1072	Villivakkam	1	No	Yes	1	1	OneVisit	PotentCustomer
2638	Medavakkam	1	No	Yes	1	1	OneVisit	PotentCustomer
3046	Madippakkam	1	Yes	No	1	3	SameDay	LoyalCustomer

In [133]:
```
y_train.head()
```

Out[133]:

	VisitPossibleNot
1875	Yes
3123	No
1072	No
2638	No
3046	Yes

In [134]:
```
combine=[X_train,X_test]
classmapping={'Yes':0,'No':1}
for dt in combine:
   dt['BranchProximity']=data['BranchProximity'].map(classmapping)
X_train.head()
```

Out[134]:

	Branch	Quantity	BranchProximity	FestivalOffer	ActualVisits	ProductsPurchased	Visitday	CustomerType
1875	Madippakkam	1	0	Yes	1	2	SameDay	LoyalCustomer
3123	Kulathoor	1	1	No	1	1	OneVisit	PotentCustomer
1072	Villivakkam	1	1	Yes	1	1	OneVisit	PotentCustomer
2638	Medavakkam	1	1	Yes	1	1	OneVisit	PotentCustomer
3046	Madippakkam	1	0	No	1	3	SameDay	LoyalCustomer

In [135]:
```
combine=[X_train,X_test]
classmapping={'Yes':0,'No':1}
for dt in combine:
   dt['FestivalOffer']=data['FestivalOffer'].map(classmapping)
X_train.head()
```

Out[135]:

	Branch	Quantity	BranchProximity	FestivalOffer	ActualVisits	ProductsPurchased	Visitday	CustomerType
1875	Madippakkam	1	0	0	1	2	SameDay	LoyalCustomer
3123	Kulathoor	1	1	1	1	1	OneVisit	PotentCustomer
1072	Villivakkam	1	1	0	1	1	OneVisit	PotentCustomer
2638	Medavakkam	1	1	0	1	1	OneVisit	PotentCustomer
3046	Madippakkam	1	0	1	1	3	SameDay	LoyalCustomer

In [136]:
```
combine=[X_train,X_test]
classmapping={'SameDay':0,'OneVisit':1 , 'DiffDay':2}
for dt in combine:
   dt['Visitday']=data['Visitday'].map(classmapping)
X_train.head()
```

Out[136]:

	Branch	Quantity	BranchProximity	FestivalOffer	ActualVisits	ProductsPurchased	Visitday	CustomerType
1875	Madippakkam	1	0	0	1	2	0	LoyalCustomer
3123	Kulathoor	1	1	1	1	1	1	PotentCustomer
1072	Villivakkam	1	1	0	1	1	1	PotentCustomer
2638	Medavakkam	1	1	0	1	1	1	PotentCustomer
3046	Madippakkam	1	0	1	1	3	0	LoyalCustomer

In [137]:
```
combine=[X_train,X_test]
classmapping={'PotentCustomer':0,'LoyalCustomer':1}
for dt in combine:
   dt['CustomerType']=data['CustomerType'].map(classmapping)
X_train.head()
```

Out[137]:

	Branch	Quantity	BranchProximity	FestivalOffer	ActualVisits	ProductsPurchased	Visitday	CustomerType
1875	Madippakkam	1	0	0	1	2	0	1
3123	Kulathoor	1	1	1	1	1	1	0
1072	Villivakkam	1	1	0	1	1	1	0
2638	Medavakkam	1	1	0	1	1	1	0
3046	Madippakkam	1	0	1	1	3	0	1

In [138]:
```
combine=[X_train,X_test]
classmapping={'Kanchipuram':0,'Kulathoor':1,'Madippakkam':2,'Medavakkam':3,'Old Washermenpet':4,'OMR':5,'Porur':6,'Purasaivakam':7,'Tambaram':8,'Thiruvanmiyur':9,'Tiruvallur':10,'Vadapalani':11,'Villivakkam':12}
for dt in combine:
   dt['Branch']=data['Branch'].map(classmapping)
X_train.head()
```

Out[138]:

	Branch	Quantity	BranchProximity	FestivalOffer	ActualVisits	ProductsPurchased	Visitday	CustomerType
1875	2	1	0	0	1	2	0	1
3123	1	1	1	1	1	1	1	0
1072	12	1	1	0	1	1	1	0
2638	3	1	1	0	1	1	1	0
3046	2	1	0	1	1	3	0	1

In [139]:
```
combine=[y_train,y_test]
classmapping={'Yes':0,'No':1}
for dt in combine:
   dt['VisitPossibleNot']=data['VisitPossibleNot'].map(classmapping)
y_train.head()
```

Out[139]:

	VisitPossibleNot
1875	0
3123	1
1072	1
2638	1
3046	0

In [140]:
```
clf = KNeighborsClassifier(n_neighbors=31)
clf.fit(X_train, y_train)
```

Out[140]:
```
KNeighborsClassifier(algorithm='auto', leaf_size=30, metric='minkowski',
           metric_params=None, n_jobs=1, n_neighbors=31, p=2,
           weights='uniform')
```

