In [29]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
from matplotlib import gridspec
```

In [30]:
```
df=pd.read_csv('D:\Christopher Bradway\Documents\creditcard.csv')
```

In [31]:
```
df
```

Out[31]:

	Time	V1	V2	V3	V4	V5	V6	V7	
0	0.0	-1.359807	-0.072781	2.536347	1.378155	-0.338321	0.462388	0.239599	0.098
1	0.0	1.191857	0.266151	0.166480	0.448154	0.060018	-0.082361	-0.078803	0.085
2	1.0	-1.358354	-1.340163	1.773209	0.379780	-0.503198	1.800499	0.791461	0.247
3	1.0	-0.966272	-0.185226	1.792993	-0.863291	-0.010309	1.247203	0.237609	0.377
4	2.0	-1.158233	0.877737	1.548718	0.403034	-0.407193	0.095921	0.592941	-0.270
...	...	...	...	...	...	...	...	...	
284802	172786.0	-11.881118	10.071785	-9.834783	-2.066656	-5.364473	-2.606837	-4.918215	7.305
284803	172787.0	-0.732789	-0.055080	2.035030	-0.738589	0.868229	1.058415	0.024330	0.294
284804	172788.0	1.919565	-0.301254	-3.249640	-0.557828	2.630515	3.031260	-0.296827	0.708
284805	172788.0	-0.240440	0.530483	0.702510	0.689799	-0.377961	0.623708	-0.686180	0.679
284806	172792.0	-0.533413	-0.189733	0.703337	-0.506271	-0.012546	-0.649617	1.577006	-0.414

284807 rows × 31 columns

In [32]:
```
df.describe()
```

Out[32]:

	Time	V1	V2	V3	V4	V5	
count	284807.000000	2.848070e+05	2.848070e+05	2.848070e+05	2.848070e+05	2.848070e+05	2.8
mean	94813.859575	1.758743e-12	-8.252298e-13	-9.636929e-13	8.316157e-13	1.591952e-13	4.
std	47488.145955	1.958696e+00	1.651309e+00	1.516255e+00	1.415869e+00	1.380247e+00	1.3
min	0.000000	-5.640751e+01	-7.271573e+01	-4.832559e+01	-5.683171e+00	-1.137433e+02	-2.6
25%	54201.500000	-9.203734e-01	-5.985499e-01	-8.903648e-01	-8.486401e-01	-6.915971e-01	-7.
50%	84692.000000	1.810880e-02	6.548556e-02	1.798463e-01	-1.984653e-02	-5.433583e-02	-2.
75%	139320.500000	1.315642e+00	8.037239e-01	1.027196e+00	7.433413e-01	6.119264e-01	3.
max	172792.000000	2.454930e+00	2.205773e+01	9.382558e+00	1.687534e+01	3.480167e+01	7.3

8 rows × 31 columns

In [33]:
```
fraud = df[df['Class'] == 1]
valid = df[df['Class'] == 0]
outlierFraction = len(fraud)/float(len(valid))
print(outlierFraction)
print('Fraud Cases: {}'.format(len(df[df['Class'] == 1])))
print('Valid Transactions: {}'.format(len(df[df['Class'] == 0])))
```

```
0.0017304750013189597
Fraud Cases: 492
Valid Transactions: 284315
```

In [34]:
```
print('Fraud:')
fraud.Amount.describe()
```

```
Fraud:
```

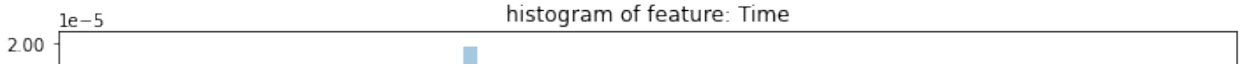
Out[34]:
```
count     492.000000
mean      122.211321
std       256.683288
min         0.000000
25%         1.000000
50%         9.250000
75%       105.890000
max      2125.870000
Name: Amount, dtype: float64
```

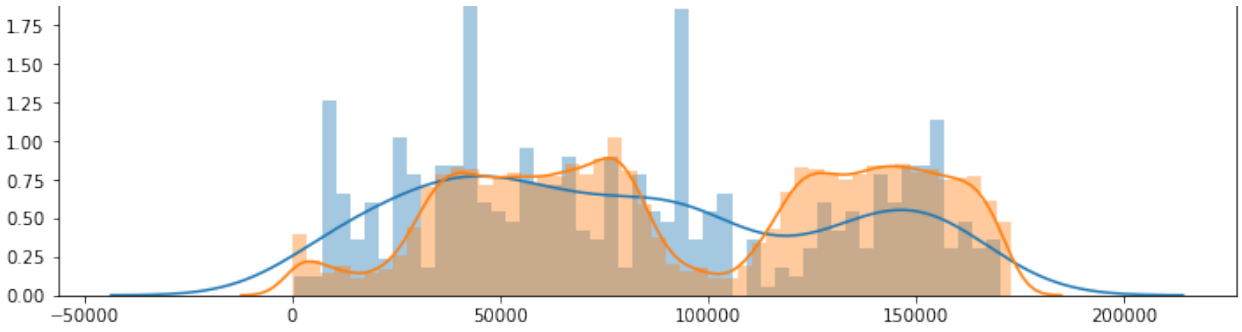
In [35]:
```
print('Valid:')
valid.Amount.describe()
```

