American Express

August 12, 2018

In [1]:
```
# Importing Libraries
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
```

In [2]:
```
# Reading the dataset
train = pd.read_csv('Dataset - Problem 2/train.csv',header=None)
test = pd.read_csv('Dataset - Problem 2/test.csv',header=None)
```

In [3]:
```
# Check if training dataset contains null values
all(train.isnull().sum()==0)
```

Out[3]: True

In [4]:
```
# Check if test dataset contains null values
all(test.isnull().sum()==0)
```

Out[4]: True

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

Out[5]:

	0	1	2	3	4	5	6	7	8	9	...	46	47	48	49	\
0	447095	3452	111	22	433	214	3677	252	210	74	...	0	0	0	0	
1	113427	3093	95	9	124	7	4115	234	227	124	...	0	0	0	0	
2	66435	2551	61	17	90	5	726	231	202	98	...	0	0	0	0	
3	8957	2944	135	3	430	13	1868	224	238	149	...	0	0	0	0	
4	434631	3030	327	34	277	101	1973	120	181	190	...	0	1	0	0	

	50	51	52	53	54	55
0	0	0	0	1	0	0
1	0	0	0	0	0	1
2	0	0	0	0	0	1
3	0	0	0	0	0	1
4	0	0	0	0	0	1

[5 rows x 56 columns]

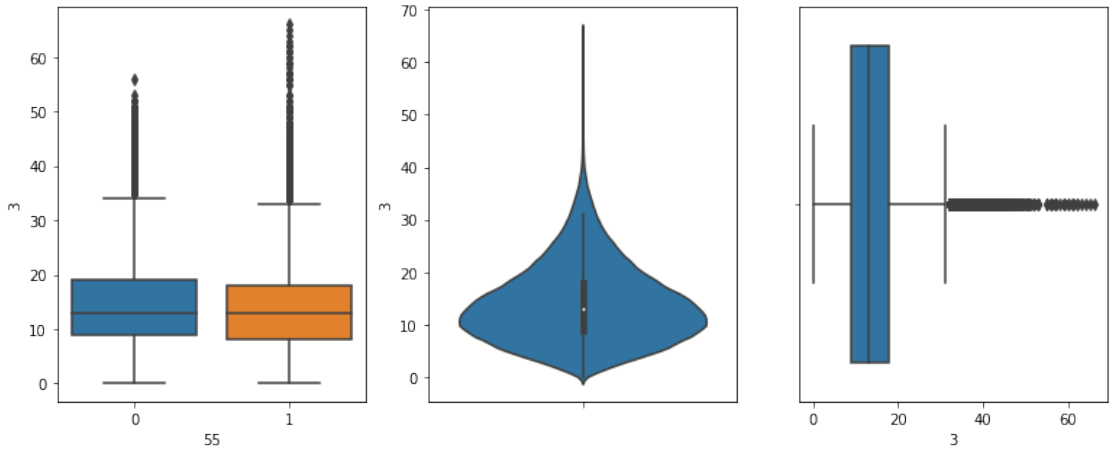
```
In [6]: # Checking the ratio of target variables to check if its imbalanced or not
        train[55].value_counts()
```

```
Out[6]: 0    208352
        1    198357
        Name: 55, dtype: int64
```

0.1 Visualization

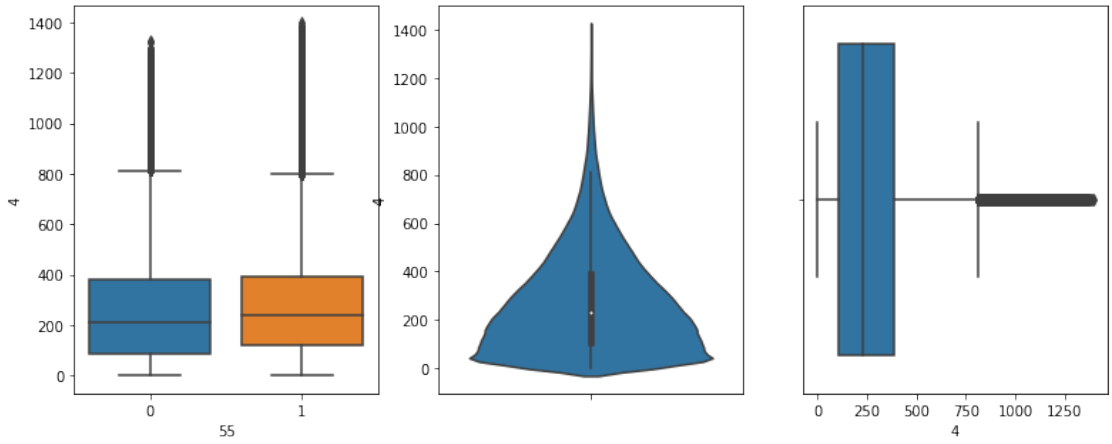
```
In [7]: def drawPlots(column):
            f, axes = plt.subplots(1, 3,figsize=(13,5))
            sns.boxplot(y=train[column],x=train[55], ax=axes[0])
            sns.violinplot(y=train[column],xa=train[55], ax=axes[1])
            sns.boxplot(train[column], ax=axes[2])
```

```
In [8]: drawPlots(3)
```