In [141]:
```
knn_pred = clf.predict(X_test)
```

In [142]:
```
knn_pred
```

Out[142]:
```
array([1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 0, 1, 1, 1, 0, 1, 1, 0,
       1, 1, 1, 0, 1, 1, 1, 0, 0, 0, 0, 1, 1, 1, 1, 0, 1, 1, 0, 0, 1, 1,
       0, 0, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1,
       0, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 0, 1, 1,
       0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 0,
       1, 1, 1, 1, 0, 1, 0, 1, 0, 1, 0, 1, 1, 1, 0, 1, 0, 1, 0, 0, 1, 0,
       1, 1, 0, 1, 0, 1, 1, 0, 0, 1, 1, 1, 1, 0, 1, 0, 1, 1, 1, 1, 0, 1,
       1, 0, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 0, 1, 1, 1,
       1, 1, 0, 0, 0, 1, 1, 0, 1, 0, 1, 0, 1, 1, 1, 0, 0, 1, 1, 1, 0, 1,
       1, 1, 1, 1, 0, 1, 0, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 0, 1,
       0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 0, 1, 1, 1, 0,
       0, 0, 1, 0, 1, 1, 1, 1, 0, 0, 0, 1, 1, 0, 1, 0, 1, 1, 0, 0, 1, 1,
       1, 0, 0, 0, 1, 1, 1, 1, 1, 0, 0, 1, 1, 1, 1, 0, 1, 1, 1, 0, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       0, 1, 1, 1, 1, 1, 1, 1, 1, 0, 0, 1, 0, 1, 1, 1, 0, 1, 1, 1, 0, 1,
       0, 1, 1, 1, 1, 0, 0, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 0,
       1, 1, 0, 0, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 0, 1, 1, 1, 0, 1, 1, 1,
       0, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 0, 1, 1, 1, 0, 1, 0, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 0, 1, 0, 1, 0, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 0, 0, 0, 1, 1, 0,
       1, 1, 1, 1, 1, 1, 0, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 0,
       1, 1, 1, 0, 0, 1, 1, 0, 0, 1, 1, 1, 0, 1, 1, 0, 0, 0, 1, 1, 1, 1,
       0, 0, 1, 0, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1, 0, 1, 1, 1, 0,
       1, 0, 1, 1, 0, 0, 1, 0, 1, 1, 1, 1, 0, 1, 1, 1, 1, 0, 0, 1, 1, 1,
       0, 1, 1, 1, 1, 1, 0, 0, 1, 1, 0, 1, 1, 0, 1, 1, 0, 0, 1, 1, 0, 0,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 0, 1, 1, 1, 1, 1, 0, 1, 0, 0, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 0, 0, 0, 0, 1, 1, 1, 1, 1, 1, 1, 1, 0, 0, 1, 0, 1, 1, 1, 1,
       0, 1, 1, 1, 0, 0, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 0, 1, 1, 0, 1, 1, 0, 0, 0, 1, 1, 1,
       0, 0, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 0,
       0, 0, 0, 1, 1, 1, 1, 1, 0, 0, 1, 1, 1, 0, 1, 1, 1, 1, 0, 1, 1, 1,
```

```
1, 1, 1, 1, 0, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 0, 0,
1, 1, 0, 1, 1, 0, 0, 1, 0, 1, 0, 1, 1, 1, 0, 1, 1, 1, 1, 0, 1, 1,
0])
```

In [143]:
```
y_test.head()
```

Out[143]:

	VisitPossibleNot
2580	1
1727	1
351	1
2483	1
1484	1

In [144]:
```
print(confusion_matrix(y_test, knn_pred))
```

```
[[252   7]
 [  2 686]]
```

In [145]:
```
target_names = ['Repeat Customer','Non Repeat Customer']
print(classification_report(y_test, knn_pred ,target_names=target_names))
```

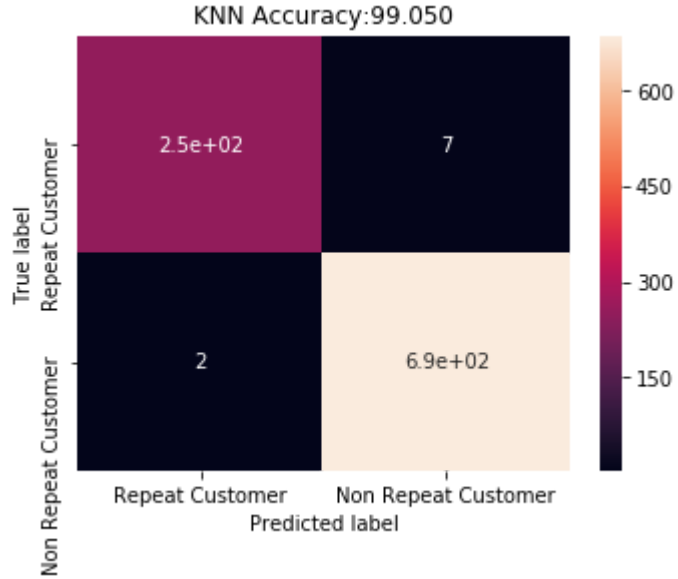
```
                    precision    recall  f1-score   support

    Repeat Customer       0.99      0.97      0.98       259
Non Repeat Customer       0.99      1.00      0.99       688

        avg / total       0.99      0.99      0.99       947
```

In [146]:
```
#Accuracy: The amount of correct classifications / the total amount of classifications.
#The train accuracy: The accuracy of a model on examples it was constructed on.
#The test accuracy is the accuracy of a model on examples it hasn't seen.
accuracy_test_knn=round(clf.score(X_test,y_test)*100,2)
accuracy_train_knn=round(clf.score(X_train,y_train)*100,2)
accuracy_knn=round(accuracy_score(y_test, knn_pred)*100,2)
print('Training accuracy of KNN',accuracy_train_knn)
print('Testing accuracy of KNN',accuracy_test_knn)
print('Accuracy of KNN:',accuracy_knn)
```

```
Training accuracy of KNN 99.28
Testing accuracy of KNN 99.05
Accuracy of KNN: 99.05
```