```
Valid:
```

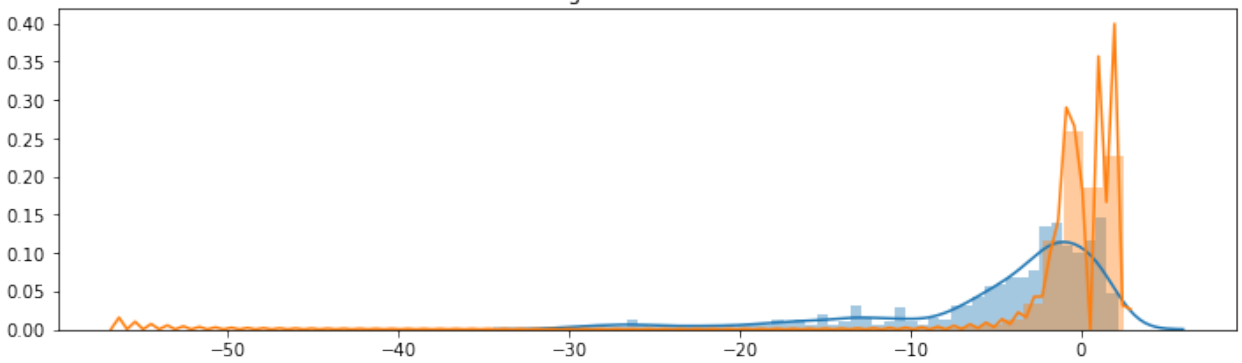
Out[35]:
```
count    284315.000000
mean         88.291022
std         250.105092
min           0.000000
25%           5.650000
50%          22.000000
75%          77.050000
max       25691.160000
Name: Amount, dtype: float64
```

In [36]:
```
features = df.iloc[:,0:28].columns
plt.figure(figsize=(12,28*4))
gs = gridspec.GridSpec(28, 1)
for i, c in enumerate(df[features]):
 ax = plt.subplot(gs[i])
 sns.distplot(df[c][df.Class == 1], bins=50)
 sns.distplot(df[c][df.Class == 0], bins=50)
 ax.set_xlabel('')