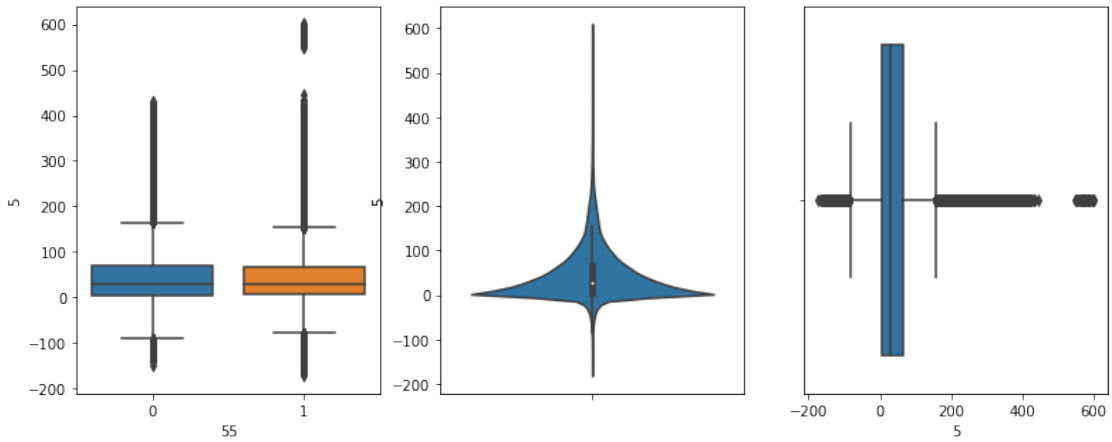

```
In [9]: # Dropping the outliers
        train = train.drop(train[(train[3]>=33)
                                 & (train[55]==0)].index).reset_index(drop=True)
        train = train.drop(train[(train[3]>=31)
                                 & (train[55]==1)].index).reset_index(drop=True)
```

```
In [10]: drawPlots(4)
```



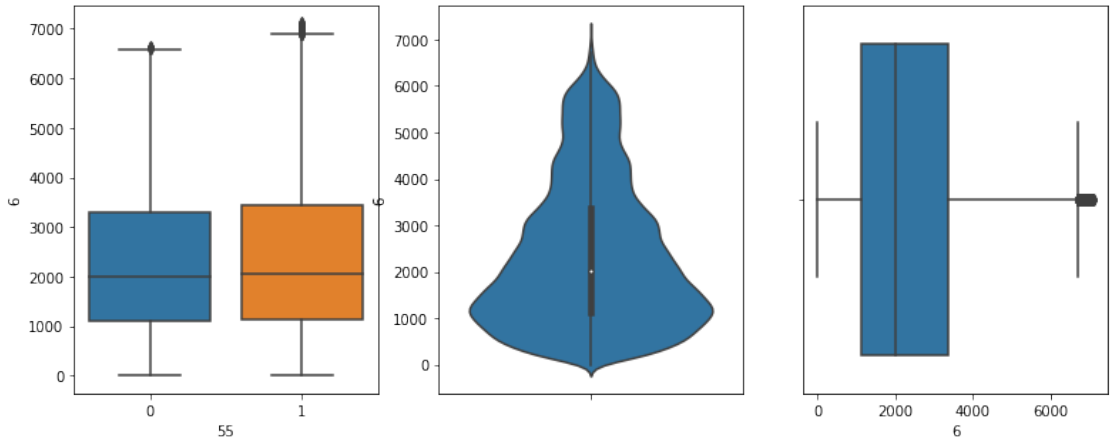
In [11]:
```
# Dropping the outliers
train = train.drop(train[(train[4]>=1300)
                         & (train[55]==1)].index).reset_index(drop=True)
train = train.drop(train[(train[4]>=1290)
                         & (train[55]==0)].index).reset_index(drop=True)
```

In [12]:
```
drawPlots(5)
```



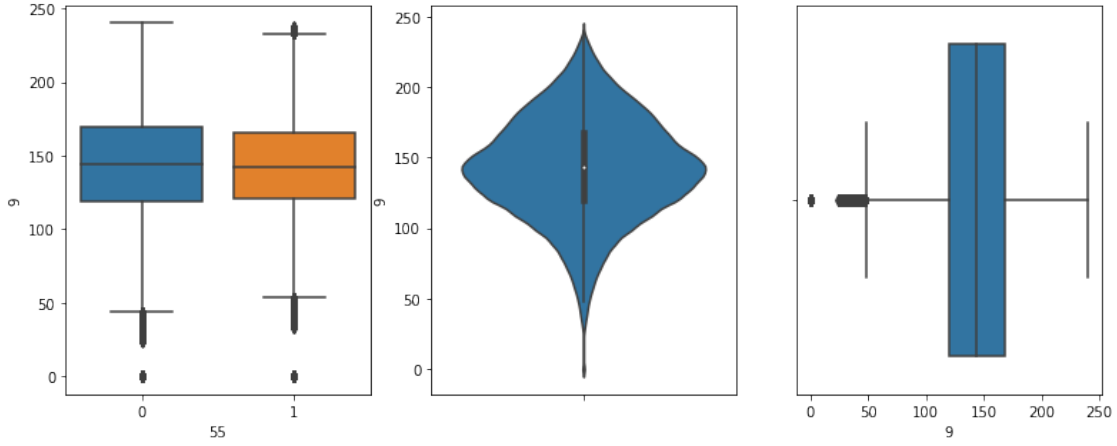
In [13]:
```
# Dropping the outliers
train = train.drop(train[(train[5]>=390)
                         & (train[55]==1)].index).reset_index(drop=True)
train = train.drop(train[(train[5]<=-140)].index).reset_index(drop=True)
train = train.drop(train[(train[5]>=400)
                         & (train[55]==0)].index).reset_index(drop=True)
```