In [147]:
```
cm=confusion_matrix(y_test, knn_pred)
cm_df = pd.DataFrame(cm,
 index = ['Repeat Customer','Non Repeat Customer'],
 columns = ['Repeat Customer','Non Repeat Customer'])
```

In [148]:
```
plt.figure(figsize=(5.5,4))
sns.heatmap(cm_df, annot=True)
plt.title('KNN Accuracy:{0:.3f}'.format(accuracy_test_knn))
plt.ylabel('True label')
plt.xlabel('Predicted label')
plt.show()
```



In [149]:
```
svm_clf = SVC()
```

In [150]:
```
svm_clf.fit(X_train,y_train)
```

Out[150]:
```
SVC(C=1.0, cache_size=200, class_weight=None, coef0=0.0,
  decision_function_shape='ovr', degree=3, gamma='auto', kernel='rbf',
  max_iter=-1, probability=False, random_state=None, shrinking=True,
  tol=0.001, verbose=False)
```

In [151]:
```
svm_pred = svm_clf.predict(X_test)
```

In [152]:
```
svm_pred
```

Out[152]:
```
array([1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 0, 1, 1, 1, 0, 1, 1, 0,
       1, 1, 1, 0, 1, 1, 1, 0, 0, 0, 0, 1, 1, 1, 1, 0, 1, 1, 0, 0, 1, 1,
       0, 0, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1,
       0, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 0, 1, 1,
       0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 0,
       1, 0, 1, 1, 0, 1, 0, 1, 0, 1, 0, 1, 1, 1, 0, 1, 0, 1, 0, 0, 1, 0,
       1, 1, 0, 1, 0, 1, 1, 0, 0, 1, 1, 1, 1, 0, 1, 0, 1, 1, 0, 1, 0, 1,
       1, 0, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 0, 1, 1, 1,
       0, 1, 0, 0, 0, 1, 1, 0, 1, 0, 1, 0, 1, 1, 1, 0, 0, 1, 1, 1, 0, 1,
       1, 1, 1, 1, 0, 1, 0, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 0, 1,
       0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 0, 1, 1, 1, 0,
       0, 0, 1, 0, 1, 1, 0, 1, 0, 0, 0, 1, 1, 0, 1, 0, 1, 1, 0, 0, 1, 1,
       1, 0, 0, 0, 1, 1, 1, 1, 1, 0, 0, 1, 1, 1, 1, 0, 1, 1, 1, 0, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       0, 1, 1, 1, 1, 1, 1, 1, 1, 0, 0, 1, 0, 1, 1, 1, 0, 1, 1, 1, 0, 1,
       0, 1, 1, 1, 1, 0, 0, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 0,
       1, 1, 0, 0, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 0, 1, 1, 1, 0, 1, 1, 1,
       0, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 0, 1, 1, 1, 0, 1, 0, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 0, 1, 0, 1, 0, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 0, 0, 0, 1, 1, 0,
       1, 1, 1, 1, 1, 1, 0, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 0,
       1, 1, 1, 0, 0, 1, 1, 0, 0, 1, 1, 1, 0, 1, 1, 0, 0, 0, 1, 1, 1, 1,
       0, 0, 1, 0, 1, 0, 0, 1, 0, 0, 1, 1, 0, 1, 0, 0, 1, 0, 1, 1, 1, 0,
       1, 0, 1, 1, 0, 0, 1, 0, 1, 1, 1, 1, 0, 1, 1, 1, 1, 0, 0, 1, 1, 1,
       0, 1, 1, 1, 1, 1, 0, 0, 1, 1, 0, 1, 1, 0, 1, 1, 1, 1, 0, 0, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       0, 1, 0, 1, 1, 1, 0, 1, 1, 1, 0, 1, 1, 0, 0, 1, 0, 1, 1, 1, 1, 1,
       0, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 0, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 0, 0, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 0,
       1, 0, 0, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0,
       0, 1, 1, 1, 1, 1, 0, 1, 0, 0, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 0, 1, 1, 1, 1, 0, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 0, 0, 0, 0, 1, 1, 1, 1, 1, 1, 1, 1, 0, 0, 1, 0, 1, 1, 1, 1,
       0, 1, 1, 1, 0, 0, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 0, 1, 1, 0, 1, 1, 0, 0, 0, 1, 1, 1,
       0, 0, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 0,
       0, 0, 0, 1, 1, 1, 1, 1, 0, 0, 1, 1, 1, 0, 1, 1, 1, 1, 0, 1, 1, 1,
```

```
       1, 1, 1, 1, 0, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 0, 0,
       1, 1, 0, 1, 1, 0, 0, 1, 0, 1, 0, 1, 1, 1, 0, 1, 1, 1, 1, 0, 1, 1,
       0])
```

In [153]:
```
print(confusion_matrix(y_test, svm_pred))
```

```
[[258   1]
 [  3 685]]
```