 ax.set_title('histogram of feature: ' + str(c))
plt.show()
```

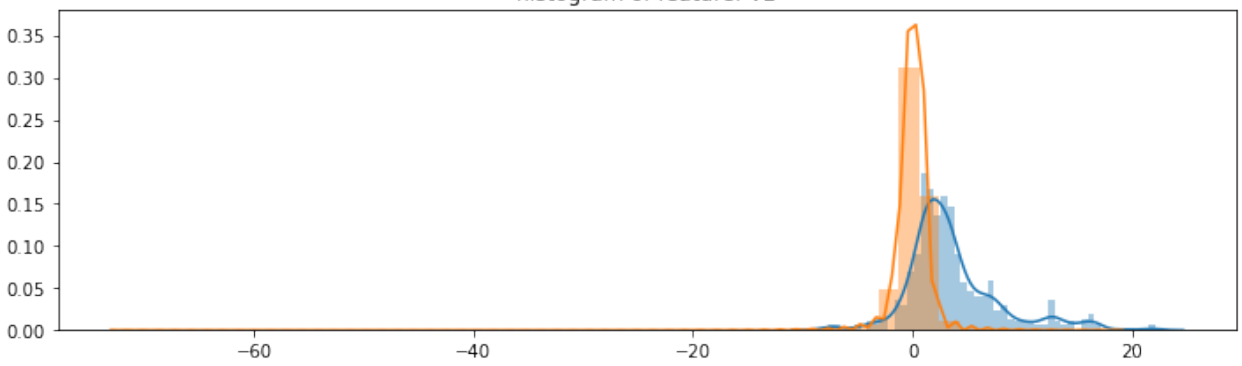




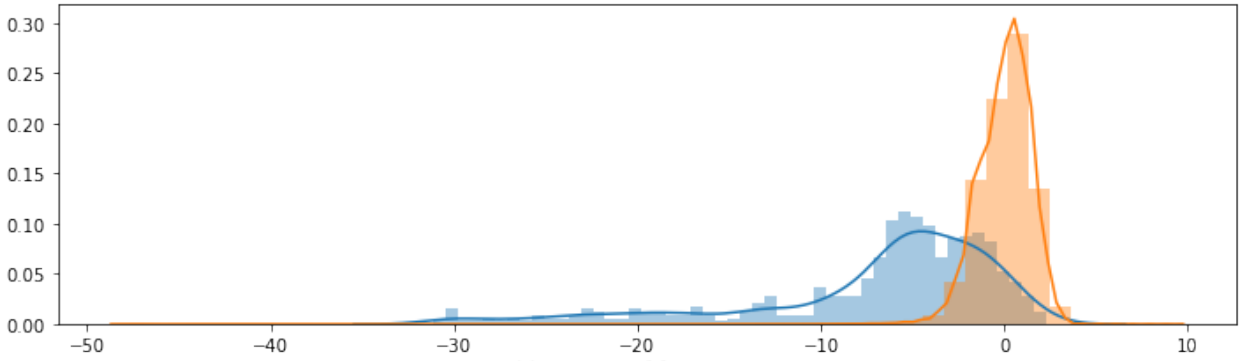
histogram of feature: V1



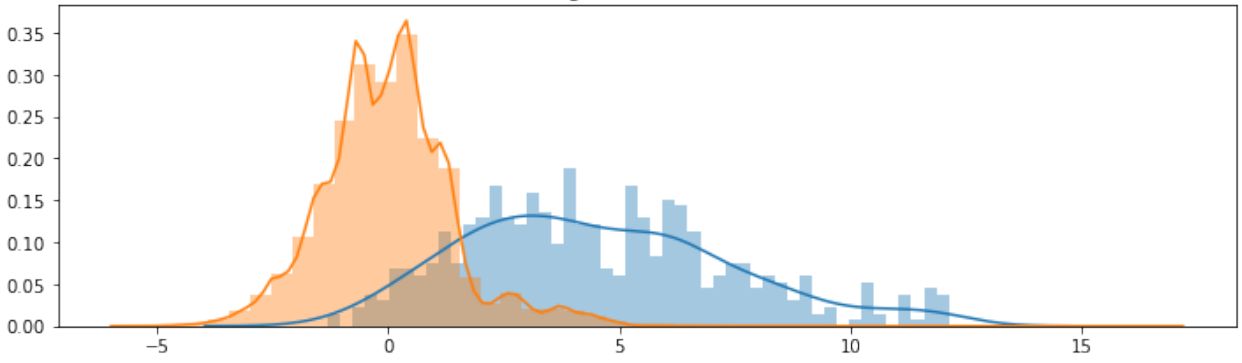
histogram of feature: V2



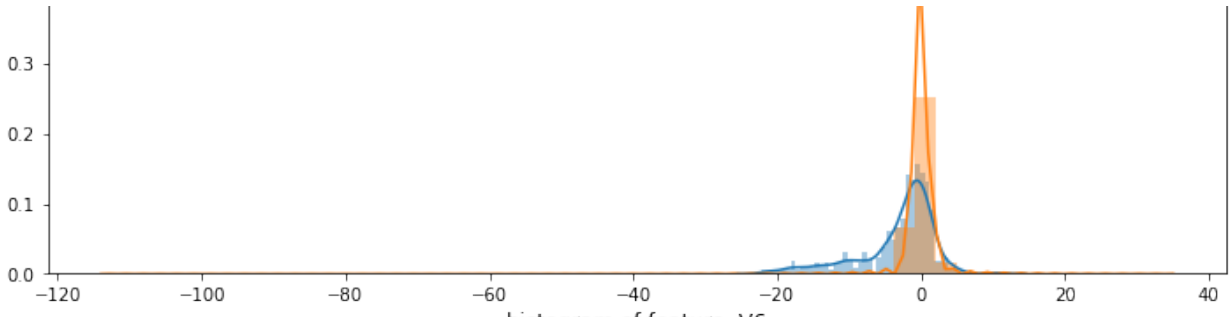
histogram of feature: V3



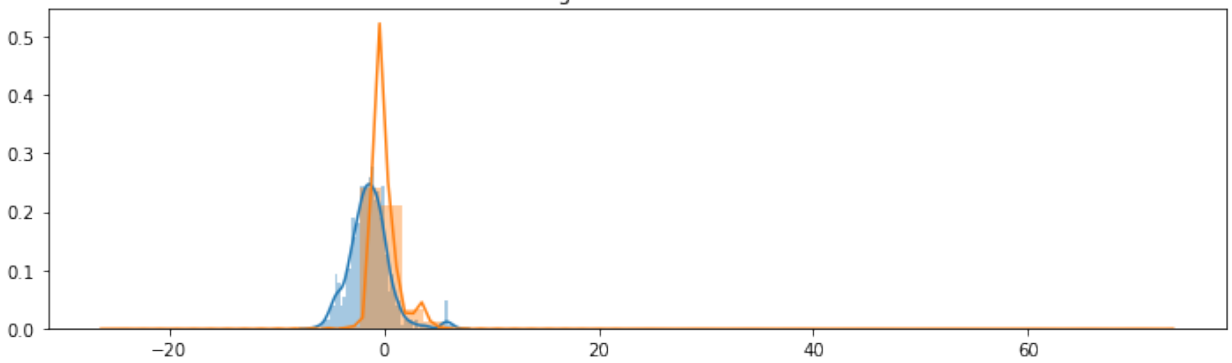
histogram of feature: V4



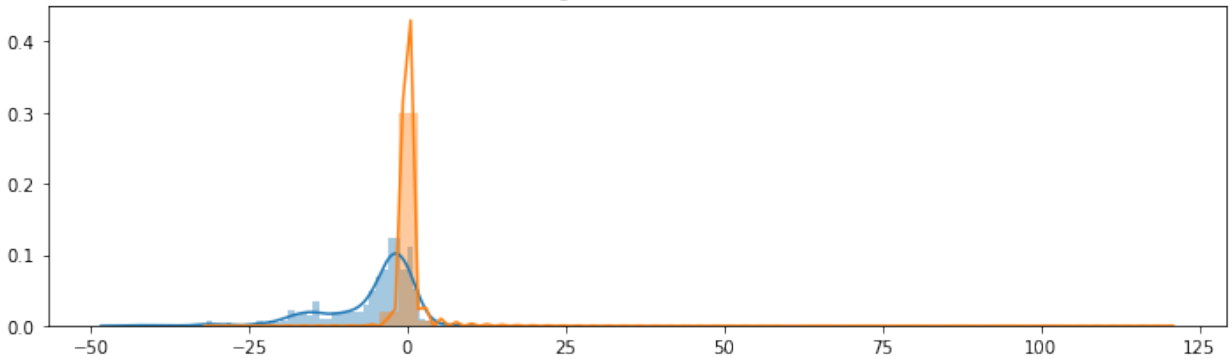
histogram of feature: V5



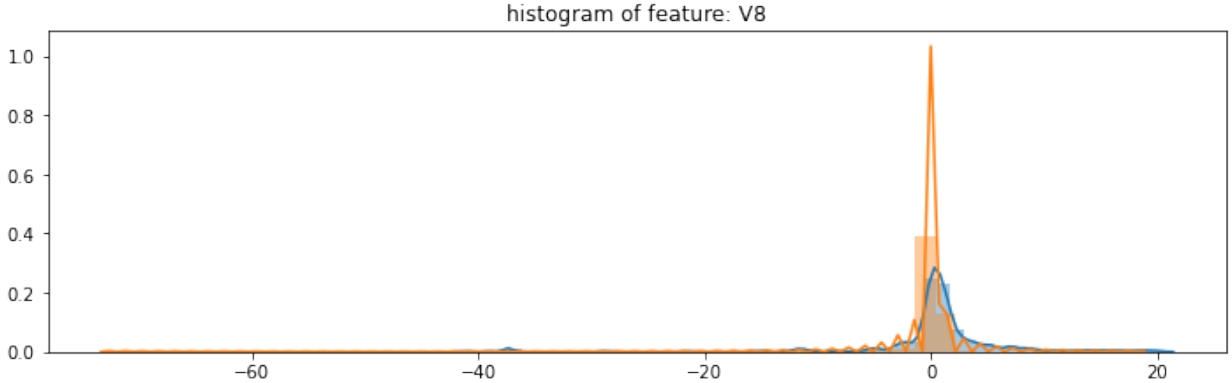
histogram of feature: V6



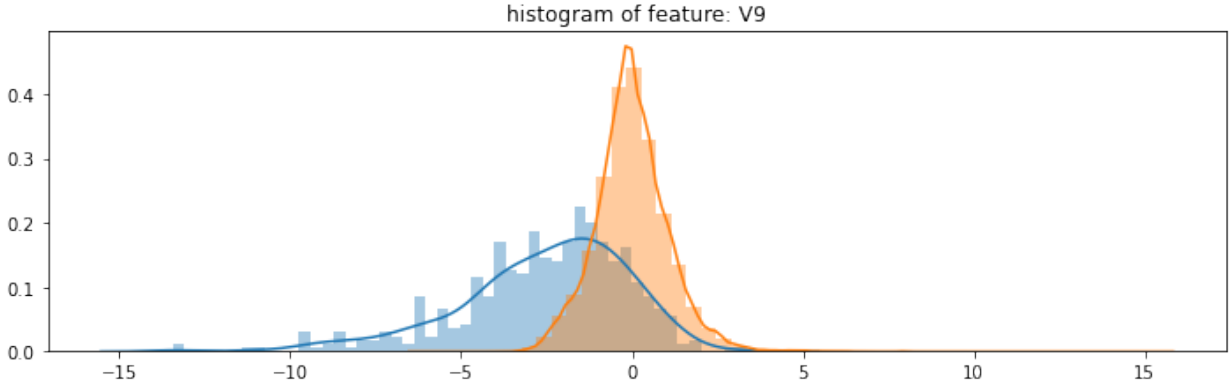