In [14]:
```
drawPlots(6)
```



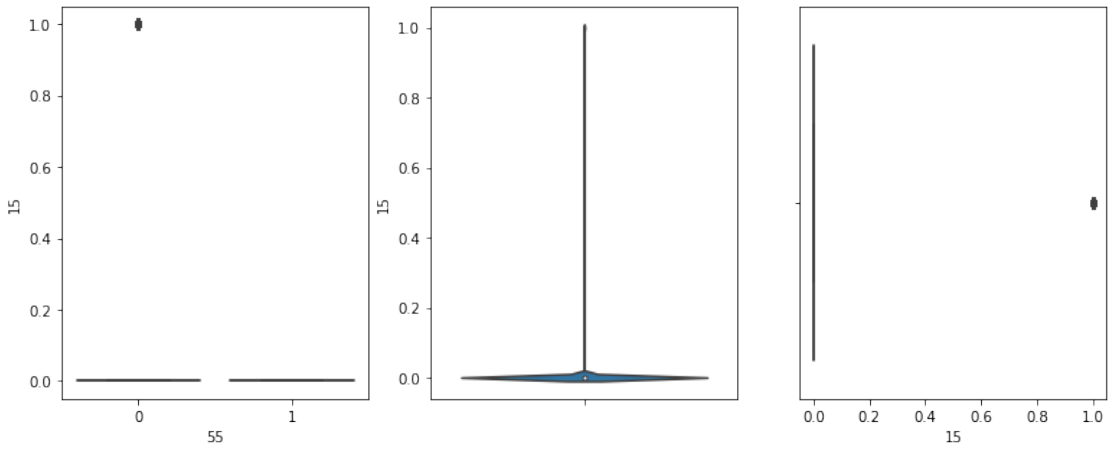
In [15]:
```
# Dropping the outliers
train = train.drop(train[(train[6]>=6700)
                         & (train[55]==1)].index).reset_index(drop=True)
train = train.drop(train[(train[6]>=6550)
                         & (train[55]==0)].index).reset_index(drop=True)
```