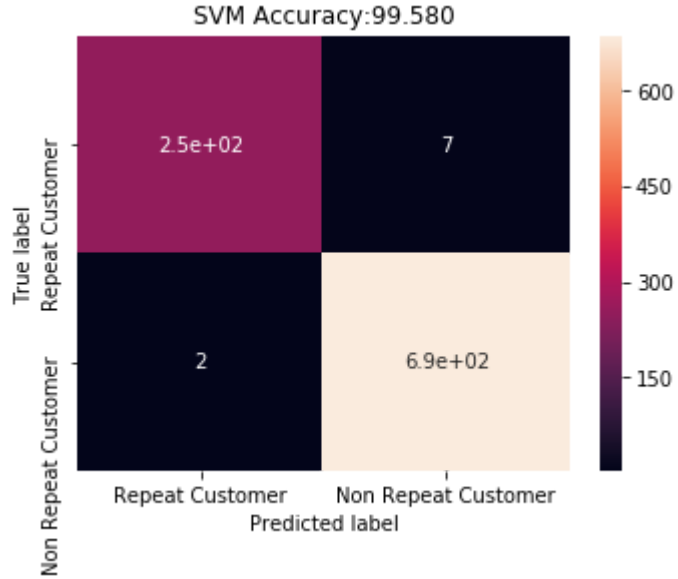
In [154]:
```
target_names = ['Repeat Customer','Non Repeat Customer']
print(classification_report(y_test, svm_pred, target_names=target_names))
```

```
                    precision    recall  f1-score   support

    Repeat Customer       0.99      1.00      0.99       259
Non Repeat Customer       1.00      1.00      1.00       688

        avg / total       1.00      1.00      1.00       947
```

In [155]:
```
accuracy_test_svm=round(svm_clf.score(X_test,y_test)*100,2)
accuracy_train_svm=round(svm_clf.score(X_train,y_train)*100,2)
accuracy_svm=round(accuracy_score(y_test, svm_pred)*100,2)
print('Training accuracy of SVM',accuracy_train_svm)
print('Testing accuracy of SVM',accuracy_test_svm)
print('Accuracy of SVM classifier:',accuracy_svm)
```

```
Training accuracy of SVM 99.95
Testing accuracy of SVM 99.58
Accuracy of SVM classifier: 99.58
```

In [156]:
```
plt.figure(figsize=(5.5,4))
sns.heatmap(cm_df, annot=True)
plt.title('SVM Accuracy:{0:.3f}'.format(accuracy_test_svm))
plt.ylabel('True label')
plt.xlabel('Predicted label')
plt.show()
```



In [157]:
```
clf = MultinomialNB()
```

In [158]:
```
clf.fit(X_train,y_train)
```

Out[158]:
```
MultinomialNB(alpha=1.0, class_prior=None, fit_prior=True)
```

In [159]:
```
mnb_pred = clf.predict(X_test)
```

In [160]:
```
mnb_pred
```

Out[160]:
```
array([1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 0, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 0, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1,
       0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0,
       1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 0,
       1, 1, 1, 1, 0, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 0, 1, 1, 0, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 0, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 0, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0,
       0, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1,
       1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 0,
       1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 0,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 0, 0, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1,
       0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 0, 1, 0, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 0, 1, 0, 1, 1,
       1, 0, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       0, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 0, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 0, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0,
       1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1,
```

```
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 0, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       1])
```

In [161]:
```
print(confusion_matrix(y_test, mnb_pred))
```

```
[[ 73 186]
 [  3 685]]
```

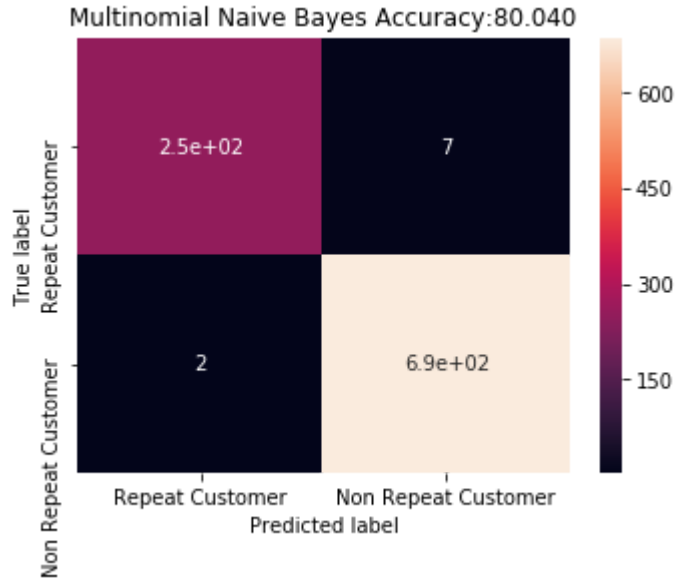
In [162]:
```
target_names = ['Repeat Customer','Non Repeat Customer']
print(classification_report(y_test, mnb_pred, target_names=target_names))
```

```
                    precision    recall  f1-score   support

    Repeat Customer       0.96      0.28      0.44       259
Non Repeat Customer       0.79      1.00      0.88       688

        avg / total       0.83      0.80      0.76       947
```

In [163]:
```
accuracy_test_mnb=round(clf.score(X_test,y_test)*100,2)
accuracy_train_mnb=round(clf.score(X_train,y_train)*100,2)
accuracy_mnb=round(accuracy_score(y_test, mnb_pred)*100,2)
print('Training accuracy of Multinomial Naive Bayes',accuracy_train_mnb)
print('Testing accuracy of Multinomial Naive Bayes',accuracy_test_mnb)
print('Accuracy of Multinomial Naive Bayes classifier:',accuracy_mnb)
```

```
Training accuracy of Multinomial Naive Bayes 79.7
Testing accuracy of Multinomial Naive Bayes 80.04
Accuracy of Multinomial Naive Bayes classifier: 80.04
```

In [164]:
```
plt.figure(figsize=(5.5,4))
sns.heatmap(cm_df, annot=True)
plt.title('Multinomial Naive Bayes Accuracy:{0:.3f}'.format(accuracy_test_mnb))
plt.ylabel('True label')
plt.xlabel('Predicted label')
plt.show()
```



In [165]:
```
clf = DecisionTreeClassifier(random_state = 86,
                             max_depth=2, min_samples_leaf=5)
```