histogram of feature: V7



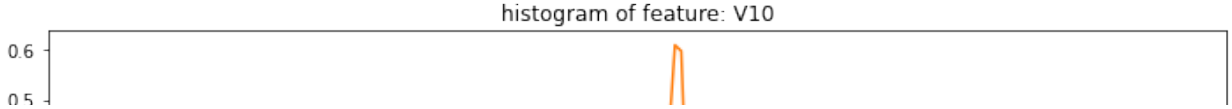
histogram of feature: V8

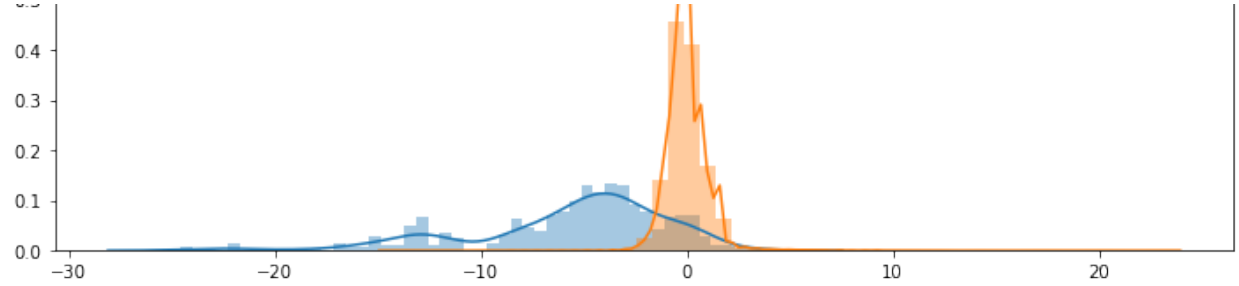


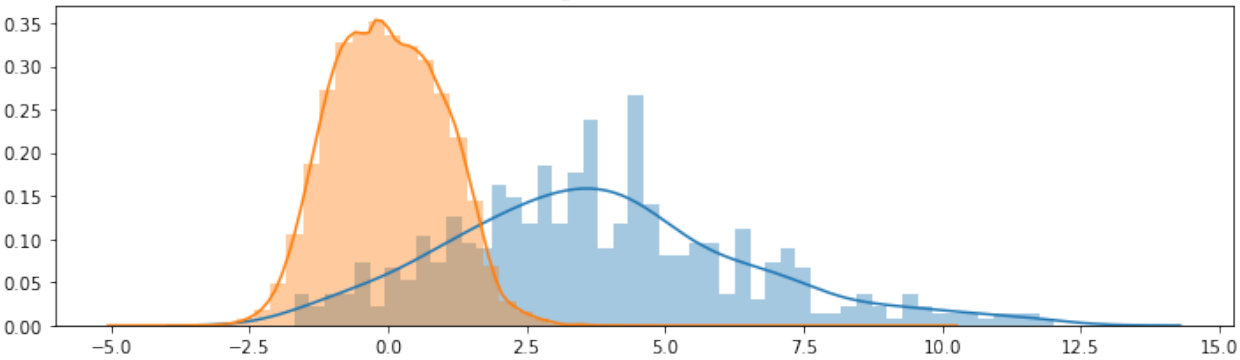
histogram of feature: V9

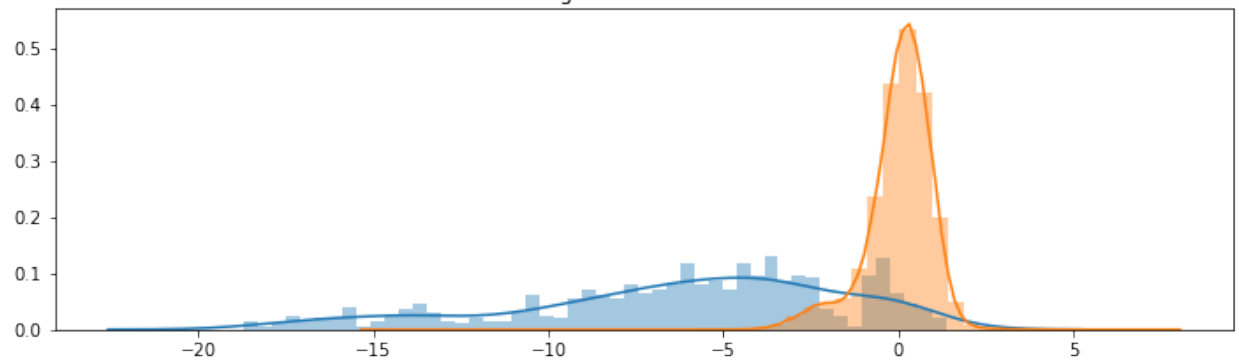


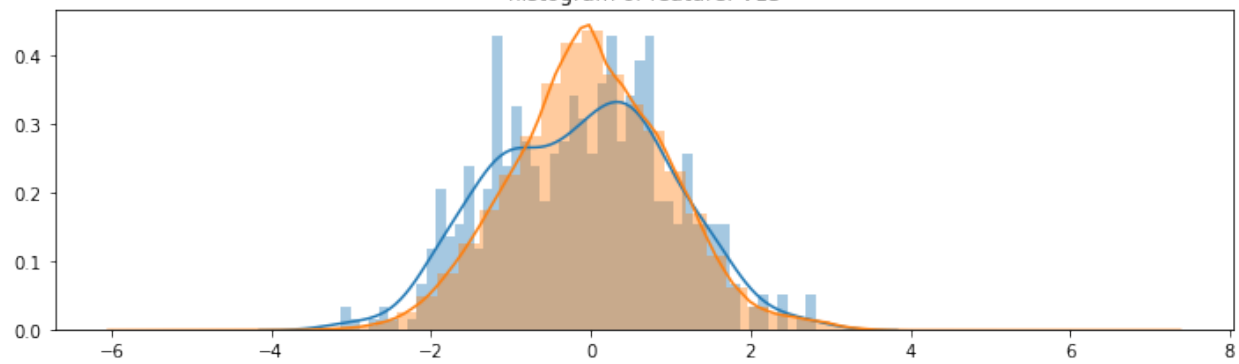
histogram of feature: V10

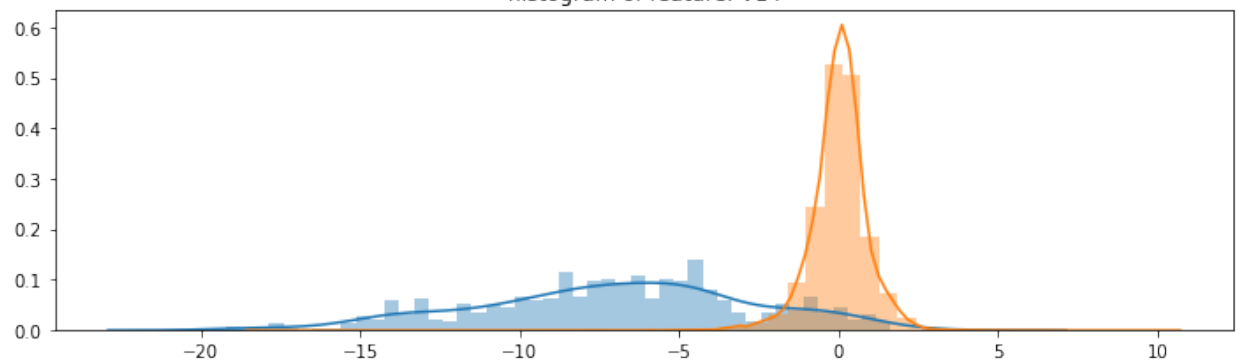


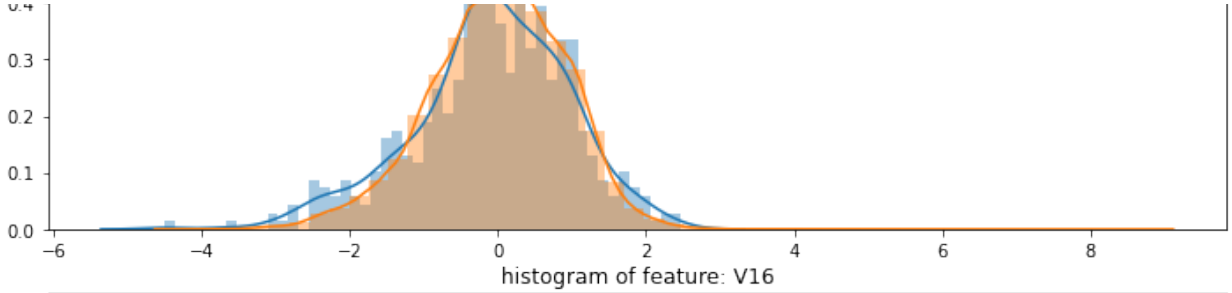

histogram of feature: V11


histogram of feature: V12

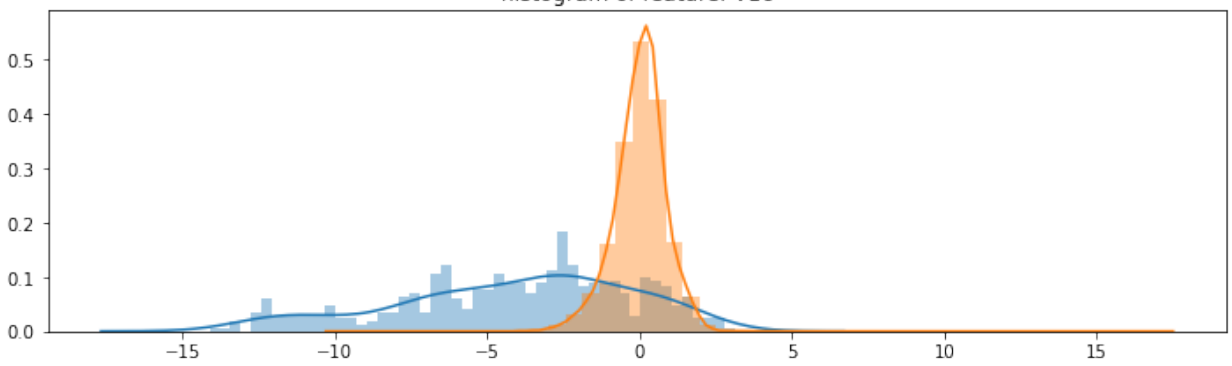

histogram of feature: V13


histogram of feature: V14

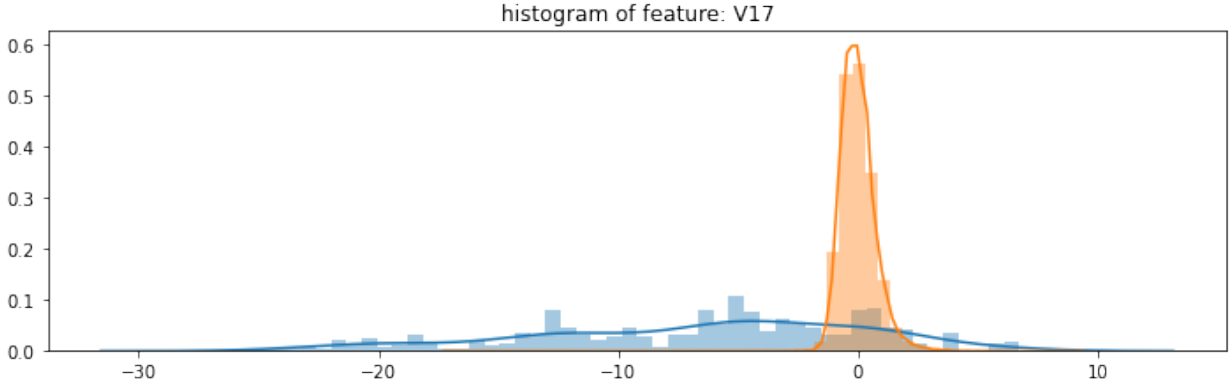