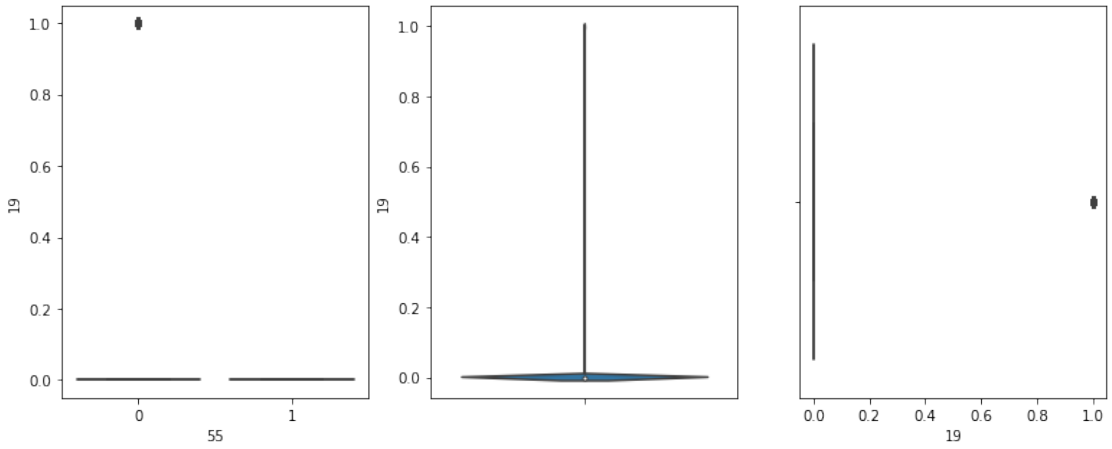
In [16]:
```
drawPlots(9)
```

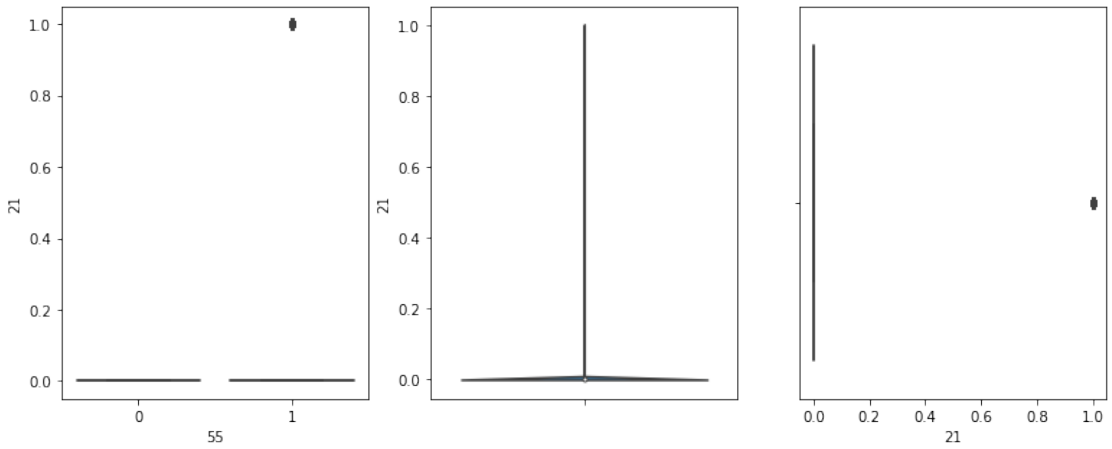


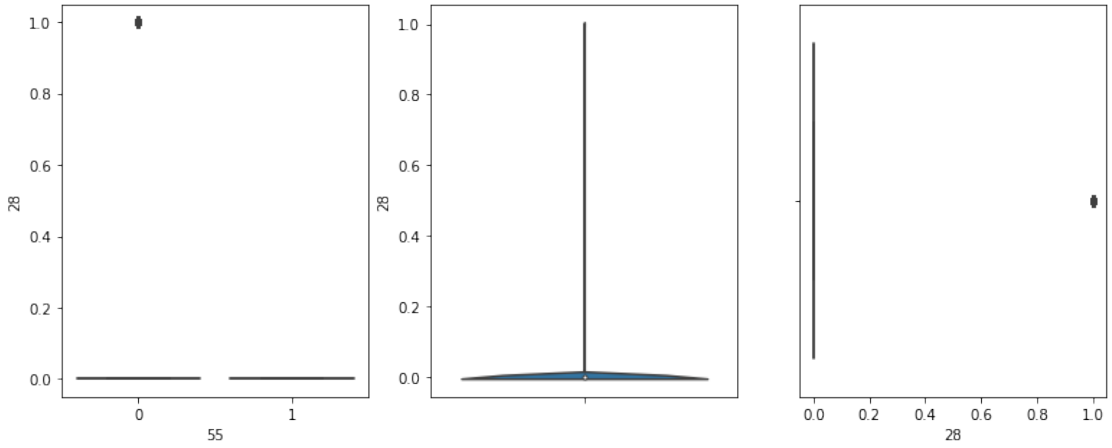
In [17]:
```
# Dropping the outliers
train = train.drop(train[(train[9]>=230)
                         & (train[55]==1)].index).reset_index(drop=True)
train = train.drop(train[(train[9]==0)
                         & (train[55]==0)].index).reset_index(drop=True)
train = train.drop(train[(train[9]==0)
                         & (train[55]==1)].index).reset_index(drop=True)
```

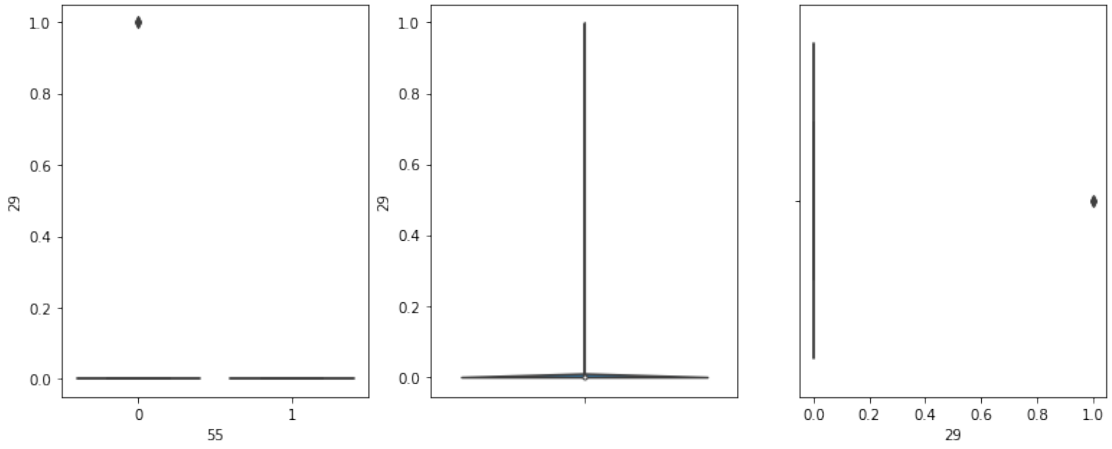
```
In [18]: for i in [15,19,21,28,29,51]:
             drawPlots(i)
```

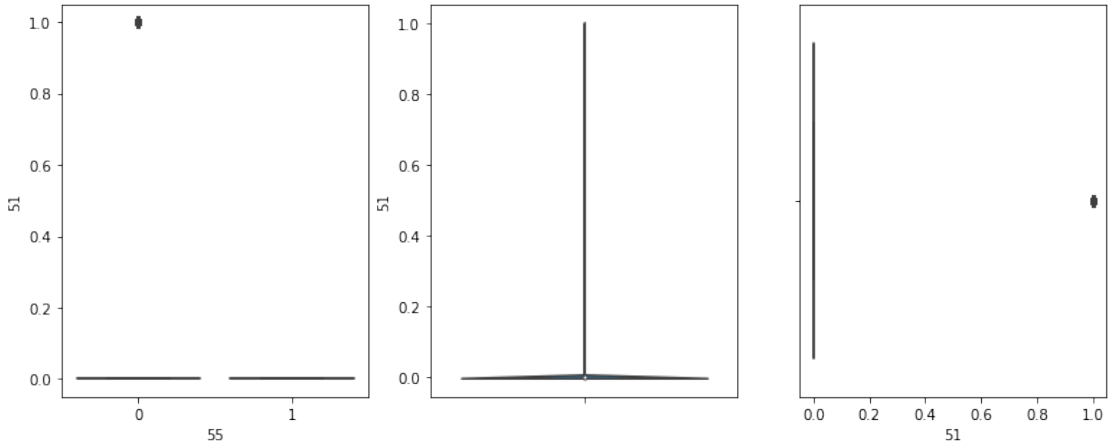







28
55
28
28


29
55
29
29


51
55
51
51

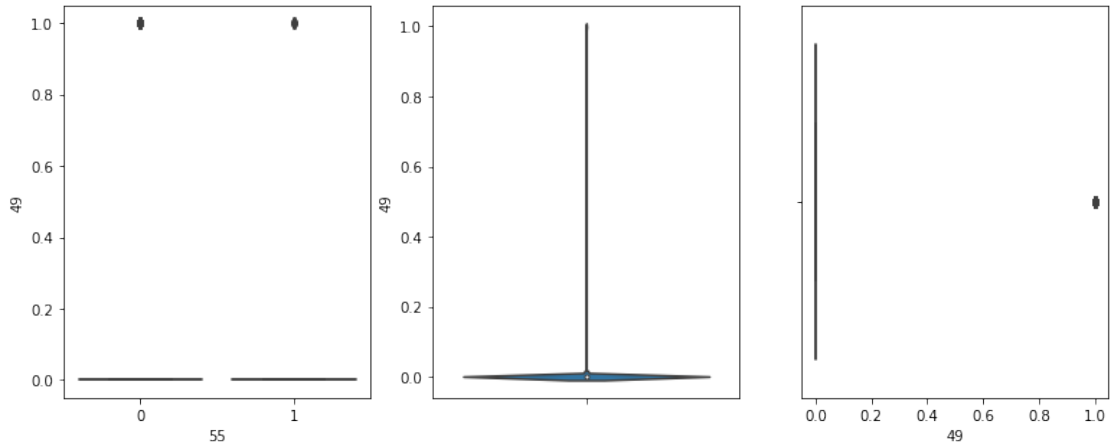
```
In [19]: for i in [15,19,21,28,29,51]:
             print("Feature",i)
             #print("Label with 0 value:\n",train[i][train[55]==0].value_counts())
             print("Label with 1 value:\n",train[i][train[55]==1].value_counts())
```

```
Feature 15
Label with 1 value:
 0    192737
Name: 15, dtype: int64
Feature 19
Label with 1 value:
 0    192737
Name: 19, dtype: int64
Feature 21
Label with 1 value:
 0    192664
1        73
Name: 21, dtype: int64
Feature 28
Label with 1 value:
 0    192737
Name: 28, dtype: int64
Feature 29
Label with 1 value:
 0    192737
Name: 29, dtype: int64
Feature 51
Label with 1 value:
 0    192737
Name: 51, dtype: int64
```

Above binary features had '0' binary value realted to binary label 1 only. And '1' binary value is related to both label. So we cant establish a relationship between them. Therefore, Dropping these features

```
In [20]: train = train.drop([15,19,21,28,29,51],axis=1)
         test = test.drop([15,19,21,28,29,51],axis=1)
```

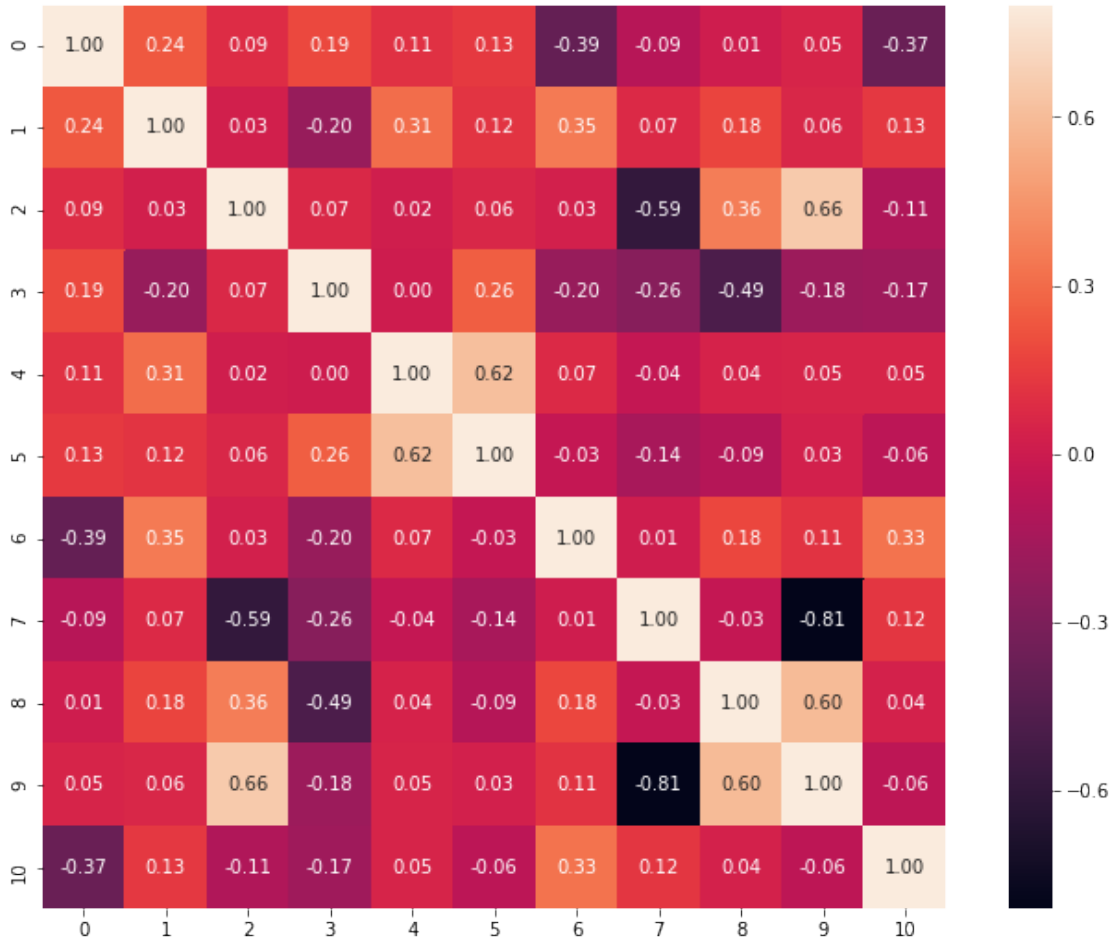
```
In [21]: drawPlots(49)
```




```
In [22]: # Dropping the outliers
         train = train.drop(train[(train[49]==1)
                                  & (train[55]==1)].index).reset_index(drop=True)
```

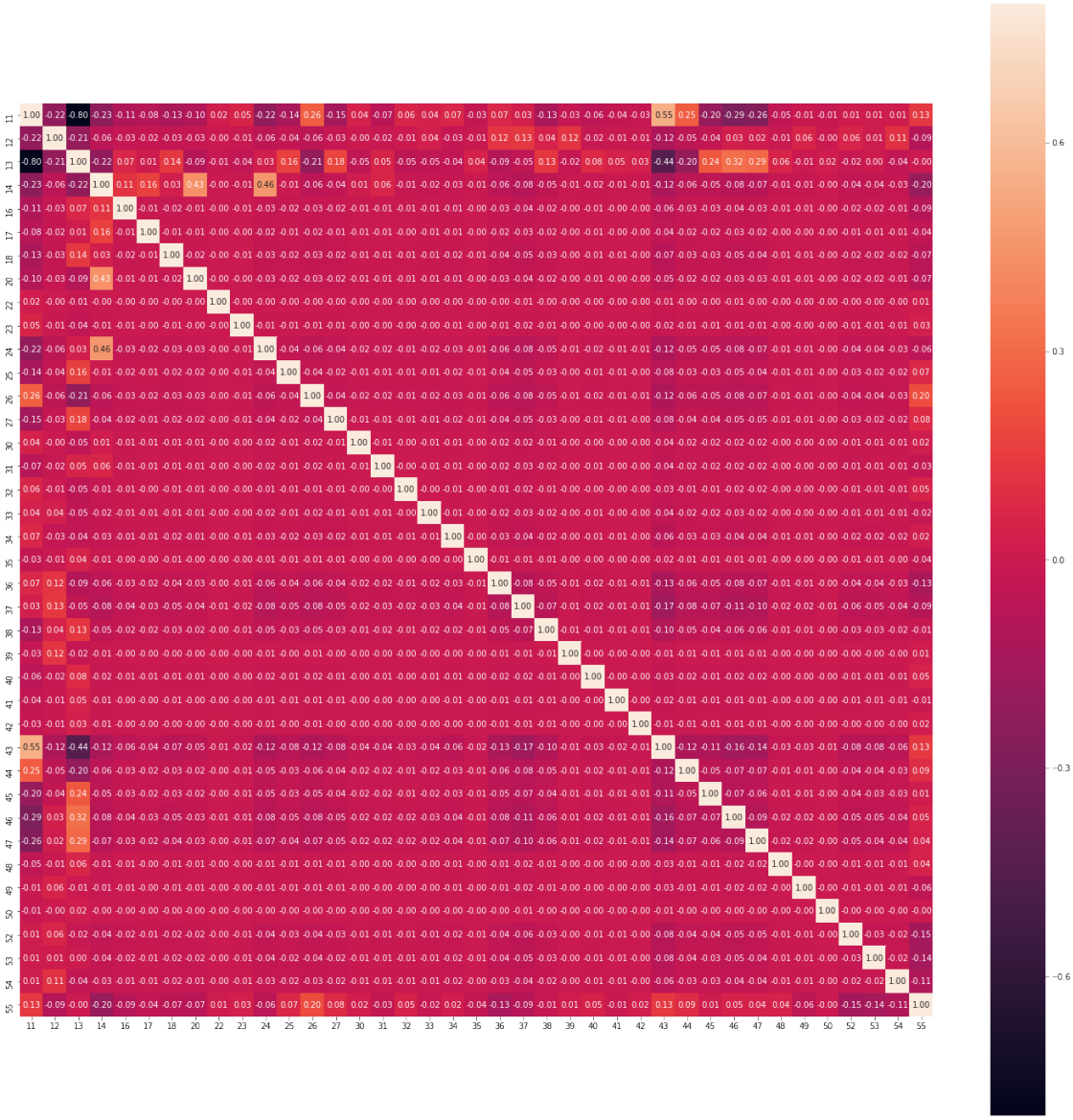
Drawing heatmap between continuous variable with correlation coefficient is Pearson.

```
In [23]: corrmat = train[[0, 1,  2,  3,  4,  5,  6,  7,  8,  9, 10]].corr()
         f, ax = plt.subplots(figsize=(12, 9))
         sns.heatmap(corrmat, vmax=.8, fmt="0.2f",annot= True, square=True);
```



Drawing heatmap between categorical variable with correlation coefficient is Kendall.

```
In [24]: corrmat = train[[11, 12, 13, 14, 16, 17,
                          18, 20, 22, 23, 24, 25, 26, 27, 30, 31, 32, 33,
                          34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50,
                          52, 53, 54, 55]].corr(method="kendall")
         f, ax = plt.subplots(figsize=(25,25))
         sns.heatmap(corrmat, vmax=.8, fmt="0.2f",annot= True, square=True);
```



```
In [25]: # Dropping feature that has negative 0.80 correlation.
         train = train.drop([7,11],axis=1)
         test = test.drop([7,11],axis=1)
```

Eliminationg these features Null Hypothesis Rejection

```
In [26]: train = train.drop([2,8],axis=1)
         test = test.drop([2,8],axis=1)
```

```
In [27]: # Seperating the feature and target variable after data cleaning
         y_train = train[55]
         X_train = train.drop(55,axis=1)
```

```
In [28]: # Converting the dataframe to numpy array
         X_train = X_train.as_matrix()
         X_test = test.as_matrix()
```

```
C:\Users\NITIN\Anaconda3\lib\site-packages\ipykernel_launcher.py:2: FutureWarning: Method .as_m

C:\Users\NITIN\Anaconda3\lib\site-packages\ipykernel_launcher.py:3: FutureWarning: Method .as_m
  This is separate from the ipykernel package so we can avoid doing imports until
```

0.2 Modelling

```
In [29]: # Importing Libraries for modelling
         from sklearn.metrics import roc_curve, auc,confusion_matrix
         from sklearn.naive_bayes import GaussianNB
         from sklearn.model_selection import cross_val_score
         from sklearn.model_selection import StratifiedKFold
         from sklearn.svm import SVC
         from scipy import interp
         from sklearn.ensemble import RandomForestClassifier,GradientBoostingClassifier
         from sklearn.metrics import confusion_matrix,roc_auc_score,classification_report
         from sklearn.linear_model import LogisticRegression,SGDClassifier
         from xgboost import XGBClassifier
         import lightgbm as lgb
         from sklearn.ensemble import AdaBoostClassifier
         from statistics import mean
         import warnings; warnings.simplefilter('ignore')
         from sklearn.svm import LinearSVC
```

0.3 Evaluation Metrics

```
In [30]: from __future__ import division

         def accumulate_truth(iterable):
             true = 0
             false = 0
             for i in iterable:
                 if i:
                     true += 1
                 else:
                     false += 1
                 yield true, false

         def AUC(scores, targets):
             total_targets = sum(targets)
             length_sub_targets = len(targets) - total_targets

             scores, targets = zip(*sorted(zip(scores, targets), reverse=True))
```

```
            tprs = []
            fprs = []
            for true, false in accumulate_truth(targets):
                tprs.append(true / total_targets)
                fprs.append(false / length_sub_targets)

            return auc(fprs,tprs)

        def LAUC(scores, targets):
            total_targets = sum(targets)
            length_sub_targets = len(targets) - total_targets

            scores, targets = zip(*sorted(zip(scores, targets), reverse=True))
            tprs = []
            fprs = []
            for true, false in accumulate_truth(targets):
                tprs.append(true / total_targets)
                fprs.append((0.95*false) / length_sub_targets)

            return auc(fprs,tprs)

        def score(y_pred,y):
            return 0.35*AUC(y_pred, y) + 0.65*LAUC(y_pred, y)
```

To show confusion matrix in tabular form

```
In [31]: def PlotConfusionMatrix(y_test,y_pred):
             cfn_matrix = confusion_matrix(y_test,y_pred)
             fig = plt.figure(figsize=(5,5))
             sns.heatmap(cfn_matrix,cmap='coolwarm_r',fmt='1',linewidths=0.5,annot=True)
             plt.title('Confusion Matrix')
             plt.ylabel('Real Classes')
             plt.xlabel('Predicted Classes')
             plt.show()
```

0.4 Cross-Validation Method

```
In [32]: def cross_validation(X_train,y_train,classifier):
             mean_score =[]
             for train, test in cv.split(X_train, y_train):
                 pred = classifier.fit(X_train[train], y_train[train]).predict_proba(X_train[te
                 mean_score.append(score(pred[:, 1],y_train[test]))
             return mean(mean_score)
```

0.5 Models

```
In [33]: cv = StratifiedKFold(n_splits=10)
         classifier_one = LogisticRegression()
```

```
classifier_two = lgb.LGBMClassifier(objective='binary')
classifier_three = RandomForestClassifier()
```

In [34]:
```
print("LogisticRegression Performace:")
cross_validation(X_train,y_train,classifier_one)
# 0.27633856719027583 0.71 score
```

```
LogisticRegression Performace:
```

Out[34]: 0.6287325567054224

In [35]:
```
print("LGBMClassifier Performace:")
cross_validation(X_train,y_train,classifier_two)
# 0.27633856719027583 0.71 score
```

```
LGBMClassifier Performace:
```

Out[35]: 0.9192080488720435

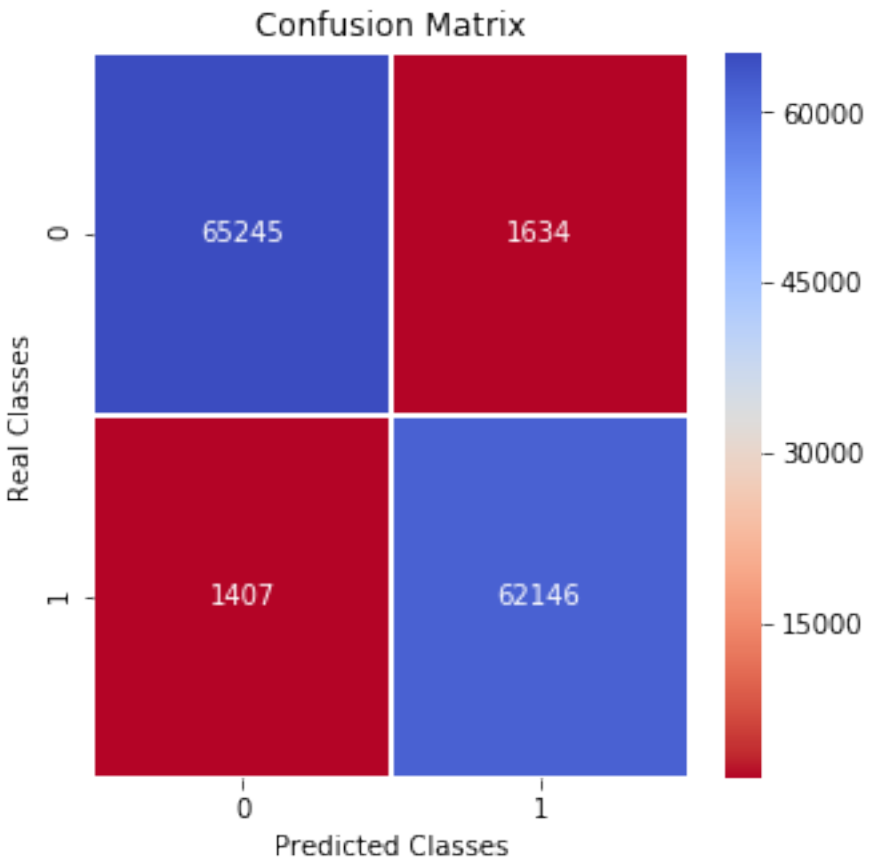
In [36]:
```
print("RandomForestClassifier Performace:")
cross_validation(X_train,y_train,classifier_three)
# 0.3804428312422048 0.96 score
```

```
RandomForestClassifier Performace:
```

Out[36]: 0.9641742241458569

0.6 Model After Hypertuning

In [37]:
```
from sklearn.model_selection import train_test_split
Xtrain, Xtest, ytrain, ytest = train_test_split(X_train, y_train, test_size=0.33, rand
classifier_three = RandomForestClassifier(n_jobs=7,random_state=7,max_features=30,n_es
classifier_three.fit(Xtrain,ytrain)
pred = classifier_three.predict(Xtest)
PlotConfusionMatrix(ytest,pred)
print(score(pred,ytest))
```




```
0.9669766752237113
```

0.6.1 Final Prediction

```
In [38]: classifier_three = RandomForestClassifier(n_jobs=7,random_state=7,max_features=30,n_es
         classifier_three.fit(X_train,y_train)
         # Predicting the test value
         pred = classifier_three.predict_proba(X_test)
```

0.6.2 Submission

```
In [39]: my_submission = pd.DataFrame({'key': test[0], 'score': pred[:,1]})
         my_submission.to_csv('submission.csv', index=False,columns= ['key','score'])
```