In [166]:
```
clf.fit(X_train,y_train)
```

Out[166]:
```
DecisionTreeClassifier(class_weight=None, criterion='gini', max_depth=2,
            max_features=None, max_leaf_nodes=None,
            min_impurity_decrease=0.0, min_impurity_split=None,
            min_samples_leaf=5, min_samples_split=2,
            min_weight_fraction_leaf=0.0, presort=False, random_state=86,
            splitter='best')
```

In [167]:
```
c_pred = clf.predict(X_test)
```

In [168]:
```
c_pred
```

```
Out[168]: array([1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 0, 1, 1, 1, 0, 1, 1, 0,
                  1, 1, 1, 0, 1, 1, 1, 0, 0, 0, 0, 1, 1, 1, 1, 0, 1, 1, 0, 0, 1, 1,
                  0, 0, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1,
                  0, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 0, 1, 1,
                  0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 0,
                  1, 0, 1, 1, 0, 1, 0, 1, 0, 1, 0, 1, 1, 1, 0, 1, 0, 1, 0, 0, 1, 0,
                  1, 1, 0, 1, 0, 1, 1, 0, 0, 1, 1, 1, 1, 0, 1, 0, 1, 1, 1, 1, 0, 1,
                  1, 0, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 0, 1, 1, 1,
                  0, 1, 0, 0, 0, 1, 1, 0, 1, 0, 1, 0, 1, 1, 1, 0, 0, 1, 1, 1, 0, 1,
                  1, 1, 1, 1, 0, 1, 0, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 0, 1,
                  0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 0, 1, 1, 1, 0,
                  0, 0, 1, 0, 1, 1, 0, 1, 0, 0, 0, 1, 1, 0, 1, 0, 1, 1, 0, 0, 1, 1,
                  1, 0, 0, 0, 1, 1, 1, 1, 1, 0, 0, 1, 1, 1, 1, 0, 1, 1, 1, 0, 1, 1,
                  1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
                  0, 1, 1, 1, 1, 1, 1, 1, 1, 0, 0, 1, 0, 1, 1, 1, 0, 1, 1, 1, 0, 1,
                  0, 1, 1, 1, 1, 0, 0, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 0,
                  1, 1, 0, 0, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 0, 1, 1, 1, 0, 1, 1, 1,
                  0, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1,
                  1, 1, 1, 1, 0, 1, 1, 1, 0, 1, 0, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
                  1, 0, 1, 0, 1, 0, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 0, 0, 0, 1, 1, 0,
                  1, 1, 1, 1, 1, 1, 0, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 0,
                  1, 1, 1, 0, 0, 1, 1, 0, 0, 1, 1, 1, 0, 1, 1, 0, 0, 0, 1, 1, 1, 1,
                  0, 0, 1, 0, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1, 0, 1, 1, 1, 0,
                  1, 0, 1, 1, 0, 0, 1, 0, 1, 1, 1, 1, 0, 1, 1, 1, 1, 0, 0, 1, 1, 1,
                  0, 1, 1, 1, 1, 1, 0, 0, 1, 1, 0, 1, 1, 0, 1, 0, 0, 1, 1, 1, 0, 0,
                  0, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 0, 1, 1, 1, 1, 1,
                  1, 0, 1, 1, 0, 1, 1, 0, 1, 0, 0, 1, 0, 1, 1, 0, 0, 1, 1, 1, 1, 1,
                  1, 1, 1, 0, 0, 1, 0, 1, 1, 1, 0, 1, 0, 1, 1, 1, 1, 0, 0, 0, 0, 1,
                  1, 0, 1, 0, 1, 0, 1, 1, 0, 0, 1, 0, 0, 1, 0, 1, 0, 1, 1, 1, 1, 1,
                  1, 1, 1, 1, 0, 1, 1, 1, 1, 0, 1, 1, 0, 0, 1, 1, 1, 0, 0, 0, 1, 1,
                  0, 1, 0, 1, 1, 1, 0, 1, 1, 1, 0, 1, 1, 0, 0, 1, 0, 1, 1, 1, 1, 1,
                  0, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 0, 1, 1, 1, 1, 1, 1,
                  1, 1, 1, 1, 1, 1, 1, 1, 0, 0, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 0,
                  1, 0, 0, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0,
                  0, 1, 1, 1, 1, 1, 0, 1, 1, 0, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
                  1, 0, 1, 1, 1, 1, 0, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
                  1, 1, 1, 0, 0, 0, 0, 1, 1, 1, 1, 1, 1, 1, 0, 0, 1, 0, 1, 1, 1, 1,
                  0, 1, 1, 1, 0, 0, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1,
                  1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 0, 1, 1, 0, 1, 1, 0, 0, 0, 1, 1, 1,
                  0, 0, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 0,
                  0, 0, 0, 1, 1, 1, 1, 1, 0, 0, 1, 1, 1, 0, 1, 1, 1, 1, 0, 1, 1, 1,
```

```
1, 1, 1, 1, 0, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 1, 1, 0, 0,
1, 1, 0, 1, 1, 0, 0, 1, 1, 1, 0, 1, 1, 0, 1, 1, 1, 0, 1, 1, 1, 1,
0])
```

In [169]:
```
y_test.head()
```

Out[169]:

	VisitPossibleNot
2580	1
1727	1
351	1
2483	1
1484	1

In [170]:
```
print(confusion_matrix(y_test, c_pred))
```

```
[[259   0]
 [  0 688]]
```

In [171]:
```
target_names = ['Repeat Customer','Non Repeat Customer']
print(classification_report(y_test, c_pred, target_names=target_names))
```

```
                    precision    recall  f1-score   support

    Repeat Customer       1.00      1.00      1.00       259
Non Repeat Customer       1.00      1.00      1.00       688

        avg / total       1.00      1.00      1.00       947
```