histogram of feature: V15



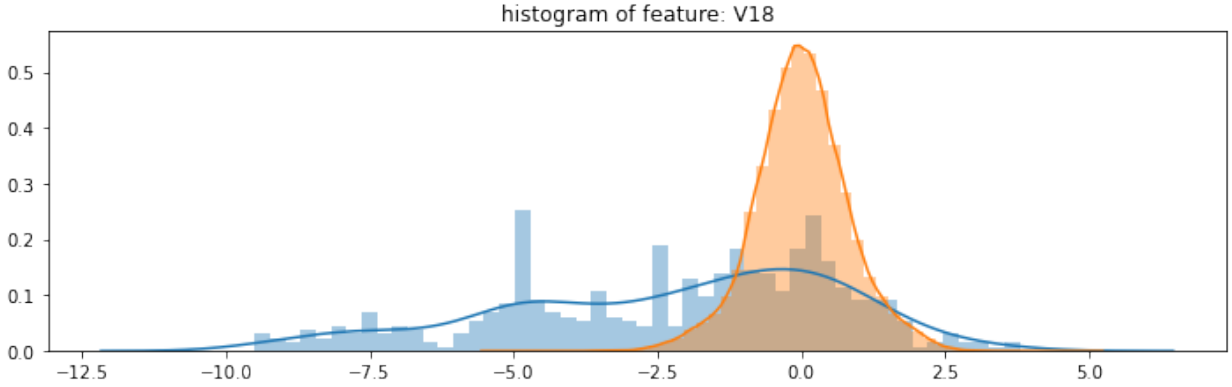
histogram of feature: V16



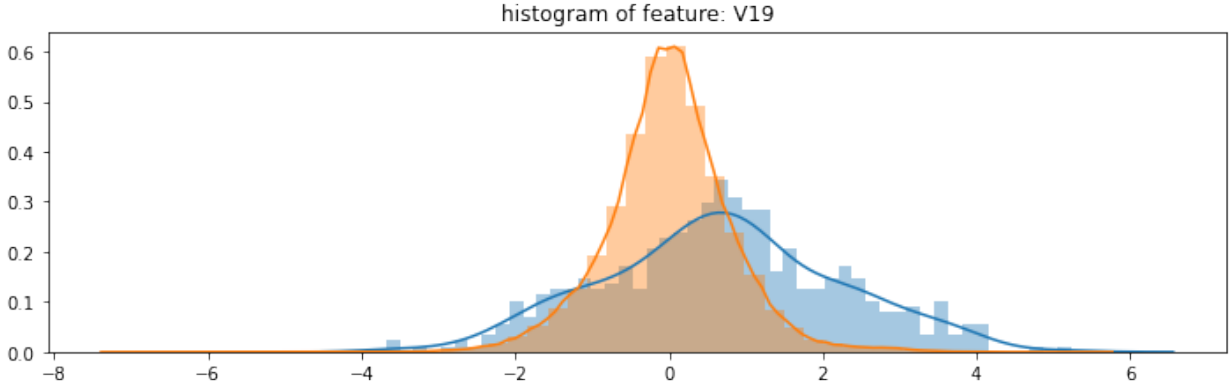
histogram of feature: V17



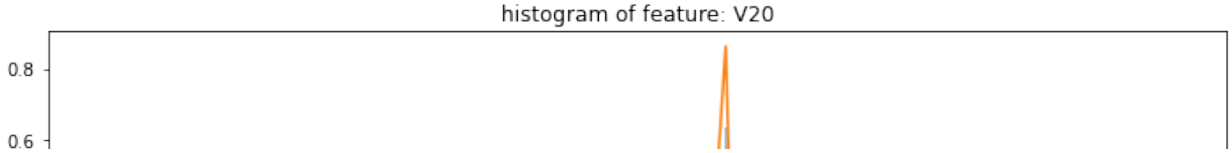
histogram of feature: V18

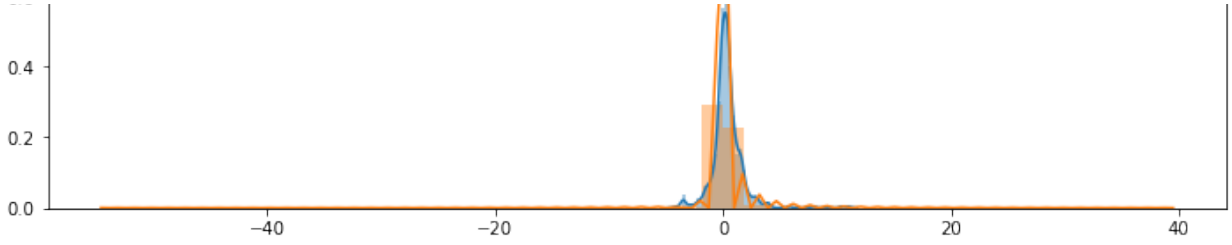


histogram of feature: V19

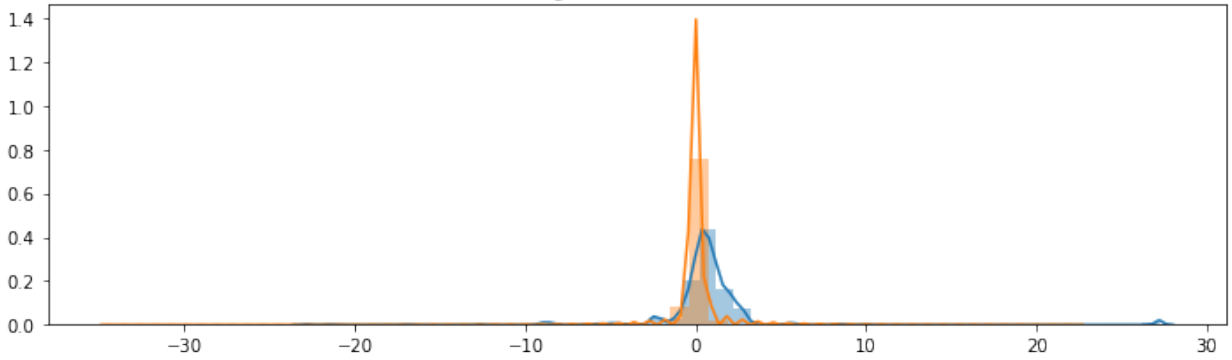


histogram of feature: V20

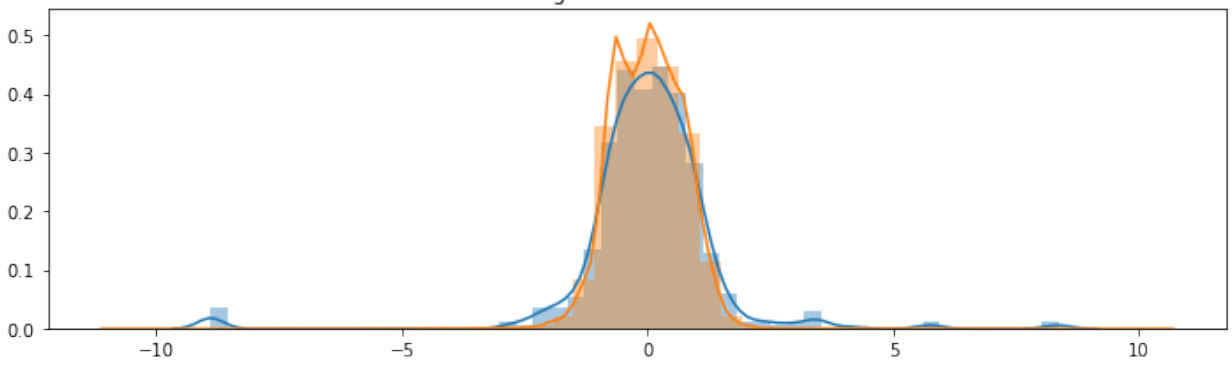




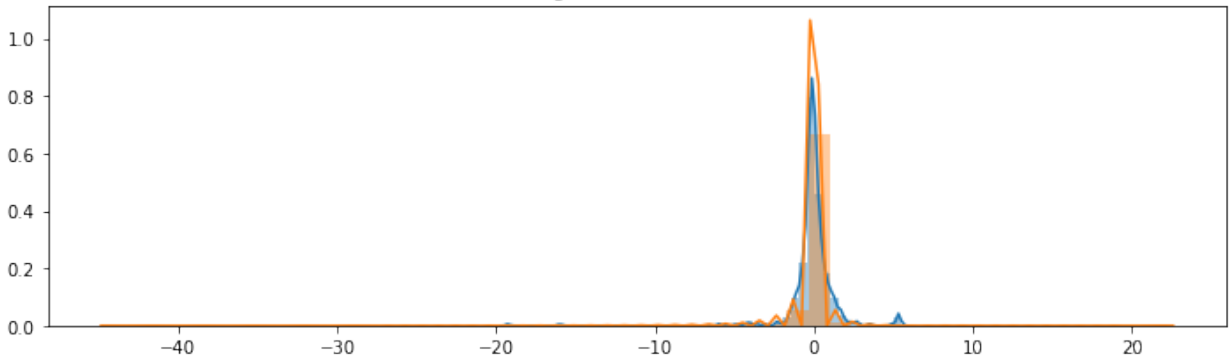
histogram of feature: V21



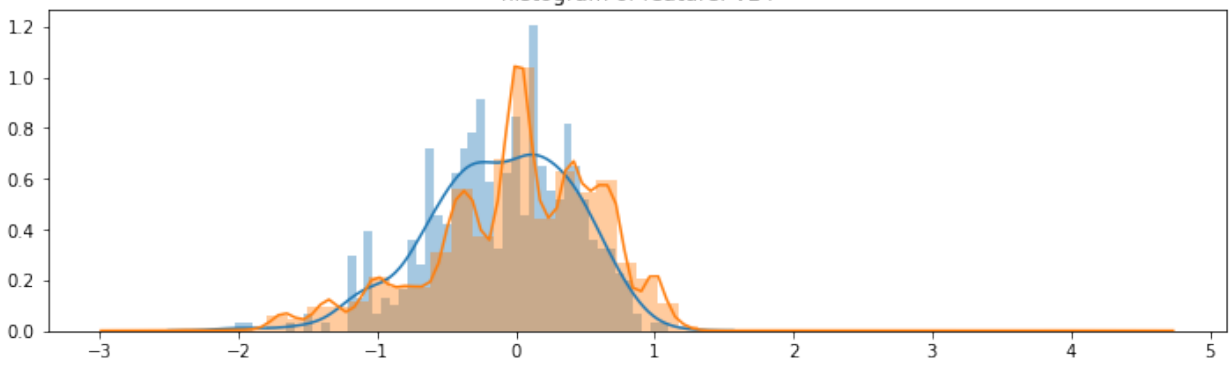
histogram of feature: V22