In [172]:
```
accuracy_test_CART=round(clf.score(X_test,y_test)*100,2)
accuracy_train_CART=round(clf.score(X_train,y_train)*100,2)
accuracy_CART=round(accuracy_score(y_test, c_pred)*100,2)
print('Training accuracy of CART',accuracy_train_CART)
print('Testing accuracy of CART',accuracy_test_CART)
print('Accuracy of CART:',accuracy_CART)
```

```
Training accuracy of CART 100.0
Testing accuracy of CART 100.0
Accuracy of CART: 100.0
```

In [173]:
```
clf = DecisionTreeClassifier(criterion='entropy',random_state = 86,
                             max_depth=2, min_samples_leaf=5)
```

In [174]:
```
clf.fit(X_train,y_train)
```

Out[174]:
```
DecisionTreeClassifier(class_weight=None, criterion='entropy', max_depth=2,
            max_features=None, max_leaf_nodes=None,
            min_impurity_decrease=0.0, min_impurity_split=None,
            min_samples_leaf=5, min_samples_split=2,
            min_weight_fraction_leaf=0.0, presort=False, random_state=86,
            splitter='best')
```

In [175]:
```
id3_pred = clf.predict(X_test)
```

In [176]:
```
target_names = ['Repeat Customer','Non Repeat Customer']
print(classification_report(y_test, id3_pred, target_names=target_names))
```

```
                    precision    recall  f1-score   support

    Repeat Customer       1.00      1.00      1.00       259
Non Repeat Customer       1.00      1.00      1.00       688

        avg / total       1.00      1.00      1.00       947
```

In [177]:
```
accuracy_test_ID3=round(clf.score(X_test,y_test)*100,2)
accuracy_train_ID3=round(clf.score(X_train,y_train)*100,2)
accuracy_ID3=round(accuracy_score(y_test, id3_pred)*100,2)
print('Training accuracy of ID3',accuracy_train_ID3)
print('Testing accuracy of ID3',accuracy_test_ID3)
print('Accuracy of ID3:',accuracy_ID3)
```

```
Training accuracy of ID3 100.0
Testing accuracy of ID3 100.0
Accuracy of ID3: 100.0
```

In [178]:
```
clf = BaggingClassifier(KNeighborsClassifier(),max_samples=0.5, max_features=0.5)
```

In [179]:
```
clf.fit(X_train,y_train)
```

Out[179]:
```
BaggingClassifier(base_estimator=KNeighborsClassifier(algorithm='auto', leaf_size=30, metric='minkowski',
           metric_params=None, n_jobs=1, n_neighbors=5, p=2,
           weights='uniform'),
          bootstrap=True, bootstrap_features=False, max_features=0.5,
          max_samples=0.5, n_estimators=10, n_jobs=1, oob_score=False,
          random_state=None, verbose=0, warm_start=False)
```

In [180]:
```
bag_pred = clf.predict(X_test)
```

In [181]:
```
target_names = ['Repeat Customer','Non Repeat Customer']
print(classification_report(y_test, bag_pred, target_names=target_names))
```

```
                     precision    recall  f1-score   support

    Repeat Customer       1.00      1.00      1.00       259
Non Repeat Customer       1.00      1.00      1.00       688

        avg / total       1.00      1.00      1.00       947
```

In [182]:
```
accuracy_test_Bag=round(clf.score(X_test,y_test)*100,2)
accuracy_train_Bag=round(clf.score(X_train,y_train)*100,2)
accuracy_Bag=round(accuracy_score(y_test, bag_pred)*100,2)
print('Training accuracy of Bagging KNN Classifier',accuracy_train_Bag)
print('Testing accuracy of Bagging KNN Classifier:',accuracy_test_Bag)
print('Accuracy of Bagging KNN Classifier:',accuracy_Bag)
```

```
Training accuracy of Bagging KNN Classifier 99.82
Testing accuracy of Bagging KNN Classifier: 99.89
Accuracy of Bagging KNN Classifier: 99.89
```

In [183]:
```
pprf1 = precision_recall_fscore_support(y_test, knn_pred, average='macro')
print("KNN precision_recall_fscore_support ", pprf1)
pps1 = precision_score(y_test, knn_pred, labels=None, pos_label=1, average='macro', sample_weight=None)
print("KNN precision_score -> %.2f"%pps1)
prs1 = recall_score(y_test, knn_pred, labels=None, pos_label=1, average='macro', sample_weight=None)
print("KNN recall_score -> %.2f"%prs1)
pf1=f1_score(y_test, knn_pred, labels=None, pos_label=1, average='macro', sample_weight=None)
print("f1_score",f1_score(y_test, knn_pred, labels=None, pos_label=1, average='macro', sample_weight=None))
print('KNN f1 score -> %.2f'%pf1)
```

```
KNN precision_recall_fscore_support  (0.9910124870754793, 0.9850329981143935, 0.9879695618481396, None)
KNN precision_score -> 0.99
KNN recall_score -> 0.99
f1_score 0.9879695618481396
KNN f1 score -> 0.99
```

In [184]:
```
pprf2 = precision_recall_fscore_support(y_test, svm_pred, average='macro')
print("SVM precision_recall_fscore_support ", pprf2)
pps2 = precision_score(y_test, svm_pred, labels=None, pos_label=1, average='macro', sample_weight=None)
print("SVM precision_score -> %.2f"%pps2)
prs2 = recall_score(y_test, svm_pred, labels=None, pos_label=1, average='macro', sample_weight=None)
print("SVM recall_score -> %.2f"%prs2)
pf2=f1_score(y_test, svm_pred, labels=None, pos_label=1, average='macro', sample_weight=None)
print("f1_score",f1_score(y_test, svm_pred, labels=None, pos_label=1, average='macro', sample_weight=None))
print('SVM f1 score -> %.2f'%pf2)
```

```
SVM precision_recall_fscore_support  (0.9935240105894574, 0.9958892655113585, 0.9946982420781547, None)
SVM precision_score -> 0.99
SVM recall_score -> 1.00
f1_score 0.9946982420781547
SVM f1 score -> 0.99
```

In [185]:
```
pprf3 = precision_recall_fscore_support(y_test, mnb_pred, average='macro')
print("Multinomial NB precision_recall_fscore_support ", pprf3)
pps3 = precision_score(y_test, mnb_pred, labels=None, pos_label=1, average='macro', sample_weight=None)
print("Multinomial NB precision_score -> %.2f"%pps3)
prs3 = recall_score(y_test, mnb_pred, labels=None, pos_label=1, average='macro', sample_weight=None)
print("Multinomial NB recall_score -> %.2f"%prs3)
pf3=f1_score(y_test, mnb_pred, labels=None, pos_label=1, average='macro', sample_weight=None)
print("f1_score",f1_score(y_test, mnb_pred, labels=None, pos_label=1, average='macro', sample_weight=None))
print('Multinomial NB f1 score -> %.2f'%pf3)
```

```
Multinomial NB precision_recall_fscore_support  (0.8734893347030033, 0.6387464083685014, 0.6572946684154596,
None)
Multinomial NB precision_score -> 0.87
Multinomial NB recall_score -> 0.64
f1_score 0.6572946684154596
Multinomial NB f1 score -> 0.66
```

In [186]:
```
pprf4 = precision_recall_fscore_support(y_test, c_pred, average='macro')
print("CART precision_recall_fscore_support ", pprf4)
pps4 = precision_score(y_test, c_pred, labels=None, pos_label=1, average='macro', sample_weight=None)
print("CART precision_score -> %.2f"%pps4)
prs4 = recall_score(y_test, c_pred, labels=None, pos_label=1, average='macro', sample_weight=None)
print("CART recall_score -> %.2f"%prs4)
pf4=f1_score(y_test, c_pred, labels=None, pos_label=1, average='macro', sample_weight=None)
print("f1_score",f1_score(y_test, c_pred, labels=None, pos_label=1, average='macro', sample_weight=None))
print('CART f1 score -> %.2f'%pf4)
```

```
CART precision_recall_fscore_support  (1.0, 1.0, 1.0, None)
CART precision_score -> 1.00
CART recall_score -> 1.00
f1_score 1.0
CART f1 score -> 1.00
```

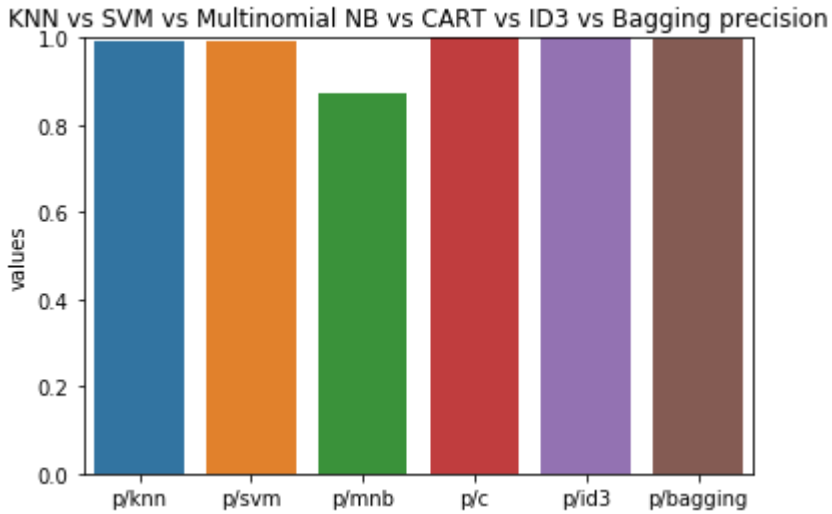
In [187]:
```
pprf5 = precision_recall_fscore_support(y_test, id3_pred, average='macro')
print("ID3 precision_recall_fscore_support ", pprf5)
pps5 = precision_score(y_test, id3_pred, labels=None, pos_label=1, average='macro', sample_weight=None)
print("ID3 precision_score -> %.2f"%pps5)
prs5 = recall_score(y_test, id3_pred, labels=None, pos_label=1, average='macro', sample_weight=None)
print("ID3 recall_score -> %.2f"%prs5)
pf5=f1_score(y_test, id3_pred, labels=None, pos_label=1, average='macro', sample_weight=None)
print("f1_score",f1_score(y_test, id3_pred, labels=None, pos_label=1, average='macro', sample_weight=None))
print('ID3 f1 score -> %.2f'%pf5)
```

```
ID3 precision_recall_fscore_support  (1.0, 1.0, 1.0, None)
ID3 precision_score -> 1.00
ID3 recall_score -> 1.00
f1_score 1.0
ID3 f1 score -> 1.00
```

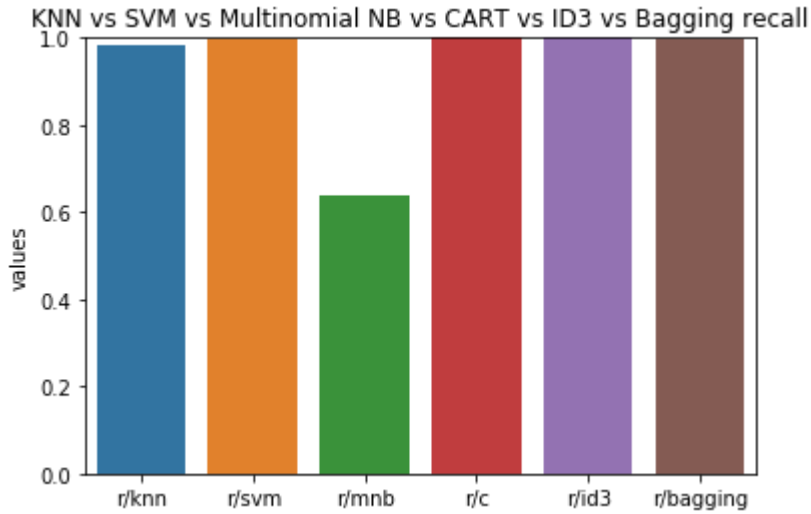
In [188]:
```
pprf6 = precision_recall_fscore_support(y_test, bag_pred, average='macro')
print("Bagging precision_recall_fscore_support ", pprf6)
pps6 = precision_score(y_test, bag_pred, labels=None, pos_label=1, average='macro', sample_weight=None)
print("Bagging precision_score -> %.2f"%pps6)
prs6 = recall_score(y_test, bag_pred, labels=None, pos_label=1, average='macro', sample_weight=None)
print("Bagging recall_score -> %.2f"%prs6)
pf6=f1_score(y_test, bag_pred, labels=None, pos_label=1, average='macro', sample_weight=None)
print("f1_score",f1_score(y_test, bag_pred, labels=None, pos_label=1, average='macro', sample_weight=None))
print('Bagging f1 score -> %.2f'%pf6)
```

```
Bagging precision_recall_fscore_support  (0.9980769230769231, 0.9992732558139534, 0.9986729724995621, None)
Bagging precision_score -> 1.00
Bagging recall_score -> 1.00
f1_score 0.9986729724995621
Bagging f1 score -> 1.00
```

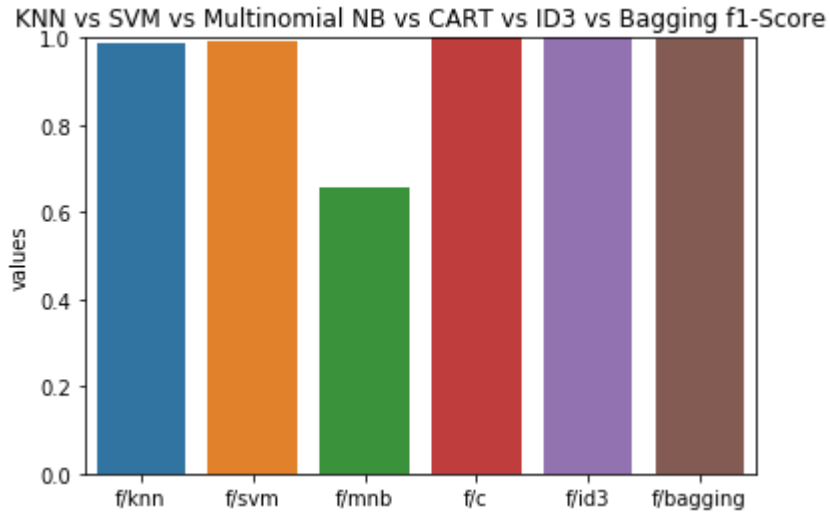
In [189]:
```
labels = ['p/knn','p/svm','p/mnb','p/c','p/id3','p/bagging']
pred=[pps1,pps2,pps3,pps4,pps5,pps6]
plt.ylabel('values')
plt.title('KNN vs SVM vs Multinomial NB vs CART vs ID3 vs Bagging precision')
sns.set_context(rc={"figure.figsize": (10, 5)})
ax = sns.barplot(x=labels, y=pred)
ax.set(ylim=(0, 1))
plt.show()
```



In [190]:
```
labels = ['r/knn','r/svm','r/mnb','r/c','r/id3','r/bagging']
pred=[prs1,prs2,prs3,prs4,prs5,prs6]
plt.ylabel('values')
plt.title('KNN vs SVM vs Multinomial NB vs CART vs ID3 vs Bagging recall')
sns.set_context(rc={"figure.figsize": (10, 5)})
ax = sns.barplot(x=labels, y=pred)
ax.set(ylim=(0, 1))
plt.show()
```



In [191]:
```
labels = ['f/knn','f/svm','f/mnb','f/c','f/id3','f/bagging']
pred=[pf1,pf2,pf3,pf4,pf5,pf6]
plt.ylabel('values')
plt.title('KNN vs SVM vs Multinomial NB vs CART vs ID3 vs Bagging f1-Score')
sns.set_context(rc={"figure.figsize": (10, 5)})
ax = sns.barplot(x=labels, y=pred)
ax.set(ylim=(0, 1))
plt.show()
```



In [192]:
```
labels = ['a/knn','a/svm','a/mnb','a/c','a/id3','a/bagging']
pred=[accuracy_knn,accuracy_svm,accuracy_mnb,accuracy_CART,accuracy_ID3,accuracy_Bag]
plt.ylabel('values')
plt.title('KNN vs SVM vs Multinomial NB vs CART vs ID3 vs Bagging Accuracy')
sns.set_context(rc={"figure.figsize": (10, 5)})
ax = sns.barplot(x=labels, y=pred)
ax.set(ylim=(0, 120))
plt.show()
```