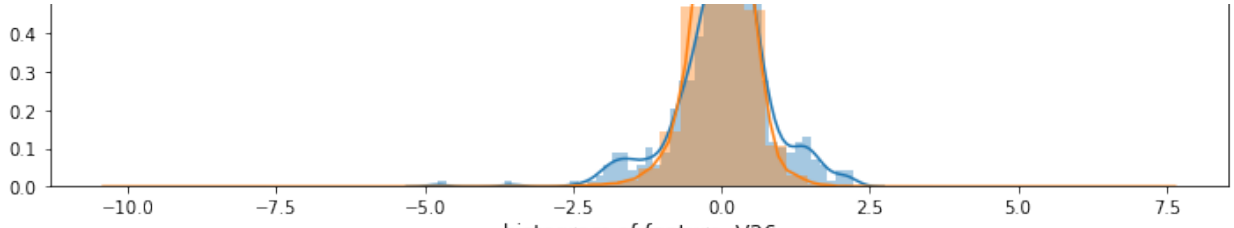
histogram of feature: V23



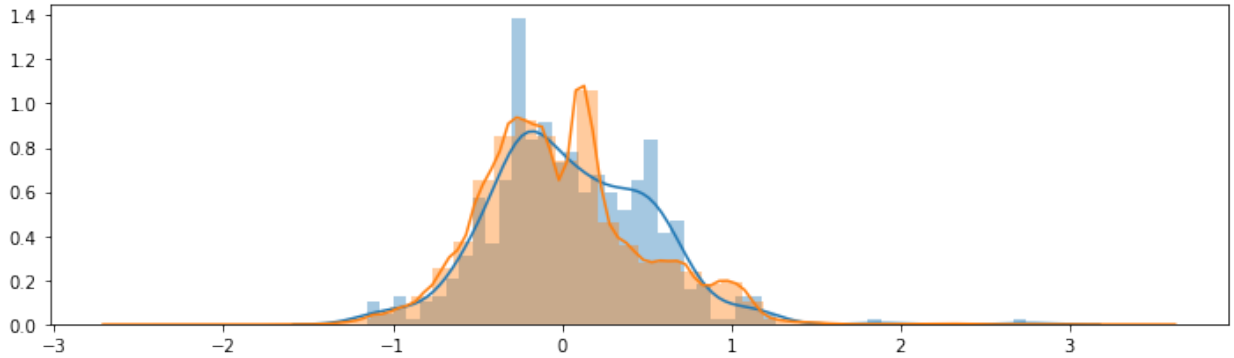
histogram of feature: V24



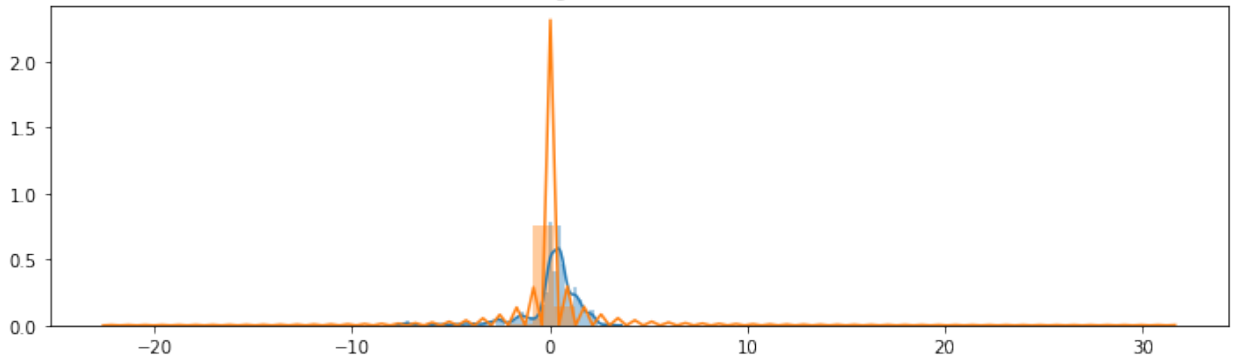
histogram of feature: V25



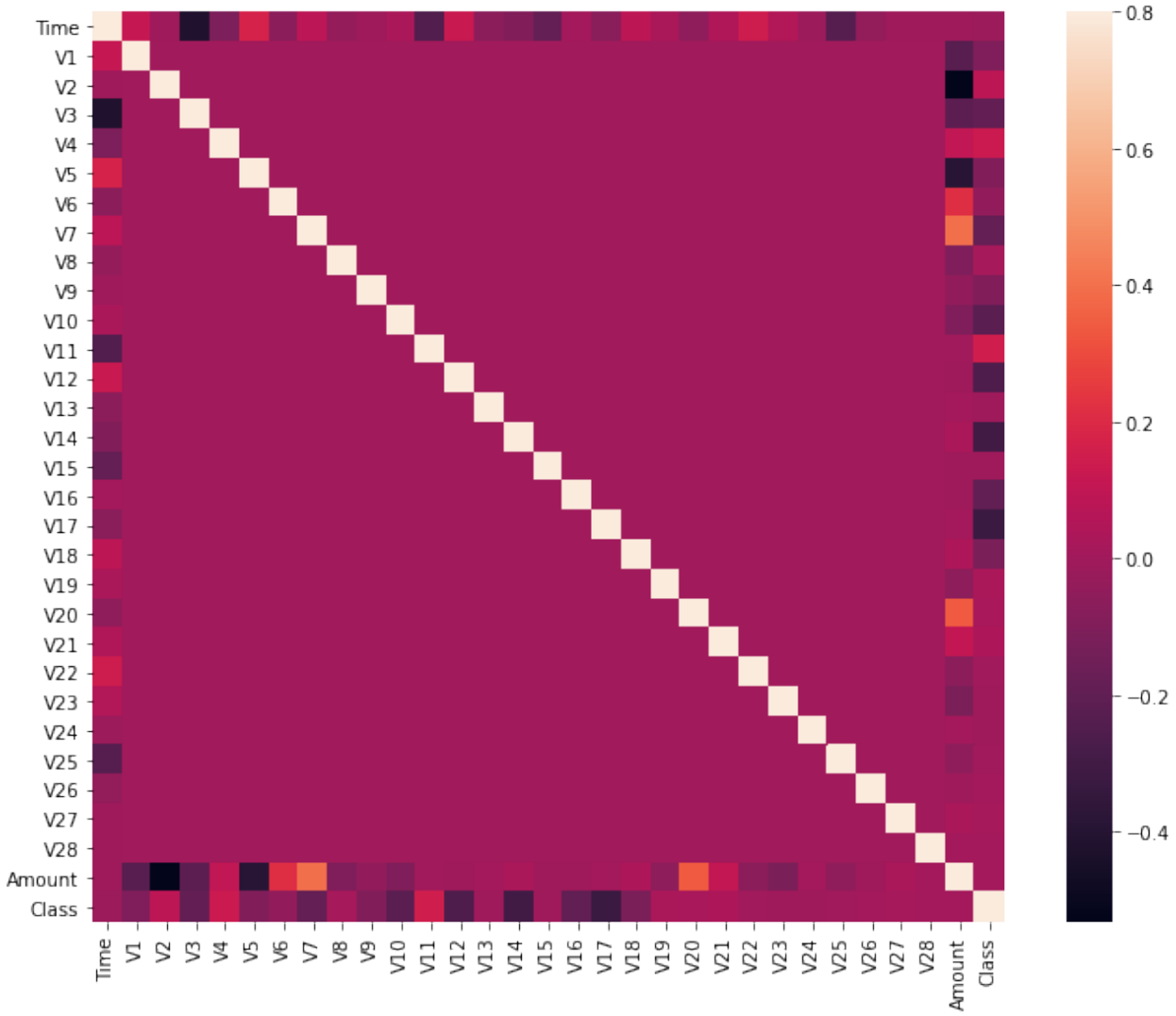
histogram of feature: V26



histogram of feature: V27



In [37]:
```
corrmat = df.corr()
fig = plt.figure(figsize = (12, 9))
sns.heatmap(corrmat, vmax = .8, square = True)
plt.show()
```



In [38]:
```
X = df.drop(['Class'], axis = 1)
Y = df["Class"]
print(X.shape)
print(Y.shape)
xdf = X.values
ydf = Y.values
```

```
(284807, 30)
(284807,)
```

In [39]:
```
from sklearn.model_selection import train_test_split
X_train, X_test, Y_train, Y_test = train_test_split(xdf, ydf, test_size =
0.2, random_state = 42)
```

In [40]:
```
from sklearn.metrics import classification_report, accuracy_score
from sklearn.metrics import precision_score, recall_score
from sklearn.metrics import f1_score, matthews_corrcoef
from sklearn.metrics import confusion_matrix
```

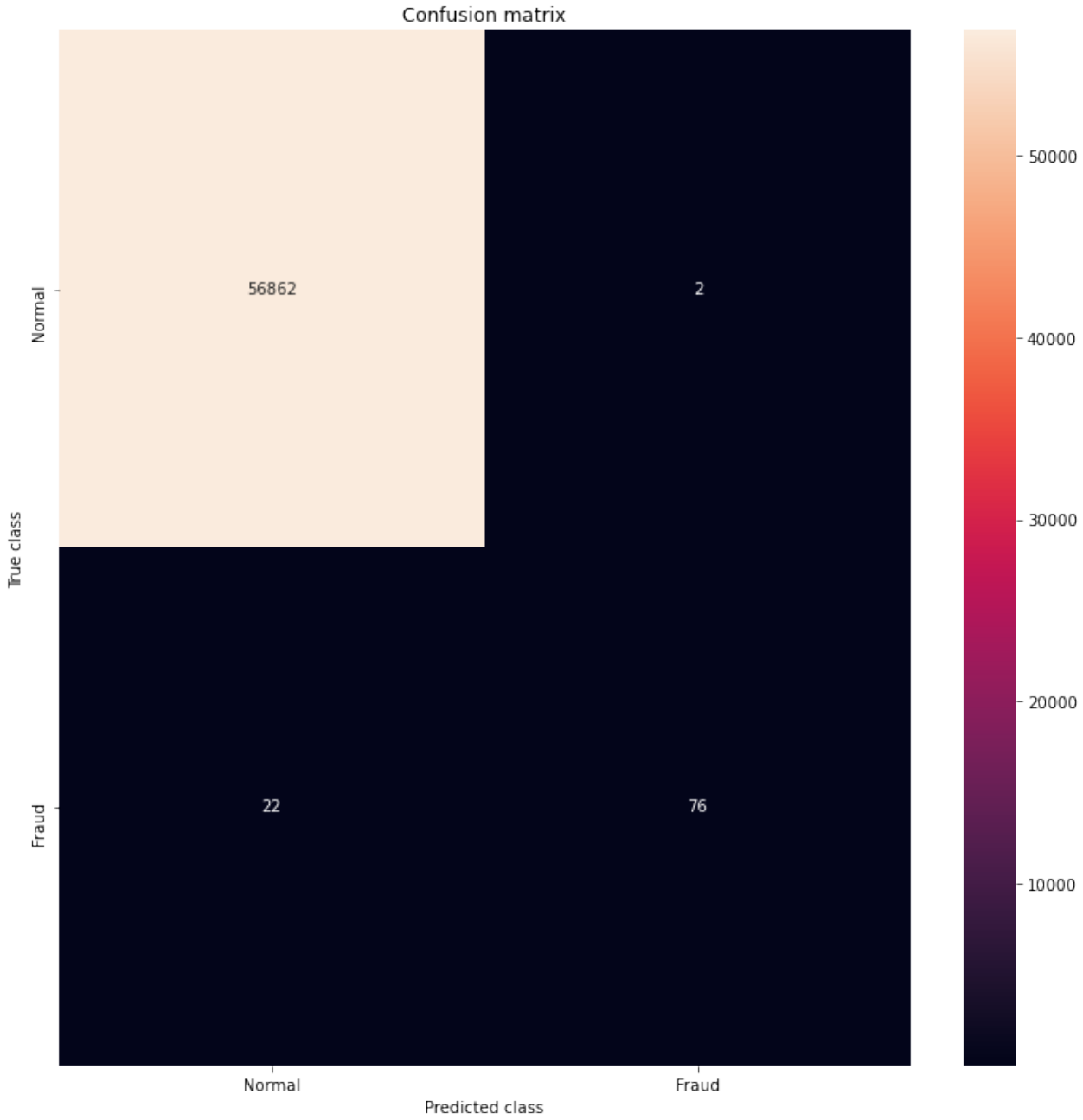
In [41]:
```
from sklearn.ensemble import RandomForestClassifier
rfc = RandomForestClassifier()
rfc.fit(X_train, Y_train)
```

```
Y_pred = rfc.predict(X_test)
```

In [42]:
```
n_outliers = len(fraud)
n_errors = (Y_pred != Y_test).sum()
print("The model used is Random Forest classifier")

acc = accuracy_score(Y_test, Y_pred)
print("The accuracy is {}".format(acc))

prec = precision_score(Y_test, Y_pred)
print("The precision is {}".format(prec))

rec = recall_score(Y_test, Y_pred)
print("The recall is {}".format(rec))

f1 = f1_score(Y_test, Y_pred)
print("The F1-Score is {}".format(f1))

MCC = matthews_corrcoef(Y_test, Y_pred)
print("The Matthews correlation coefficient is{}".format(MCC))
```

```
The model used is Random Forest classifier
The accuracy is 0.9995786664794073
The precision is 0.9743589743589743
The recall is 0.7755102040816326
The F1-Score is 0.8636363636363635
The Matthews correlation coefficient is0.8690748763736589
```

In [69]:
```
LABELS = ['Normal', 'Fraud']
conf_matrix = confusion_matrix(Y_test, Y_pred)
plt.figure(figsize =(12, 12))
sns.heatmap(conf_matrix, xticklabels = LABELS,
            yticklabels = LABELS, annot = True, fmt ="d");
plt.title("Confusion matrix")
plt.ylabel('True class')
plt.xlabel('Predicted class')
plt.show()
```

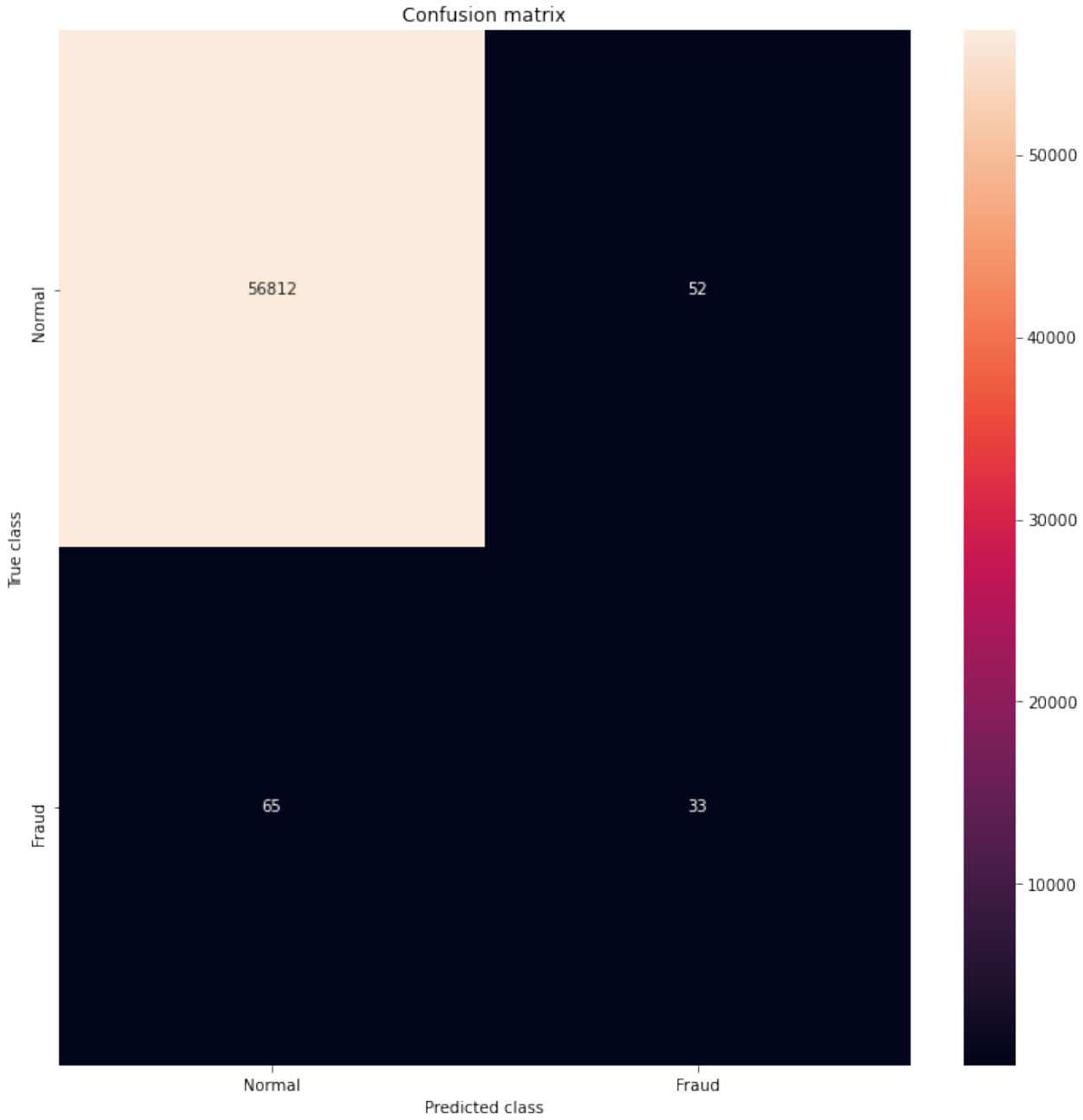


In [65]:
```
from sklearn.ensemble import IsolationForest
ifc=IsolationForest(max_samples=len(X_train),
                    contamination=outlier_fraction,random_state=1)
ifc.fit(X_train)
scores_pred = ifc.decision_function(X_train)
y_pred = ifc.predict(X_test)

y_pred[y_pred == 1] = 0
y_pred[y_pred == -1] = 1

n_errors = (y_pred != Y_test).sum()
```

In [67]:
```
n_outliers = len(fraud)
print("the Model used is {}".format("Isolation Forest"))
acc= accuracy_score(Y_test,y_pred)
print("The accuracy is  {}".format(acc))
prec= precision_score(Y_test,y_pred)
```

```
print("The precision is {}".format(prec))
rec= recall_score(Y_test,y_pred)
print("The recall is {}".format(rec))
f1= f1_score(Y_test,y_pred)
print("The F1-Score is {}".format(f1))
MCC=matthews_corrcoef(Y_test,y_pred)
print("The Matthews correlation coefficient is{}".format(MCC))

LABELS = ['Normal', 'Fraud']
conf_matrix = confusion_matrix(Y_test, y_pred)
plt.figure(figsize=(12, 12))
sns.heatmap(conf_matrix, xticklabels=LABELS,
            yticklabels=LABELS, annot=True, fmt="d");
plt.title("Confusion matrix")
plt.ylabel('True class')
plt.xlabel('Predicted class')
plt.show()
```

```
the Model used is Isolation Forest
The accuracy is  0.9979459990871107
The precision is 0.38823529411764707
The recall is 0.336734693877551
The F1-Score is 0.36065573770491804
The Matthews correlation coefficient is0.3605460930519415
```


Confusion matrix
56812
52
65
33
Normal
Fraud
True class
Normal
Fraud
Predicted class
50000
40000
30000
20000
10000

In [ ]: