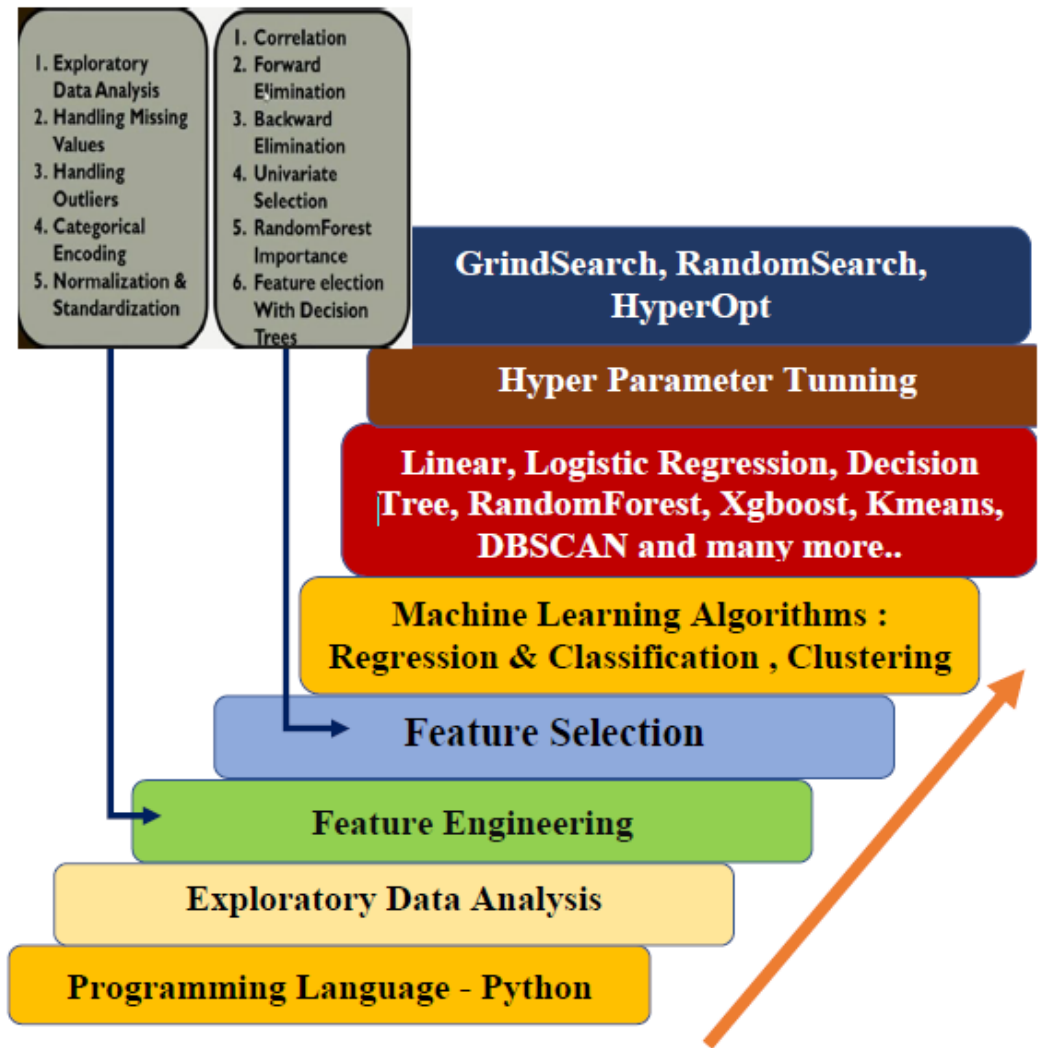


Problem Statement:

Parkinson's Disease (PD) classification  
Features are extracted from speech recordings of Parkinson's Disease patients

<https://www.kaggle.com/dipayanbiswas/parkinsons-disease-speech-signal-features/code>

Flow Chart To Build End to End ML Model



Step 1 - Exploratory Data Analysis (EDA)

In [1]:

```
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
from sklearn import svm
from sklearn.metrics import accuracy_score
from sklearn.preprocessing import StandardScaler
#from sklearn.neighbors import KNeighborsClassifier as knn
#from sklearn.linear_model import LogisticRegression as LGR,Lasso
from sklearn.ensemble import RandomForestClassifier
from sklearn.model_selection import train_test_split
from sklearn import metrics
# Import the RFE from sklearn library
from sklearn.feature_selection import RFE,SelectFromModel
from sklearn.neighbors import KNeighborsClassifier
from sklearn.metrics import confusion_matrix
from sklearn.metrics import f1_score
import math
```

C:\Users\Lenovo\Anaconda3\lib\site-packages\statsmodels\tools\\_testing.py:19: FutureWarning: pandas.util.testing is deprecated. Use the functions in the public API at pandas.testing instead.

```
import pandas.util.testing as tm
```

In [2]:

```
# loading the data from csv file to a Pandas DataFrame
parkinsons_data = pd.read_csv('pd_speech_features.csv')
```

In [3]:

```
# printing the first 5 rows of the dataframe
parkinsons_data.head()
```

Out[3]:

	id	gender	PPE	DFA	RPDE	numPulses	numPeriodsPulses	meanPeriodPulses	stdDevPeriodPulses	locPctJitter	...
0	0	1	0.85247	0.71826	0.57227	240	239	0.008064	0.000087	0.00218	...
1	0	1	0.76686	0.69481	0.53966	234	233	0.008258	0.000073	0.00195	...
2	0	1	0.85083	0.67604	0.58982	232	231	0.008340	0.000060	0.00176	...
3	1	0	0.41121	0.79672	0.59257	178	177	0.010858	0.000183	0.00419	...
4	1	0	0.32790	0.79782	0.53028	236	235	0.008162	0.002669	0.00535	...

5 rows x 755 columns



In [4]:

```
# number of rows and columns in the dataframe
parkinsons_data.shape
```

Out[4]:

(756, 755)

In [5]:

```
# getting more information about the dataset
parkinsons_data.info()
```

<class 'pandas.core.frame.DataFrame'>  
RangeIndex: 756 entries, 0 to 755  
Columns: 755 entries, id to class  
dtypes: float64(749), int64(6)  
memory usage: 4.4 MB

## Handling Missing Values / Null Values (If Any)

In [6]:

```
# checking for missing values in each column
parkinsons_data.isnull().sum()
```

Out[6]:

```
id          0
gender      0
PPE         0
DFA         0
RPDE        0
...
tqwt_kurtosisValue_dec_33  0
tqwt_kurtosisValue_dec_34  0
tqwt_kurtosisValue_dec_35  0
tqwt_kurtosisValue_dec_36  0
class        0
Length: 755, dtype: int64
```

## Getting Important Insights of Dataset

In [7]:

```
# getting some statistical measures about the data
parkinsons_data.describe()
```

Out[7]:

	id	gender	PPE	DFA	RPDE	numPulses	numPeriodsPulses	meanPeriodPulses	stdDevPeri
count	756.000000	756.000000	756.000000	756.000000	756.000000	756.000000	756.000000	756.000000	756.000000
mean	125.500000	0.515873	0.746284	0.700414	0.489058	323.972222	322.678571	0.006360	0.002107
std	72.793721	0.500079	0.169294	0.069718	0.137442	99.219059	99.402499	0.001826	0.005350
min	0.000000	0.000000	0.041551	0.543500	0.154300	2.000000	1.000000	0.002107	0.000000
25%	62.750000	0.000000	0.762833	0.647053	0.386537	251.000000	250.000000	0.005003	0.000000
50%	125.500000	1.000000	0.809655	0.700525	0.484355	317.000000	316.000000	0.006048	0.000000
75%	188.250000	1.000000	0.834315	0.754985	0.586515	384.250000	383.250000	0.007528	0.000000

max

251.000000

id

1.000000

gender

0.907669

PPE

0.852640

DFA

0.871499

RPDE

0.907800

numPulses

805.900000

numPeriodsPulses

805.900000

meanPeriodPulses

0.012866

stdDevPeriodPulses

0.000290

8 rows x 755 columns



```
In [8]:  
  
# Counting Number of Rows & Columns  
parkinsons_data.shape
```

Out[8]:

(756, 755)

```
In [9]:  
  
# distribution of target Variable  
parkinsons_data['class'].value_counts() # 1. Parkinson disease positive || 0. Healthy person
```

Out[9]:

1	564
0	192

Name: class, dtype: int64

```
In [10]:  
  
# grouping the data bas3ed on the target variable  
parkinsons_data.groupby('class').mean()
```

Out[10]:

	id	gender	PPE	DFA	RPDE	numPulses	numPeriodsPulses	meanPeriodPulses	stdDevPeriodPulses
class									
0	139.421875	0.359375	0.767434	0.663866	0.430807	372.244792	371.031250	0.005699	0.000290
1	120.760638	0.569149	0.739084	0.712856	0.508888	307.539007	306.218085	0.006585	0.000414

2 rows x 754 columns

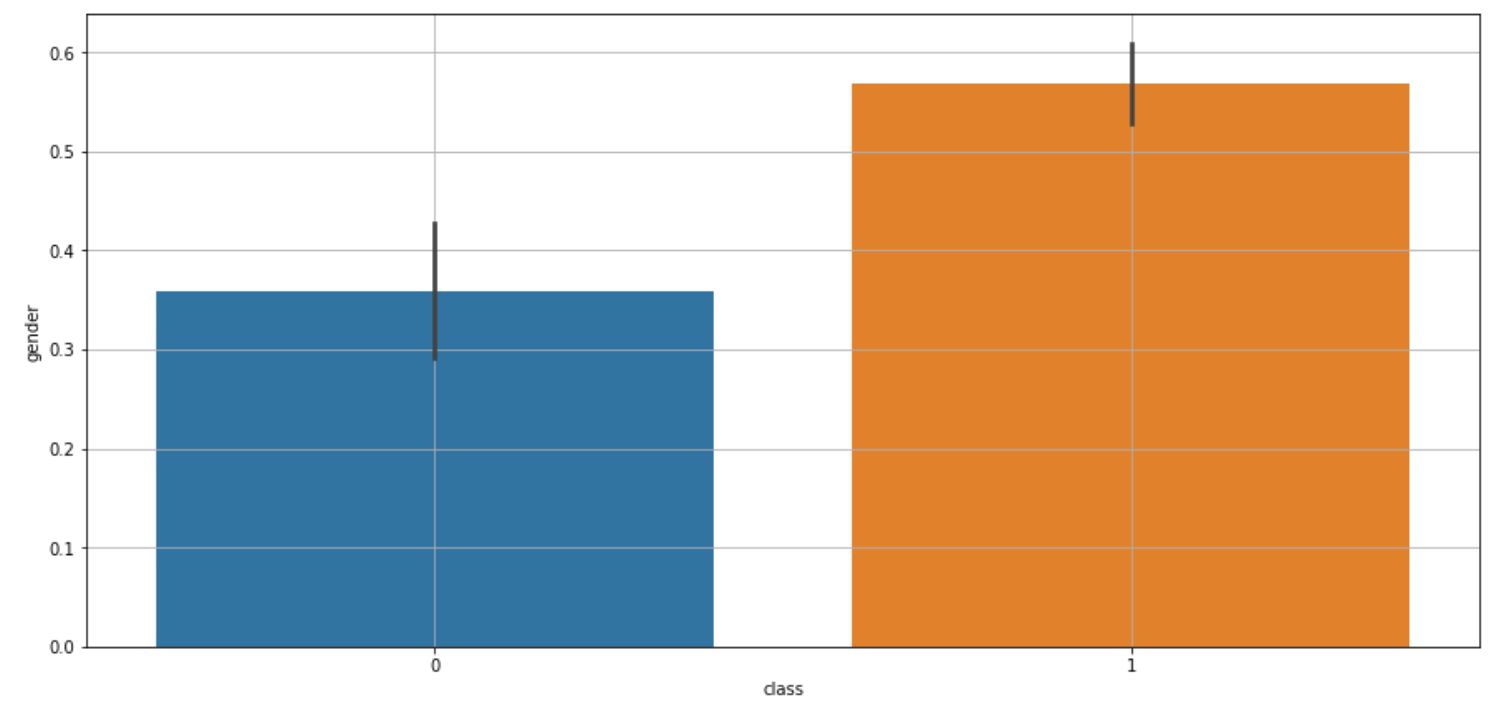


## Data Visualization

```
In [11]:  
  
from matplotlib import pyplot as plt  
%matplotlib inline  
import seaborn as sns
```

```
In [12]:  
  
plt.figure(figsize=(15,7))  
plt.suptitle('Featured Analysis of Male-Female Ratio wrt Parkinson Classes', fontsize=20)  
sns.barplot(x='class',y='gender',data=parkinsons_data)  
plt.grid()
```

Featured Analysis of Male-Female Ratio wrt Parkinson Classes

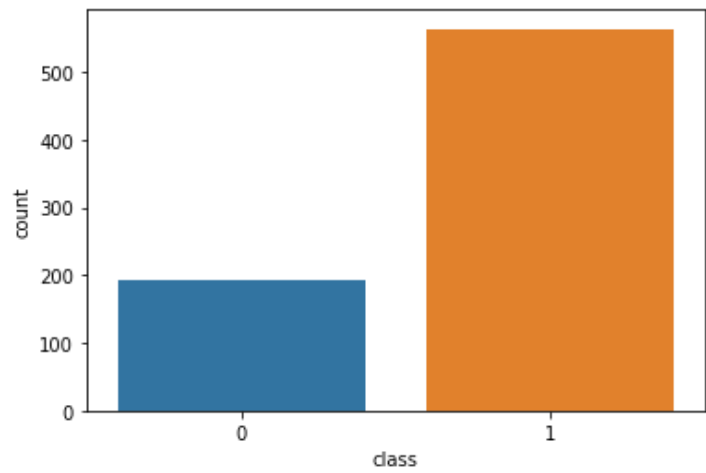


In [13]:

```
sns.countplot(x="class",data=parkinsons_data)
```

Out[13]:

<matplotlib.axes.\_subplots.AxesSubplot at 0x2121f98f3c8>

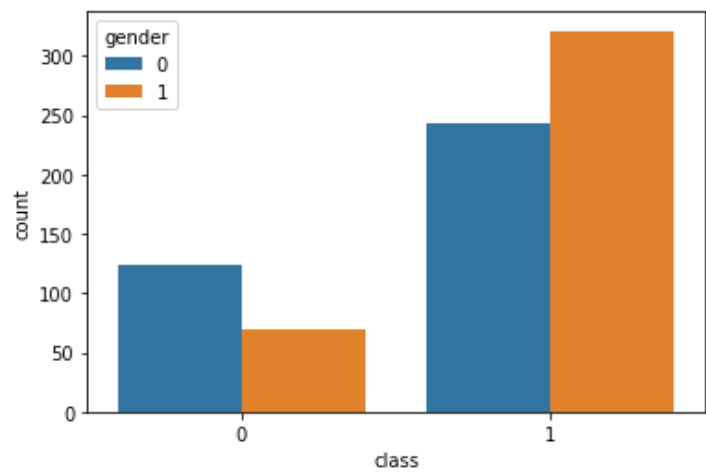


In [14]:

```
sns.countplot(x="class",hue="gender",data=parkinsons_data)
```

Out[14]:

<matplotlib.axes.\_subplots.AxesSubplot at 0x2121f948c08>



In [ ]:

```
import seaborn as sns
#Using Spearman Correlation
plt.figure(figsize=(20,20))
cor = parkinsons_data.corr('spearman')
sns.heatmap(cor, annot=True, cmap=plt.cm.CMRmap_r)
plt.show()
```

## Checking Multicollinearity in Model

In [11]:

```
import statsmodels.api as sm
x = parkinsons_data.drop(columns=['id','gender','class'], axis=1)
y = parkinsons_data['class']
```

In [17]:

```
X = sm.add_constant(x)
```

In [18]:

```
model = sm.OLS(y,X).fit() # Ordinary Least Square Method
```

In [19]:

```
model.summary()
```

Out[19]:

### OLS Regression Results

Dep. Variable:	class	R-squared:	0.960
Model:	OLS	Adj. R-squared:	0.882
Method:	Least Squares	F-statistic:	12.28

Method:	Least Squares	F-statistic:	12.20
Date:	Tue, 16 Nov 2021	Prob (F-statistic):	1.95e-80
Time:	23:29:54	Log-Likelihood:	771.76
No. Observations:	756	AIC:	-543.5
Df Residuals:	256	BIC:	1771.
Df Model:	499		
Covariance Type:	nonrobust		

	coef	std err	t	P> t	[0.025	0.975]
const	0.1237	0.060	2.071	0.039	0.006	0.241
PPE	0.8045	0.369	2.178	0.030	0.077	1.532
DFA	2.2594	1.437	1.572	0.117	-0.571	5.089
RPDE	-0.8080	0.393	-2.054	0.041	-1.583	-0.033
numPulses	0.0361	0.052	0.697	0.486	-0.066	0.138
numPeriodsPulses	-0.0377	0.051	-0.733	0.464	-0.139	0.064
meanPeriodPulses	-71.1707	73.111	-0.973	0.331	-215.147	72.805
stdDevPeriodPulses	-93.5991	61.479	-1.522	0.129	-214.668	27.470
locPctJitter	19.0231	66.914	0.284	0.776	-112.750	150.796
locAbsJitter	-10.8258	3.663	-2.955	0.003	-18.039	-3.612
rapJitter	10.7443	23.674	0.454	0.650	-35.876	57.364
ppq5Jitter	-37.1035	109.416	-0.339	0.735	-252.574	178.367
ddpJitter	-38.5382	69.362	-0.556	0.579	-175.130	98.054
locShimmer	-8.3342	11.226	-0.742	0.459	-30.441	13.772
locDbShimmer	1.4027	0.833	1.684	0.093	-0.238	3.043
apq3Shimmer	-0.6686	4.105	-0.163	0.871	-8.752	7.415
apq5Shimmer	10.0351	5.947	1.688	0.093	-1.676	21.746
apq11Shimmer	-4.1749	2.322	-1.798	0.073	-8.748	0.398
ddaShimmer	-3.9032	2.805	-1.391	0.165	-9.427	1.621
meanAutoCorrHarmonicity	0.3348	5.729	0.058	0.953	-10.947	11.616
meanNoiseToHarmHarmonicity	-0.5890	3.392	-0.174	0.862	-7.269	6.092
meanHarmToNoiseHarmonicity	-0.0208	0.014	-1.460	0.146	-0.049	0.007
minIntensity	0.0009	0.029	0.031	0.975	-0.057	0.059
maxIntensity	0.0795	0.042	1.886	0.060	-0.004	0.163
meanIntensity	-0.0901	0.043	-2.078	0.039	-0.175	-0.005
f1	0.0003	0.000	0.774	0.440	-0.001	0.001
f2	-0.0002	0.000	-0.629	0.530	-0.001	0.000
f3	-8.827e-06	9.93e-05	-0.089	0.929	-0.000	0.000
f4	-2.84e-05	9.77e-05	-0.291	0.772	-0.000	0.000
b1	-1.559e-05	7.08e-05	-0.220	0.826	-0.000	0.000
b2	-7.231e-05	4.57e-05	-1.583	0.115	-0.000	1.76e-05
b3	2.342e-05	2.22e-05	1.055	0.292	-2.03e-05	6.71e-05
b4	1.512e-05	2.76e-05	0.547	0.585	-3.93e-05	6.96e-05
GQ_prc5_95	-0.1799	0.307	-0.586	0.558	-0.785	0.425
GQ_std_cycle_open	0.0001	0.001	0.097	0.923	-0.003	0.003
GQ_std_cycle_closed	-0.0059	0.008	-0.747	0.456	-0.021	0.010
GNE_mean	0.6693	0.165	4.060	0.000	0.345	0.994
GNE_std	-0.3753	0.320	-1.175	0.241	-1.005	0.254
GNE_SNR_TKEO	-2.0952	1.237	-1.694	0.091	-4.531	0.340
GNE_SNR_SEO	1.326e-07	7.85e-08	1.689	0.092	-2.2e-08	2.87e-07
GNE_NSR_TKEO	1.4928	1.028	1.452	0.148	-0.532	3.518
GNE_NSR_SEO	0.8435	0.348	2.421	0.016	0.157	1.530
VFER_mean	325.6604	108.007	3.015	0.003	112.965	538.355
VFER_std	-14.0969	18.495	-0.762	0.447	-50.519	22.325
VFER_entropy	-0.1473	0.045	-3.272	0.001	-0.236	-0.059
VFER_SNR_TKEO	-0.0002	0.000	-1.004	0.316	-0.001	0.000

VFER_SNR_SEO	7.478e-05	9.82e-05	0.761	0.447	-0.000	0.000
VFER_NSR_TKEO	-0.0746	0.627	-0.119	0.905	-1.309	1.160
VFER_NSR_SEO	-0.0737	0.465	-0.158	0.874	-0.989	0.842
IMF_SNR_SEO	0.0007	0.000	1.964	0.051	-1.97e-06	0.001
IMF_SNR_TKEO	0.0122	0.017	0.732	0.465	-0.021	0.045
IMF_SNR_entropy	-0.0005	0.007	-0.066	0.947	-0.014	0.013
IMF_NSR_SEO	-5.3912	2.386	-2.260	0.025	-10.090	-0.693
IMF_NSR_TKEO	-0.0039	0.002	-1.614	0.108	-0.009	0.001
IMF_NSR_entropy	8.0824	4.273	1.892	0.060	-0.332	16.497
mean_Log_energy	0.1676	0.145	1.158	0.248	-0.117	0.452
mean_MFCC_0th_coef	-0.0979	0.038	-2.581	0.010	-0.173	-0.023
mean_MFCC_1st_coef	-0.1401	0.059	-2.388	0.018	-0.256	-0.025
mean_MFCC_2nd_coef	-0.0978	0.057	-1.726	0.086	-0.209	0.014
mean_MFCC_3rd_coef	-0.0054	0.046	-0.117	0.907	-0.096	0.086
mean_MFCC_4th_coef	-0.1357	0.061	-2.230	0.027	-0.255	-0.016
mean_MFCC_5th_coef	-0.0697	0.068	-1.026	0.306	-0.203	0.064
mean_MFCC_6th_coef	-0.2019	0.059	-3.397	0.001	-0.319	-0.085
mean_MFCC_7th_coef	0.0926	0.072	1.280	0.202	-0.050	0.235
mean_MFCC_8th_coef	-0.0546	0.049	-1.117	0.265	-0.151	0.042
mean_MFCC_9th_coef	-0.0474	0.054	-0.881	0.379	-0.153	0.059
mean_MFCC_10th_coef	-0.0936	0.071	-1.317	0.189	-0.234	0.046
mean_MFCC_11th_coef	0.1346	0.072	1.862	0.064	-0.008	0.277
mean_MFCC_12th_coef	0.0739	0.059	1.253	0.211	-0.042	0.190
mean_delta_log_energy	-9.1799	12.057	-0.761	0.447	-32.923	14.563
mean_0th_delta	7.7978	4.347	1.794	0.074	-0.763	16.359
mean_1st_delta	5.4671	5.971	0.916	0.361	-6.292	17.226
mean_2nd_delta	-5.0909	4.928	-1.033	0.303	-14.796	4.614
mean_3rd_delta	3.8998	5.066	0.770	0.442	-6.077	13.877
mean_4th_delta	-13.1053	6.028	-2.174	0.031	-24.975	-1.235
mean_5th_delta	-0.8362	6.060	-0.138	0.890	-12.770	11.097
mean_6th_delta	0.5700	5.940	0.096	0.924	-11.128	12.268
mean_7th_delta	-6.3491	6.943	-0.914	0.361	-20.022	7.323
mean_8th_delta	-3.5691	7.063	-0.505	0.614	-17.479	10.341
mean_9th_delta	16.6381	7.773	2.141	0.033	1.331	31.945
mean_10th_delta	25.8226	6.818	3.787	0.000	12.396	39.249
mean_11th_delta	-0.0802	6.918	-0.012	0.991	-13.703	13.543
mean_12th_delta	9.2214	7.925	1.164	0.246	-6.385	24.828
mean_delta_delta_log_energy	475.4791	116.684	4.075	0.000	245.696	705.263
mean_delta_delta_0th	-104.2913	41.016	-2.543	0.012	-185.064	-23.519
mean_1st_delta_delta	-93.1719	52.292	-1.782	0.076	-196.150	9.806
mean_2nd_delta_delta	-73.2387	44.738	-1.637	0.103	-161.340	14.863
mean_3rd_delta_delta	63.1185	44.550	1.417	0.158	-24.612	150.849
mean_4th_delta_delta	-17.8828	49.817	-0.359	0.720	-115.986	80.221
mean_5th_delta_delta	102.4731	54.130	1.893	0.059	-4.123	209.070
mean_6th_delta_delta	123.8179	51.039	2.426	0.016	23.308	224.327
mean_7th_delta_delta	-32.9493	53.725	-0.613	0.540	-138.749	72.850
mean_8th_delta_delta	157.2718	47.422	3.316	0.001	63.886	250.658
mean_9th_delta_delta	3.6471	54.783	0.067	0.947	-104.236	111.530
mean_10th_delta_delta	199.3396	56.126	3.552	0.000	88.812	309.867
mean_11th_delta_delta	-50.0479	61.517	-0.814	0.417	-171.192	71.096
mean_12th_delta_delta	-9.3241	66.959	-0.139	0.889	-141.185	122.537
std_Log_energy	-0.7805	0.545	-1.431	0.154	-1.855	0.294
std_MFCC_0th_coef	0.1729	0.125	1.386	0.167	-0.073	0.419
std_MFCC_1st_coef	-0.4003	0.251	-1.598	0.111	-0.894	0.093

std_MFCC_2nd_coef	-0.4398	0.242	-1.816	0.071	-0.917	0.037
std_MFCC_3rd_coef	-0.8046	0.304	-2.647	0.009	-1.403	-0.206
std_MFCC_4th_coef	-1.1114	0.295	-3.764	0.000	-1.693	-0.530
std_MFCC_5th_coef	0.9757	0.327	2.982	0.003	0.331	1.620
std_MFCC_6th_coef	0.1084	0.340	0.319	0.750	-0.561	0.777
std_MFCC_7th_coef	-1.8114	0.466	-3.885	0.000	-2.730	-0.893
std_MFCC_8th_coef	1.1161	0.418	2.667	0.008	0.292	1.940
std_MFCC_9th_coef	0.6470	0.485	1.335	0.183	-0.308	1.602
std_MFCC_10th_coef	-0.3730	0.426	-0.875	0.382	-1.212	0.466
std_MFCC_11th_coef	-0.7464	0.489	-1.527	0.128	-1.709	0.216
std_MFCC_12th_coef	-1.4633	0.560	-2.613	0.010	-2.566	-0.361
std_delta_log_energy	-1.6174	5.901	-0.274	0.784	-13.237	10.002
std_0th_delta	-2.5235	2.502	-1.009	0.314	-7.450	2.403
std_1st_delta	0.8592	3.717	0.231	0.817	-6.460	8.179
std_2nd_delta	10.6429	3.915	2.719	0.007	2.933	18.352
std_3rd_delta	-4.6545	5.767	-0.807	0.420	-16.012	6.703
std_4th_delta	16.6964	5.179	3.224	0.001	6.498	26.895
std_5th_delta	5.6902	5.190	1.096	0.274	-4.530	15.911
std_6th_delta	19.0107	6.041	3.147	0.002	7.115	30.906
std_7th_delta	-9.4151	6.189	-1.521	0.129	-21.602	2.772
std_8th_delta	-4.8035	6.841	-0.702	0.483	-18.275	8.669
std_9th_delta	-5.4657	6.357	-0.860	0.391	-17.985	7.054
std_10th_delta	22.0452	7.063	3.121	0.002	8.136	35.954
std_11th_delta	11.3432	7.185	1.579	0.116	-2.806	25.492
std_12th_delta	-6.9086	8.063	-0.857	0.392	-22.786	8.969
std_delta_delta_log_energy	17.3866	13.266	1.311	0.191	-8.739	43.512
std_delta_delta_0th	12.2897	5.213	2.358	0.019	2.025	22.555
std_1st_delta_delta	-4.5814	7.389	-0.620	0.536	-19.132	9.969
std_2nd_delta_delta	-23.2387	7.647	-3.039	0.003	-38.298	-8.180
std_3rd_delta_delta	17.1025	11.678	1.464	0.144	-5.895	40.100
std_4th_delta_delta	-14.1813	11.948	-1.187	0.236	-37.709	9.347
std_5th_delta_delta	-33.7238	12.313	-2.739	0.007	-57.971	-9.476
std_6th_delta_delta	-26.5976	15.334	-1.735	0.084	-56.794	3.599
std_7th_delta_delta	47.0688	14.116	3.335	0.001	19.271	74.866
std_8th_delta_delta	-3.2605	15.630	-0.209	0.835	-34.041	27.520
std_9th_delta_delta	8.8287	14.120	0.625	0.532	-18.977	36.634
std_10th_delta_delta	-59.9746	17.818	-3.366	0.001	-95.062	-24.887
std_11th_delta_delta	-13.7591	15.242	-0.903	0.368	-43.775	16.257
std_12th_delta_delta	23.7329	19.033	1.247	0.214	-13.749	61.214
Ea	10.2473	17.859	0.574	0.567	-24.922	45.417
Ed_1_coef	-474.1156	184.527	-2.569	0.011	-837.500	-110.731
Ed_2_coef	329.2559	222.268	1.481	0.140	-108.451	766.963
Ed_3_coef	128.7040	175.333	0.734	0.464	-216.574	473.982
Ed_4_coef	111.8013	118.373	0.944	0.346	-121.308	344.911
Ed_5_coef	-53.7821	100.984	-0.533	0.595	-252.647	145.082
Ed_6_coef	-67.0515	105.910	-0.633	0.527	-275.617	141.514
Ed_7_coef	131.2318	103.947	1.262	0.208	-73.469	335.932
Ed_8_coef	-17.1140	49.450	-0.346	0.730	-114.494	80.266
Ed_9_coef	272.2329	164.445	1.655	0.099	-51.604	596.070
Ed_10_coef	-57.8537	31.364	-1.845	0.066	-119.619	3.911
det_entropy_shannon_1_coef	-7.442e-06	1.52e-05	-0.491	0.624	-3.73e-05	2.24e-05
det_entropy_shannon_2_coef	1.758e-05	1.03e-05	1.710	0.088	-2.66e-06	3.78e-05
det_entropy_shannon_3_coef	6.817e-07	8.47e-06	0.080	0.936	-1.6e-05	1.74e-05
det_entropy_shannon_4_coef	-1.474e-06	3.29e-06	-0.448	0.655	-7.96e-06	5.01e-06

det_entropy_shannon_5_coef	-3.469e-06	3.78e-06	-0.917	0.360	-1.09e-05	3.98e-06
det_entropy_shannon_6_coef	7.925e-06	4.61e-06	1.719	0.087	-1.15e-06	1.7e-05
det_entropy_shannon_7_coef	1.437e-05	1.02e-05	1.413	0.159	-5.66e-06	3.44e-05
det_entropy_shannon_8_coef	2.6e-06	3.57e-06	0.729	0.467	-4.42e-06	9.62e-06
det_entropy_shannon_9_coef	1.403e-05	1.82e-05	0.769	0.442	-2.19e-05	4.99e-05
det_entropy_shannon_10_coef	-2.29e-06	2.12e-06	-1.082	0.280	-6.46e-06	1.88e-06
det_entropy_log_1_coef	-0.0042	0.008	-0.533	0.594	-0.020	0.011
det_entropy_log_2_coef	0.0005	0.008	0.067	0.947	-0.015	0.017
det_entropy_log_3_coef	-0.0193	0.008	-2.422	0.016	-0.035	-0.004
det_entropy_log_4_coef	0.0416	0.013	3.223	0.001	0.016	0.067
det_entropy_log_5_coef	0.0144	0.017	0.836	0.404	-0.020	0.048
det_entropy_log_6_coef	-0.0105	0.014	-0.758	0.449	-0.038	0.017
det_entropy_log_7_coef	0.0193	0.013	1.524	0.129	-0.006	0.044
det_entropy_log_8_coef	-0.0421	0.015	-2.810	0.005	-0.072	-0.013
det_entropy_log_9_coef	-0.0193	0.018	-1.048	0.296	-0.056	0.017
det_entropy_log_10_coef	-0.0327	0.016	-2.093	0.037	-0.063	-0.002
det_TKEO_mean_1_coef	-0.0078	0.017	-0.466	0.642	-0.041	0.025
det_TKEO_mean_2_coef	0.0120	0.007	1.658	0.099	-0.002	0.026
det_TKEO_mean_3_coef	0.0016	0.004	0.374	0.709	-0.007	0.010
det_TKEO_mean_4_coef	-0.0010	0.002	-0.626	0.532	-0.004	0.002
det_TKEO_mean_5_coef	-0.0032	0.001	-3.577	0.000	-0.005	-0.001
det_TKEO_mean_6_coef	-0.0009	0.001	-1.242	0.215	-0.002	0.001
det_TKEO_mean_7_coef	-0.0015	0.002	-0.898	0.370	-0.005	0.002
det_TKEO_mean_8_coef	0.0011	0.001	1.430	0.154	-0.000	0.003
det_TKEO_mean_9_coef	-0.0167	0.005	-3.078	0.002	-0.027	-0.006
det_TKEO_mean_10_coef	0.0026	0.001	2.247	0.025	0.000	0.005
det_TKEO_std_1_coef	0.0022	0.002	1.384	0.168	-0.001	0.005
det_TKEO_std_2_coef	-0.0020	0.002	-1.205	0.229	-0.005	0.001
det_TKEO_std_3_coef	0.0012	0.001	1.115	0.266	-0.001	0.003
det_TKEO_std_4_coef	0.0001	0.000	0.234	0.816	-0.001	0.001
det_TKEO_std_5_coef	0.0009	0.000	2.278	0.024	0.000	0.002
det_TKEO_std_6_coef	-8.291e-05	0.000	-0.272	0.786	-0.001	0.001
det_TKEO_std_7_coef	0.0015	0.001	1.717	0.087	-0.000	0.003
det_TKEO_std_8_coef	-0.0006	0.000	-2.113	0.036	-0.001	-3.83e-05
det_TKEO_std_9_coef	0.0034	0.001	2.694	0.008	0.001	0.006
det_TKEO_std_10_coef	-0.0012	0.000	-2.539	0.012	-0.002	-0.000
app_entropy_shannon_1_coef	-4.094e-06	2.34e-06	-1.751	0.081	-8.7e-06	5.1e-07
app_entropy_shannon_2_coef	6.981e-06	5.75e-06	1.213	0.226	-4.35e-06	1.83e-05
app_entropy_shannon_3_coef	-7.867e-07	6.36e-06	-0.124	0.902	-1.33e-05	1.17e-05
app_entropy_shannon_4_coef	-1.057e-05	4.39e-06	-2.407	0.017	-1.92e-05	-1.92e-06
app_entropy_shannon_5_coef	1.115e-05	3.97e-06	2.808	0.005	3.33e-06	1.9e-05
app_entropy_shannon_6_coef	-2.833e-07	3.79e-06	-0.075	0.940	-7.74e-06	7.18e-06
app_entropy_shannon_7_coef	3.387e-06	3.23e-06	1.049	0.295	-2.97e-06	9.74e-06
app_entropy_shannon_8_coef	-2.837e-05	2.34e-05	-1.215	0.226	-7.44e-05	1.76e-05
app_entropy_shannon_9_coef	1.764e-05	2.09e-05	0.846	0.398	-2.34e-05	5.87e-05
app_entropy_shannon_10_coef	-2.354e-06	4.86e-06	-0.484	0.629	-1.19e-05	7.22e-06
app_entropy_log_1_coef	3.7863	2.183	1.734	0.084	-0.513	8.085
app_entropy_log_2_coef	3.3664	3.314	1.016	0.311	-3.159	9.892
app_entropy_log_3_coef	1.9683	6.030	0.326	0.744	-9.907	13.843
app_entropy_log_4_coef	-6.7930	12.475	-0.545	0.587	-31.359	17.773
app_entropy_log_5_coef	54.8308	16.806	3.263	0.001	21.736	87.926
app_entropy_log_6_coef	-51.5763	37.567	-1.373	0.171	-125.556	22.403
app_entropy_log_7_coef	-49.6562	36.534	-1.359	0.175	-121.602	22.290
app_entropy_log_8_coef	-119.9301	56.627	-2.118	0.035	-231.444	-8.416



app_entropy_log_9_coef	8.0888	67.975	0.119	0.905	-125.772	141.949
app_entropy_log_10_coef	164.8178	110.678	1.489	0.138	-53.138	382.774
app_det_TKEO_mean_1_coef	0.0002	0.005	0.030	0.976	-0.010	0.010
app_det_TKEO_mean_2_coef	0.0006	0.002	0.247	0.805	-0.004	0.005
app_det_TKEO_mean_3_coef	0.0015	0.001	1.708	0.089	-0.000	0.003
app_det_TKEO_mean_4_coef	-0.0009	0.001	-1.054	0.293	-0.003	0.001
app_det_TKEO_mean_5_coef	0.0024	0.001	2.459	0.015	0.000	0.004
app_det_TKEO_mean_6_coef	0.0002	0.001	0.225	0.822	-0.001	0.002
app_det_TKEO_mean_7_coef	0.0009	0.001	0.960	0.338	-0.001	0.003
app_det_TKEO_mean_8_coef	0.0034	0.002	1.750	0.081	-0.000	0.007
app_det_TKEO_mean_9_coef	-0.0020	0.002	-0.800	0.425	-0.007	0.003
app_det_TKEO_mean_10_coef	-5.683e-05	0.001	-0.050	0.960	-0.002	0.002
app_TKEO_std_1_coef	0.0001	0.000	0.258	0.797	-0.001	0.001
app_TKEO_std_2_coef	-0.0004	0.000	-1.788	0.075	-0.001	4.1e-05
app_TKEO_std_3_coef	0.0001	0.000	0.777	0.438	-0.000	0.000
app_TKEO_std_4_coef	-0.0002	0.000	-1.579	0.116	-0.001	5.68e-05
app_TKEO_std_5_coef	0.0003	0.000	3.339	0.001	0.000	0.001
app_TKEO_std_6_coef	-0.0001	9.5e-05	-1.264	0.208	-0.000	6.7e-05
app_TKEO_std_7_coef	0.0002	7.8e-05	2.098	0.037	1.01e-05	0.000
app_TKEO_std_8_coef	-0.0005	0.000	-3.560	0.000	-0.001	-0.000
app_TKEO_std_9_coef	0.0001	4.43e-05	2.310	0.022	1.51e-05	0.000
app_TKEO_std_10_coef	0.0002	5.06e-05	3.638	0.000	8.44e-05	0.000
Ea2	-164.6476	84.306	-1.953	0.052	-330.669	1.373
Ed2_1_coef	19.8830	7.295	2.726	0.007	5.518	34.248
Ed2_2_coef	6.5684	5.061	1.298	0.195	-3.397	16.534
Ed2_3_coef	12.0054	5.499	2.183	0.030	1.176	22.835
Ed2_4_coef	-3.9365	10.695	-0.368	0.713	-24.998	17.125
Ed2_5_coef	-0.6732	6.030	-0.112	0.911	-12.549	11.202
Ed2_6_coef	12.2672	6.496	1.889	0.060	-0.525	25.059
Ed2_7_coef	20.7163	9.048	2.290	0.023	2.899	38.534
Ed2_8_coef	91.9644	28.655	3.209	0.002	35.534	148.395
Ed2_9_coef	14.2265	6.630	2.146	0.033	1.171	27.282
Ed2_10_coef	109.6644	40.916	2.680	0.008	29.090	190.239
det_LT_entropy_shannon_1_coef	-0.7553	0.514	-1.470	0.143	-1.767	0.257
det_LT_entropy_shannon_2_coef	0.1972	0.517	0.381	0.703	-0.821	1.215
det_LT_entropy_shannon_3_coef	0.2552	0.356	0.718	0.474	-0.445	0.956
det_LT_entropy_shannon_4_coef	-0.0433	0.171	-0.254	0.800	-0.379	0.293
det_LT_entropy_shannon_5_coef	0.0461	0.216	0.214	0.831	-0.378	0.471
det_LT_entropy_shannon_6_coef	0.0717	0.199	0.360	0.719	-0.321	0.465
det_LT_entropy_shannon_7_coef	-0.1058	0.296	-0.357	0.721	-0.688	0.477
det_LT_entropy_shannon_8_coef	-0.1836	0.089	-2.058	0.041	-0.359	-0.008
det_LT_entropy_shannon_9_coef	-0.9845	0.410	-2.400	0.017	-1.792	-0.177
det_LT_entropy_shannon_10_coef	0.0701	0.055	1.273	0.204	-0.038	0.178
det_LT_entropy_log_1_coef	0.0055	0.008	0.709	0.479	-0.010	0.021
det_LT_entropy_log_2_coef	-0.0007	0.008	-0.092	0.927	-0.017	0.015
det_LT_entropy_log_3_coef	0.0194	0.008	2.434	0.016	0.004	0.035
det_LT_entropy_log_4_coef	-0.0424	0.013	-3.259	0.001	-0.068	-0.017
det_LT_entropy_log_5_coef	-0.0158	0.017	-0.916	0.361	-0.050	0.018
det_LT_entropy_log_6_coef	0.0105	0.014	0.762	0.447	-0.017	0.038
det_LT_entropy_log_7_coef	-0.0159	0.013	-1.263	0.208	-0.041	0.009
det_LT_entropy_log_8_coef	0.0429	0.015	2.881	0.004	0.014	0.072
det_LT_entropy_log_9_coef	0.0143	0.019	0.772	0.441	-0.022	0.051
det_LT_entropy_log_10_coef	0.0364	0.016	2.343	0.020	0.006	0.067
det_LT_TKEO_mean_1_coef	424.1778	155.957	2.720	0.007	117.056	731.300

det_LT_TKEO_mean_2_coef	-347.3935	138.342	-2.511	0.013	-619.827	-74.960
det_LT_TKEO_mean_3_coef	-32.0968	53.752	-0.597	0.551	-137.948	73.755
det_LT_TKEO_mean_4_coef	29.3757	27.033	1.087	0.278	-23.860	82.612
det_LT_TKEO_mean_5_coef	56.8107	21.802	2.606	0.010	13.876	99.745
det_LT_TKEO_mean_6_coef	7.2994	8.611	0.848	0.397	-9.658	24.257
det_LT_TKEO_mean_7_coef	38.3225	27.716	1.383	0.168	-16.257	92.903
det_LT_TKEO_mean_8_coef	-20.0807	16.440	-1.221	0.223	-52.455	12.293
det_LT_TKEO_mean_9_coef	292.7234	134.631	2.174	0.031	27.598	557.848
det_LT_TKEO_mean_10_coef	-94.1528	47.742	-1.972	0.050	-188.169	-0.136
det_LT_TKEO_std_1_coef	-110.7801	28.319	-3.912	0.000	-166.547	-55.013
det_LT_TKEO_std_2_coef	80.1569	28.205	2.842	0.005	24.614	135.700
det_LT_TKEO_std_3_coef	3.6988	13.249	0.279	0.780	-22.392	29.790
det_LT_TKEO_std_4_coef	-4.6649	8.835	-0.528	0.598	-22.064	12.734
det_LT_TKEO_std_5_coef	-16.4273	7.692	-2.136	0.034	-31.575	-1.280
det_LT_TKEO_std_6_coef	4.9563	5.878	0.843	0.400	-6.620	16.533
det_LT_TKEO_std_7_coef	-10.0751	14.943	-0.674	0.501	-39.501	19.351
det_LT_TKEO_std_8_coef	5.7573	5.227	1.101	0.272	-4.536	16.051
det_LT_TKEO_std_9_coef	-54.7625	29.189	-1.876	0.062	-112.244	2.719
det_LT_TKEO_std_10_coef	17.5067	8.730	2.005	0.046	0.315	34.699
app_LT_entropy_shannon_1_coef	0.0962	0.047	2.031	0.043	0.003	0.190
app_LT_entropy_shannon_2_coef	0.1328	0.118	1.126	0.261	-0.099	0.365
app_LT_entropy_shannon_3_coef	-0.1797	0.172	-1.043	0.298	-0.519	0.160
app_LT_entropy_shannon_4_coef	0.1637	0.163	1.004	0.317	-0.158	0.485
app_LT_entropy_shannon_5_coef	-0.2944	0.151	-1.945	0.053	-0.592	0.004
app_LT_entropy_shannon_6_coef	0.2736	0.099	2.766	0.006	0.079	0.468
app_LT_entropy_shannon_7_coef	-0.1383	0.044	-3.118	0.002	-0.226	-0.051
app_LT_entropy_shannon_8_coef	0.9636	1.010	0.954	0.341	-1.025	2.953
app_LT_entropy_shannon_9_coef	-1.0169	1.034	-0.984	0.326	-3.053	1.019
app_LT_entropy_shannon_10_coef	0.2712	0.267	1.015	0.311	-0.255	0.797
app_LT_entropy_log_1_coef	-6.0818	4.745	-1.282	0.201	-15.426	3.263
app_LT_entropy_log_2_coef	30.6342	33.246	0.921	0.358	-34.837	96.105
app_LT_entropy_log_3_coef	-81.3794	67.152	-1.212	0.227	-213.621	50.862
app_LT_entropy_log_4_coef	61.8326	87.282	0.708	0.479	-110.049	233.714
app_LT_entropy_log_5_coef	-364.9090	167.199	-2.182	0.030	-694.169	-35.649
app_LT_entropy_log_6_coef	591.3895	198.802	2.975	0.003	199.894	982.885
app_LT_entropy_log_7_coef	-285.6842	171.408	-1.667	0.097	-623.233	51.865
app_LT_entropy_log_8_coef	-95.3418	70.524	-1.352	0.178	-234.222	43.539
app_LT_entropy_log_9_coef	-91.2573	69.160	-1.320	0.188	-227.451	44.937
app_LT_entropy_log_10_coef	302.1338	67.456	4.479	0.000	169.294	434.973
app_LT_TKEO_mean_1_coef	-1.4534	40.137	-0.036	0.971	-80.493	77.587
app_LT_TKEO_mean_2_coef	-4.6144	22.432	-0.206	0.837	-48.788	39.560
app_LT_TKEO_mean_3_coef	-38.8034	21.156	-1.834	0.068	-80.465	2.858
app_LT_TKEO_mean_4_coef	16.7255	11.404	1.467	0.144	-5.733	39.184
app_LT_TKEO_mean_5_coef	-23.4036	8.400	-2.786	0.006	-39.945	-6.863
app_LT_TKEO_mean_6_coef	-0.5546	7.889	-0.070	0.944	-16.089	14.980
app_LT_TKEO_mean_7_coef	14.1761	17.179	0.825	0.410	-19.655	48.007
app_LT_TKEO_mean_8_coef	-45.4574	16.078	-2.827	0.005	-77.119	-13.796
app_LT_TKEO_mean_9_coef	58.8048	20.532	2.864	0.005	18.372	99.238
app_LT_TKEO_mean_10_coef	-15.2574	11.263	-1.355	0.177	-37.436	6.922
app_LT_TKEO_std_1_coef	-2.3904	2.777	-0.861	0.390	-7.858	3.077
app_LT_TKEO_std_2_coef	2.8547	1.841	1.550	0.122	-0.772	6.481
app_LT_TKEO_std_3_coef	-5.2159	1.875	-2.782	0.006	-8.907	-1.524
app_LT_TKEO_std_4_coef	1.6529	2.802	0.590	0.556	-3.865	7.171
app_LT_TKEO_std_5_coef	-2.0562	2.066	-0.995	0.321	-6.125	2.013

app_LT_TKEO_std_6_coef	1.2572	1.388	0.906	0.366	-1.476	3.990
app_LT_TKEO_std_7_coef	-1.9779	1.413	-1.400	0.163	-4.761	0.805
app_LT_TKEO_std_8_coef	-1.8594	2.240	-0.830	0.407	-6.270	2.552
app_LT_TKEO_std_9_coef	4.6148	1.902	2.426	0.016	0.869	8.360
app_LT_TKEO_std_10_coef	-4.0038	1.596	-2.509	0.013	-7.146	-0.861
tqwt_energy_dec_1	80.9023	78.640	1.029	0.305	-73.962	235.766
tqwt_energy_dec_2	-80.5451	114.792	-0.702	0.484	-306.602	145.511
tqwt_energy_dec_3	31.1839	89.061	0.350	0.727	-144.201	206.569
tqwt_energy_dec_4	-65.7872	85.296	-0.771	0.441	-233.758	102.184
tqwt_energy_dec_5	111.7663	115.874	0.965	0.336	-116.421	339.953
tqwt_energy_dec_6	-282.9960	129.634	-2.183	0.030	-538.280	-27.712
tqwt_energy_dec_7	316.2620	123.038	2.570	0.011	73.967	558.557
tqwt_energy_dec_8	8.7199	91.024	0.096	0.924	-170.531	187.970
tqwt_energy_dec_9	-96.2546	80.783	-1.192	0.235	-255.339	62.830
tqwt_energy_dec_10	198.8413	81.043	2.454	0.015	39.246	358.437
tqwt_energy_dec_11	-235.2349	63.044	-3.731	0.000	-359.386	-111.084
tqwt_energy_dec_12	141.1134	43.123	3.272	0.001	56.193	226.034
tqwt_energy_dec_13	-75.7769	20.117	-3.767	0.000	-115.392	-36.162
tqwt_energy_dec_14	37.0383	10.811	3.426	0.001	15.749	58.328
tqwt_energy_dec_15	-9.5604	7.372	-1.297	0.196	-24.077	4.956
tqwt_energy_dec_16	4.2629	5.640	0.756	0.450	-6.843	15.369
tqwt_energy_dec_17	-2.3637	5.381	-0.439	0.661	-12.960	8.233
tqwt_energy_dec_18	7.9723	5.502	1.449	0.149	-2.864	18.808
tqwt_energy_dec_19	-1.0406	5.396	-0.193	0.847	-11.667	9.586
tqwt_energy_dec_20	6.1986	5.164	1.200	0.231	-3.971	16.369
tqwt_energy_dec_21	-0.3688	5.632	-0.065	0.948	-11.459	10.722
tqwt_energy_dec_22	5.5094	5.508	1.000	0.318	-5.337	16.356
tqwt_energy_dec_23	-0.0484	5.509	-0.009	0.993	-10.897	10.800
tqwt_energy_dec_24	4.2483	5.280	0.805	0.422	-6.150	14.647
tqwt_energy_dec_25	4.2024	5.388	0.780	0.436	-6.407	14.812
tqwt_energy_dec_26	3.2544	5.194	0.627	0.532	-6.974	13.483
tqwt_energy_dec_27	1.3460	5.353	0.251	0.802	-9.195	11.887
tqwt_energy_dec_28	7.4503	5.294	1.407	0.161	-2.975	17.876
tqwt_energy_dec_29	4.5984	7.517	0.612	0.541	-10.204	19.400
tqwt_energy_dec_30	-37.3878	29.264	-1.278	0.203	-95.016	20.241
tqwt_energy_dec_31	-98.0594	61.699	-1.589	0.113	-219.561	23.442
tqwt_energy_dec_32	255.6833	98.554	2.594	0.010	61.603	449.764
tqwt_energy_dec_33	-404.8196	165.500	-2.446	0.015	-730.734	-78.905
tqwt_energy_dec_34	73.0613	145.676	0.502	0.616	-213.815	359.938
tqwt_energy_dec_35	84.9751	174.631	0.487	0.627	-258.922	428.872
tqwt_energy_dec_36	0.9507	27.364	0.035	0.972	-52.936	54.838
tqwt_entropy_shannon_dec_1	0.0006	0.016	0.035	0.972	-0.031	0.032
tqwt_entropy_shannon_dec_2	-0.0010	0.024	-0.042	0.966	-0.049	0.047
tqwt_entropy_shannon_dec_3	-0.0352	0.023	-1.512	0.132	-0.081	0.011
tqwt_entropy_shannon_dec_4	0.0690	0.019	3.704	0.000	0.032	0.106
tqwt_entropy_shannon_dec_5	-0.0235	0.012	-1.925	0.055	-0.048	0.001
tqwt_entropy_shannon_dec_6	-0.0117	0.013	-0.926	0.355	-0.037	0.013
tqwt_entropy_shannon_dec_7	0.0035	0.012	0.279	0.780	-0.021	0.028
tqwt_entropy_shannon_dec_8	-0.0123	0.009	-1.319	0.188	-0.031	0.006
tqwt_entropy_shannon_dec_9	0.0126	0.009	1.475	0.141	-0.004	0.029
tqwt_entropy_shannon_dec_10	-0.0114	0.007	-1.552	0.122	-0.026	0.003
tqwt_entropy_shannon_dec_11	-0.0047	0.010	-0.473	0.637	-0.024	0.015
tqwt_entropy_shannon_dec_12	-0.0038	0.006	-0.665	0.507	-0.015	0.007
tqwt_entropy_shannon_dec_13	0.0056	0.003	2.165	0.031	0.001	0.011

tqwt_entropy_shannon_dec_14	-0.0018	0.001	-1.302	0.194	-0.004	0.001
tqwt_entropy_shannon_dec_15	0.0004	0.001	0.399	0.690	-0.002	0.002
tqwt_entropy_shannon_dec_16	0.0007	0.001	0.868	0.386	-0.001	0.002
tqwt_entropy_shannon_dec_17	0.0009	0.001	1.578	0.116	-0.000	0.002
tqwt_entropy_shannon_dec_18	-0.0011	0.001	-2.133	0.034	-0.002	-8.28e-05
tqwt_entropy_shannon_dec_19	-0.0012	0.001	-2.247	0.025	-0.002	-0.000
tqwt_entropy_shannon_dec_20	0.0034	0.001	2.724	0.007	0.001	0.006
tqwt_entropy_shannon_dec_21	-0.0012	0.001	-1.159	0.248	-0.003	0.001
tqwt_entropy_shannon_dec_22	1.242e-05	0.001	0.008	0.993	-0.003	0.003
tqwt_entropy_shannon_dec_23	-0.0025	0.001	-2.478	0.014	-0.004	-0.001
tqwt_entropy_shannon_dec_24	6.607e-05	0.000	0.158	0.874	-0.001	0.001
tqwt_entropy_shannon_dec_25	-0.0003	0.000	-0.559	0.577	-0.001	0.001
tqwt_entropy_shannon_dec_26	-0.0017	0.001	-3.284	0.001	-0.003	-0.001
tqwt_entropy_shannon_dec_27	0.0016	0.000	3.959	0.000	0.001	0.002
tqwt_entropy_shannon_dec_28	0.0024	0.001	2.191	0.029	0.000	0.005
tqwt_entropy_shannon_dec_29	0.0057	0.004	1.536	0.126	-0.002	0.013
tqwt_entropy_shannon_dec_30	-0.0675	0.028	-2.399	0.017	-0.123	-0.012
tqwt_entropy_shannon_dec_31	-0.1758	0.057	-3.060	0.002	-0.289	-0.063
tqwt_entropy_shannon_dec_32	0.2404	0.082	2.932	0.004	0.079	0.402
tqwt_entropy_shannon_dec_33	-0.2084	0.092	-2.269	0.024	-0.389	-0.028
tqwt_entropy_shannon_dec_34	-0.2301	0.129	-1.785	0.075	-0.484	0.024
tqwt_entropy_shannon_dec_35	0.3034	0.144	2.111	0.036	0.020	0.586
tqwt_entropy_shannon_dec_36	-0.0173	0.009	-1.954	0.052	-0.035	0.000
tqwt_entropy_log_dec_1	1.192e-06	5.6e-07	2.127	0.034	8.85e-08	2.3e-06
tqwt_entropy_log_dec_2	3.462e-07	1.3e-06	0.266	0.791	-2.22e-06	2.91e-06
tqwt_entropy_log_dec_3	-6.07e-06	1.8e-06	-3.371	0.001	-9.62e-06	-2.52e-06
tqwt_entropy_log_dec_4	6.715e-06	1.98e-06	3.389	0.001	2.81e-06	1.06e-05
tqwt_entropy_log_dec_5	-1.296e-06	1.95e-06	-0.664	0.507	-5.14e-06	2.55e-06
tqwt_entropy_log_dec_6	4.413e-07	2.53e-06	0.175	0.861	-4.53e-06	5.42e-06
tqwt_entropy_log_dec_7	-1.72e-06	3.86e-06	-0.445	0.656	-9.32e-06	5.88e-06
tqwt_entropy_log_dec_8	-6.02e-06	4.87e-06	-1.237	0.217	-1.56e-05	3.56e-06
tqwt_entropy_log_dec_9	3.936e-06	5.48e-06	0.718	0.474	-6.86e-06	1.47e-05
tqwt_entropy_log_dec_10	-3.37e-06	5.14e-06	-0.656	0.512	-1.35e-05	6.75e-06
tqwt_entropy_log_dec_11	1.081e-05	4.74e-06	2.280	0.023	1.47e-06	2.01e-05
tqwt_entropy_log_dec_12	1.346e-06	5.32e-06	0.253	0.800	-9.12e-06	1.18e-05
tqwt_entropy_log_dec_13	5.82e-06	8.95e-06	0.650	0.516	-1.18e-05	2.35e-05
tqwt_entropy_log_dec_14	-1.445e-05	1.56e-05	-0.928	0.354	-4.51e-05	1.62e-05
tqwt_entropy_log_dec_15	1.882e-05	1.74e-05	1.081	0.281	-1.55e-05	5.31e-05
tqwt_entropy_log_dec_16	9.003e-06	1.82e-05	0.494	0.622	-2.69e-05	4.49e-05
tqwt_entropy_log_dec_17	5.45e-05	2.41e-05	2.261	0.025	7.04e-06	0.000
tqwt_entropy_log_dec_18	-0.0001	2.94e-05	-3.449	0.001	-0.000	-4.35e-05
tqwt_entropy_log_dec_19	1.33e-05	3.22e-05	0.414	0.680	-5e-05	7.66e-05
tqwt_entropy_log_dec_20	-1.37e-05	3.43e-05	-0.400	0.690	-8.12e-05	5.38e-05
tqwt_entropy_log_dec_21	1.625e-05	4.32e-05	0.376	0.707	-6.89e-05	0.000
tqwt_entropy_log_dec_22	-9.32e-05	4.34e-05	-2.148	0.033	-0.000	-7.74e-06
tqwt_entropy_log_dec_23	-1.255e-05	5.1e-05	-0.246	0.806	-0.000	8.79e-05
tqwt_entropy_log_dec_24	2.452e-05	4.41e-05	0.556	0.579	-6.23e-05	0.000
tqwt_entropy_log_dec_25	7.027e-06	3.7e-05	0.190	0.850	-6.58e-05	7.99e-05
tqwt_entropy_log_dec_26	-4.391e-05	3.62e-05	-1.212	0.226	-0.000	2.74e-05
tqwt_entropy_log_dec_27	1.341e-05	4.01e-05	0.334	0.739	-6.57e-05	9.25e-05
tqwt_entropy_log_dec_28	0.0003	5.09e-05	5.302	0.000	0.000	0.000
tqwt_entropy_log_dec_29	-0.0002	7.67e-05	-2.700	0.007	-0.000	-5.61e-05
tqwt_entropy_log_dec_30	0.0001	0.000	1.036	0.301	-0.000	0.000
tqwt_entropy_log_dec_31	-0.0001	0.000	-0.517	0.606	-0.000	0.000

tqwt_entropy_log_dec_32	-0.0003	0.000	-1.200	0.231	-0.001	0.000
tqwt_entropy_log_dec_33	0.0005	0.000	2.194	0.029	5.29e-05	0.001
tqwt_entropy_log_dec_34	-0.0010	0.000	-3.948	0.000	-0.001	-0.000
tqwt_entropy_log_dec_35	0.0006	0.000	2.424	0.016	0.000	0.001
tqwt_entropy_log_dec_36	2.733e-05	0.000	0.250	0.802	-0.000	0.000
tqwt_TKEO_mean_dec_1	-3.9614	2.008	-1.973	0.050	-7.915	-0.008
tqwt_TKEO_mean_dec_2	-3.0930	1.812	-1.707	0.089	-6.662	0.476
tqwt_TKEO_mean_dec_3	-29.1160	9.947	-2.927	0.004	-48.704	-9.528
tqwt_TKEO_mean_dec_4	-96.1975	29.485	-3.263	0.001	-154.261	-38.134
tqwt_TKEO_mean_dec_5	-85.1277	35.910	-2.371	0.019	-155.844	-14.411
tqwt_TKEO_mean_dec_6	130.7291	38.671	3.381	0.001	54.576	206.882
tqwt_TKEO_mean_dec_7	100.3185	23.901	4.197	0.000	53.250	147.387
tqwt_TKEO_mean_dec_8	15.7505	49.258	0.320	0.749	-81.252	112.753
tqwt_TKEO_mean_dec_9	110.5926	42.837	2.582	0.010	26.236	194.949
tqwt_TKEO_mean_dec_10	161.4522	72.024	2.242	0.026	19.618	303.287
tqwt_TKEO_mean_dec_11	884.2194	269.386	3.282	0.001	353.725	1414.714
tqwt_TKEO_mean_dec_12	47.2397	101.002	0.468	0.640	-151.661	246.140
tqwt_TKEO_mean_dec_13	28.0155	15.493	1.808	0.072	-2.494	58.525
tqwt_TKEO_mean_dec_14	-32.1059	7.562	-4.246	0.000	-46.998	-17.214
tqwt_TKEO_mean_dec_15	3.5345	3.521	1.004	0.316	-3.399	10.468
tqwt_TKEO_mean_dec_16	-1.6322	2.930	-0.557	0.578	-7.401	4.137
tqwt_TKEO_mean_dec_17	7.7290	2.391	3.232	0.001	3.020	12.438
tqwt_TKEO_mean_dec_18	-5.7804	2.157	-2.680	0.008	-10.028	-1.533
tqwt_TKEO_mean_dec_19	-3.3083	2.053	-1.612	0.108	-7.351	0.734
tqwt_TKEO_mean_dec_20	4.6887	2.052	2.284	0.023	0.647	8.730
tqwt_TKEO_mean_dec_21	-3.0838	2.264	-1.362	0.174	-7.541	1.374
tqwt_TKEO_mean_dec_22	-0.1599	2.204	-0.073	0.942	-4.501	4.181
tqwt_TKEO_mean_dec_23	-5.0328	1.958	-2.570	0.011	-8.889	-1.177
tqwt_TKEO_mean_dec_24	-0.1628	0.891	-0.183	0.855	-1.918	1.593
tqwt_TKEO_mean_dec_25	-0.9655	0.935	-1.033	0.303	-2.806	0.875
tqwt_TKEO_mean_dec_26	-2.2570	0.742	-3.041	0.003	-3.718	-0.796
tqwt_TKEO_mean_dec_27	2.1802	0.588	3.705	0.000	1.021	3.339
tqwt_TKEO_mean_dec_28	3.0597	1.074	2.849	0.005	0.945	5.174
tqwt_TKEO_mean_dec_29	2.6097	1.820	1.434	0.153	-0.974	6.193
tqwt_TKEO_mean_dec_30	-12.5922	9.566	-1.316	0.189	-31.431	6.246
tqwt_TKEO_mean_dec_31	71.7760	21.074	3.406	0.001	30.275	113.277
tqwt_TKEO_mean_dec_32	-79.3398	26.492	-2.995	0.003	-131.510	-27.169
tqwt_TKEO_mean_dec_33	70.0864	17.940	3.907	0.000	34.758	105.414
tqwt_TKEO_mean_dec_34	-4.5337	29.611	-0.153	0.878	-62.845	53.778
tqwt_TKEO_mean_dec_35	27.0497	21.468	1.260	0.209	-15.227	69.326
tqwt_TKEO_mean_dec_36	-16.0214	6.216	-2.577	0.011	-28.262	-3.780
tqwt_TKEO_std_dec_1	-34.5181	25.081	-1.376	0.170	-83.910	14.873
tqwt_TKEO_std_dec_2	-69.8239	18.884	-3.697	0.000	-107.012	-32.636
tqwt_TKEO_std_dec_3	-244.2161	68.659	-3.557	0.000	-379.424	-109.008
tqwt_TKEO_std_dec_4	-503.5994	164.657	-3.058	0.002	-827.854	-179.344
tqwt_TKEO_std_dec_5	-378.5510	180.482	-2.097	0.037	-733.970	-23.132
tqwt_TKEO_std_dec_6	446.6904	139.548	3.201	0.002	171.883	721.498
tqwt_TKEO_std_dec_7	507.1419	137.178	3.697	0.000	237.000	777.284
tqwt_TKEO_std_dec_8	-197.1900	131.548	-1.499	0.135	-456.244	61.864
tqwt_TKEO_std_dec_9	-167.8472	147.453	-1.138	0.256	-458.223	122.529
tqwt_TKEO_std_dec_10	-285.8899	114.971	-2.487	0.014	-512.299	-59.480
tqwt_TKEO_std_dec_11	-70.0606	104.103	-0.673	0.502	-275.068	134.947
tqwt_TKEO_std_dec_12	-83.6666	53.388	-1.567	0.118	-188.802	21.469
tqwt_TKEO_std_dec_13	16.5303	16.884	0.979	0.328	-16.718	49.779

tqwt_TKEO_std_dec_14	5.5374	7.465	0.742	0.459	-9.163	20.238
tqwt_TKEO_std_dec_15	4.7206	4.615	1.023	0.307	-4.368	13.809
tqwt_TKEO_std_dec_16	-3.7647	3.043	-1.237	0.217	-9.757	2.227
tqwt_TKEO_std_dec_17	2.5161	1.498	1.679	0.094	-0.434	5.467
tqwt_TKEO_std_dec_18	-2.3956	0.950	-2.521	0.012	-4.267	-0.524
tqwt_TKEO_std_dec_19	-1.1079	1.230	-0.901	0.369	-3.530	1.315
tqwt_TKEO_std_dec_20	3.7645	2.081	1.809	0.072	-0.334	7.863
tqwt_TKEO_std_dec_21	-0.9649	1.860	-0.519	0.604	-4.628	2.698
tqwt_TKEO_std_dec_22	2.9725	2.255	1.318	0.189	-1.468	7.413
tqwt_TKEO_std_dec_23	-1.7795	1.694	-1.050	0.295	-5.116	1.557
tqwt_TKEO_std_dec_24	-1.5644	0.873	-1.793	0.074	-3.283	0.154
tqwt_TKEO_std_dec_25	1.7700	0.542	3.266	0.001	0.703	2.837
tqwt_TKEO_std_dec_26	-1.8614	0.598	-3.112	0.002	-3.039	-0.683
tqwt_TKEO_std_dec_27	2.2214	0.675	3.289	0.001	0.891	3.551
tqwt_TKEO_std_dec_28	-0.0677	0.785	-0.086	0.931	-1.614	1.479
tqwt_TKEO_std_dec_29	0.6634	2.515	0.264	0.792	-4.290	5.617
tqwt_TKEO_std_dec_30	-3.1713	8.843	-0.359	0.720	-20.586	14.243
tqwt_TKEO_std_dec_31	-30.2885	19.704	-1.537	0.125	-69.091	8.514
tqwt_TKEO_std_dec_32	12.7110	23.268	0.546	0.585	-33.111	58.533
tqwt_TKEO_std_dec_33	43.7103	13.585	3.218	0.001	16.958	70.463
tqwt_TKEO_std_dec_34	-24.1943	20.819	-1.162	0.246	-65.193	16.804
tqwt_TKEO_std_dec_35	-3.8646	20.388	-0.190	0.850	-44.014	36.285
tqwt_TKEO_std_dec_36	1.1051	2.539	0.435	0.664	-3.894	6.104
tqwt_medianValue_dec_1	17.5660	4.673	3.759	0.000	8.364	26.768
tqwt_medianValue_dec_2	1.0734	3.877	0.277	0.782	-6.561	8.708
tqwt_medianValue_dec_3	-5.6552	5.102	-1.109	0.269	-15.701	4.391
tqwt_medianValue_dec_4	22.8908	14.058	1.628	0.105	-4.794	50.576
tqwt_medianValue_dec_5	49.4856	20.019	2.472	0.014	10.062	88.909
tqwt_medianValue_dec_6	-22.1136	40.357	-0.548	0.584	-101.588	57.361
tqwt_medianValue_dec_7	-94.6406	57.089	-1.658	0.099	-207.064	17.782
tqwt_medianValue_dec_8	225.7795	53.951	4.185	0.000	119.535	332.024
tqwt_medianValue_dec_9	-971.4471	264.692	-3.670	0.000	-1492.698	-450.196
tqwt_medianValue_dec_10	-164.9632	214.102	-0.770	0.442	-586.590	256.663
tqwt_medianValue_dec_11	-158.6780	196.587	-0.807	0.420	-545.812	228.456
tqwt_medianValue_dec_12	14.5681	275.340	0.053	0.958	-527.652	556.788
tqwt_medianValue_dec_13	70.7702	101.064	0.700	0.484	-128.252	269.792
tqwt_medianValue_dec_14	50.4891	17.242	2.928	0.004	16.536	84.443
tqwt_medianValue_dec_15	-17.0005	9.373	-1.814	0.071	-35.459	1.458
tqwt_medianValue_dec_16	3.7550	20.813	0.180	0.857	-37.232	44.742
tqwt_medianValue_dec_17	44.1274	17.827	2.475	0.014	9.022	79.233
tqwt_medianValue_dec_18	14.5848	13.983	1.043	0.298	-12.952	42.122
tqwt_medianValue_dec_19	-5.1272	5.152	-0.995	0.321	-15.272	5.018
tqwt_medianValue_dec_20	-6.6849	14.618	-0.457	0.648	-35.471	22.102
tqwt_medianValue_dec_21	-25.3251	15.431	-1.641	0.102	-55.714	5.063
tqwt_medianValue_dec_22	18.6669	14.761	1.265	0.207	-10.402	47.736
tqwt_medianValue_dec_23	10.6103	7.979	1.330	0.185	-5.102	26.323
tqwt_medianValue_dec_24	4.4518	6.516	0.683	0.495	-8.380	17.284
tqwt_medianValue_dec_25	5.2393	5.030	1.042	0.299	-4.666	15.145
tqwt_medianValue_dec_26	6.9204	5.975	1.158	0.248	-4.847	18.688
tqwt_medianValue_dec_27	0.6470	1.776	0.364	0.716	-2.851	4.145
tqwt_medianValue_dec_28	4.9609	1.727	2.873	0.004	1.561	8.361
tqwt_medianValue_dec_29	0.7073	5.755	0.123	0.902	-10.626	12.041
tqwt_medianValue_dec_30	69.7141	39.213	1.778	0.077	-7.508	146.936
tqwt_medianValue_dec_31	-69.4333	19.289	-3.600	0.000	-107.419	-31.447

tqwt_medianValue_dec_32	-53.0522	16.908	-3.138	0.002	-86.349	-19.755
tqwt_medianValue_dec_33	-36.9881	14.704	-2.516	0.012	-65.944	-8.032
tqwt_medianValue_dec_34	-26.9424	18.021	-1.495	0.136	-62.431	8.547
tqwt_medianValue_dec_35	-17.0169	19.492	-0.873	0.383	-55.403	21.369
tqwt_medianValue_dec_36	0.7073	7.020	0.101	0.920	-13.117	14.532
tqwt_meanValue_dec_1	-1.049e-11	3.4e-12	-3.085	0.002	-1.72e-11	-3.79e-12
tqwt_meanValue_dec_2	-2.026e-12	2.32e-12	-0.874	0.383	-6.59e-12	2.54e-12
tqwt_meanValue_dec_3	-1.895e-12	2.32e-12	-0.817	0.415	-6.46e-12	2.67e-12
tqwt_meanValue_dec_4	3.104e-14	2.01e-12	0.015	0.988	-3.93e-12	3.99e-12
tqwt_meanValue_dec_5	4.531e-12	1.98e-12	2.286	0.023	6.27e-13	8.44e-12
tqwt_meanValue_dec_6	-2.686e-12	2.69e-12	-0.998	0.319	-7.99e-12	2.62e-12
tqwt_meanValue_dec_7	5.109e-12	2.14e-12	2.388	0.018	8.95e-13	9.32e-12
tqwt_meanValue_dec_8	2.027e-12	2.27e-12	0.892	0.373	-2.45e-12	6.5e-12
tqwt_meanValue_dec_9	-5.197e-12	2.86e-12	-1.815	0.071	-1.08e-11	4.42e-13
tqwt_meanValue_dec_10	6.78e-12	2.11e-12	3.212	0.001	2.62e-12	1.09e-11
tqwt_meanValue_dec_11	-4.772e-12	1.54e-12	-3.099	0.002	-7.81e-12	-1.74e-12
tqwt_meanValue_dec_12	1.074e-12	2.17e-12	0.494	0.622	-3.21e-12	5.36e-12
tqwt_meanValue_dec_13	1.111e-11	2.54e-12	4.375	0.000	6.11e-12	1.61e-11
tqwt_meanValue_dec_14	3.494e-13	1.49e-12	0.234	0.815	-2.59e-12	3.29e-12
tqwt_meanValue_dec_15	5.928e-12	2.52e-12	2.355	0.019	9.71e-13	1.09e-11
tqwt_meanValue_dec_16	3.955e-12	1.48e-12	2.670	0.008	1.04e-12	6.87e-12
tqwt_meanValue_dec_17	3.097e-12	1.4e-12	2.218	0.027	3.47e-13	5.85e-12
tqwt_meanValue_dec_18	4.493e-12	3.69e-12	1.219	0.224	-2.77e-12	1.18e-11
tqwt_meanValue_dec_19	-6.505e-12	1.91e-12	-3.397	0.001	-1.03e-11	-2.73e-12
tqwt_meanValue_dec_20	2.803e-14	2.3e-12	0.012	0.990	-4.5e-12	4.56e-12
tqwt_meanValue_dec_21	-2.851e-12	2.17e-12	-1.313	0.190	-7.13e-12	1.43e-12
tqwt_meanValue_dec_22	4.139e-12	2.36e-12	1.752	0.081	-5.12e-13	8.79e-12
tqwt_meanValue_dec_23	6.421e-12	2.32e-12	2.762	0.006	1.84e-12	1.1e-11
tqwt_meanValue_dec_24	-2.342e-12	2.07e-12	-1.130	0.259	-6.42e-12	1.74e-12
tqwt_meanValue_dec_25	-1.273e-11	2.65e-12	-4.806	0.000	-1.8e-11	-7.52e-12
tqwt_meanValue_dec_26	-7.555e-12	7.07e-12	-1.069	0.286	-2.15e-11	6.36e-12
tqwt_meanValue_dec_27	-1.236e-11	4.84e-12	-2.553	0.011	-2.19e-11	-2.83e-12
tqwt_meanValue_dec_28	-4.462e-13	5.23e-12	-0.085	0.932	-1.07e-11	9.86e-12
tqwt_meanValue_dec_29	1.342e-12	1.95e-12	0.688	0.492	-2.5e-12	5.19e-12
tqwt_meanValue_dec_30	-2.826e-13	2.39e-12	-0.118	0.906	-4.99e-12	4.42e-12
tqwt_meanValue_dec_31	-4.122e-12	1.46e-12	-2.822	0.005	-7e-12	-1.25e-12
tqwt_meanValue_dec_32	-3.823e-12	1.84e-12	-2.076	0.039	-7.45e-12	-1.96e-13
tqwt_meanValue_dec_33	8.96e-12	1.85e-12	4.846	0.000	5.32e-12	1.26e-11
tqwt_meanValue_dec_34	-9.262e-12	2.27e-12	-4.073	0.000	-1.37e-11	-4.78e-12
tqwt_meanValue_dec_35	1.737e-12	1.17e-12	1.487	0.138	-5.64e-13	4.04e-12
tqwt_meanValue_dec_36	-0.2958	10.026	-0.030	0.976	-20.040	19.448
tqwt_stdValue_dec_1	-67.7489	138.343	-0.490	0.625	-340.185	204.687
tqwt_stdValue_dec_2	-137.5349	190.705	-0.721	0.471	-513.086	238.016
tqwt_stdValue_dec_3	526.0611	184.525	2.851	0.005	162.680	889.442
tqwt_stdValue_dec_4	-474.5543	165.112	-2.874	0.004	-799.704	-149.404
tqwt_stdValue_dec_5	125.9623	118.349	1.064	0.288	-107.099	359.024
tqwt_stdValue_dec_6	40.7322	95.260	0.428	0.669	-146.861	228.326
tqwt_stdValue_dec_7	-64.8030	100.315	-0.646	0.519	-262.351	132.745
tqwt_stdValue_dec_8	110.3236	80.986	1.362	0.174	-49.159	269.807
tqwt_stdValue_dec_9	-71.6569	72.418	-0.989	0.323	-214.267	70.953
tqwt_stdValue_dec_10	75.0799	51.817	1.449	0.149	-26.961	177.121
tqwt_stdValue_dec_11	-43.3225	41.768	-1.037	0.301	-125.575	38.930
tqwt_stdValue_dec_12	6.2791	28.940	0.217	0.828	-50.711	63.270
tqwt_stdValue_dec_13	-30.2671	21.208	-1.427	0.155	-72.032	11.497

tqwt_stdValue_dec_14	20.5893	16.134	1.276	0.203	-11.183	52.361
tqwt_stdValue_dec_15	-7.9060	11.627	-0.680	0.497	-30.803	14.991
tqwt_stdValue_dec_16	-1.1714	8.493	-0.138	0.890	-17.896	15.554
tqwt_stdValue_dec_17	-15.3155	7.293	-2.100	0.037	-29.677	-0.954
tqwt_stdValue_dec_18	13.1034	6.401	2.047	0.042	0.499	25.708
tqwt_stdValue_dec_19	6.5508	5.355	1.223	0.222	-3.995	17.096
tqwt_stdValue_dec_20	-13.4412	6.257	-2.148	0.033	-25.763	-1.119
tqwt_stdValue_dec_21	7.5023	5.280	1.421	0.157	-2.895	17.900
tqwt_stdValue_dec_22	0.7647	5.813	0.132	0.895	-10.682	12.212
tqwt_stdValue_dec_23	5.0362	4.454	1.131	0.259	-3.735	13.808
tqwt_stdValue_dec_24	5.0413	2.879	1.751	0.081	-0.628	10.711
tqwt_stdValue_dec_25	-3.8767	2.786	-1.392	0.165	-9.362	1.609
tqwt_stdValue_dec_26	9.1476	2.543	3.598	0.000	4.140	14.155
tqwt_stdValue_dec_27	-5.9161	2.635	-2.245	0.026	-11.105	-0.727
tqwt_stdValue_dec_28	-8.9621	3.033	-2.955	0.003	-14.934	-2.990
tqwt_stdValue_dec_29	3.4636	3.826	0.905	0.366	-4.071	10.998
tqwt_stdValue_dec_30	25.7312	13.708	1.877	0.062	-1.264	52.726
tqwt_stdValue_dec_31	22.7108	16.048	1.415	0.158	-8.892	54.313
tqwt_stdValue_dec_32	-24.4509	20.470	-1.194	0.233	-64.763	15.861
tqwt_stdValue_dec_33	3.6834	17.554	0.210	0.834	-30.885	38.251
tqwt_stdValue_dec_34	58.1383	20.762	2.800	0.005	17.252	99.025
tqwt_stdValue_dec_35	-63.6082	17.507	-3.633	0.000	-98.085	-29.132
tqwt_stdValue_dec_36	7.4982	3.652	2.053	0.041	0.307	14.689
tqwt_minValue_dec_1	6.0268	2.410	2.501	0.013	1.281	10.773
tqwt_minValue_dec_2	-15.2104	7.097	-2.143	0.033	-29.185	-1.235
tqwt_minValue_dec_3	-0.9458	5.624	-0.168	0.867	-12.022	10.130
tqwt_minValue_dec_4	-7.2314	5.875	-1.231	0.219	-18.801	4.338
tqwt_minValue_dec_5	0.3128	6.412	0.049	0.961	-12.315	12.941
tqwt_minValue_dec_6	-7.0512	4.706	-1.498	0.135	-16.320	2.217
tqwt_minValue_dec_7	7.1138	3.882	1.833	0.068	-0.530	14.758
tqwt_minValue_dec_8	2.0958	3.973	0.527	0.598	-5.729	9.921
tqwt_minValue_dec_9	7.9588	3.251	2.448	0.015	1.558	14.360
tqwt_minValue_dec_10	-5.6178	2.814	-1.996	0.047	-11.159	-0.076
tqwt_minValue_dec_11	2.1461	2.105	1.019	0.309	-1.999	6.292
tqwt_minValue_dec_12	-1.2338	2.097	-0.588	0.557	-5.363	2.895
tqwt_minValue_dec_13	6.5225	1.456	4.481	0.000	3.656	9.389
tqwt_minValue_dec_14	-0.0805	0.747	-0.108	0.914	-1.552	1.391
tqwt_minValue_dec_15	1.0750	0.706	1.523	0.129	-0.315	2.465
tqwt_minValue_dec_16	-0.1075	0.743	-0.145	0.885	-1.570	1.355
tqwt_minValue_dec_17	0.2916	0.714	0.408	0.683	-1.115	1.699
tqwt_minValue_dec_18	0.2205	0.617	0.357	0.721	-0.994	1.435
tqwt_minValue_dec_19	-1.2348	0.553	-2.234	0.026	-2.323	-0.146
tqwt_minValue_dec_20	-0.7077	0.929	-0.761	0.447	-2.538	1.122
tqwt_minValue_dec_21	-2.0082	0.899	-2.233	0.026	-3.779	-0.237
tqwt_minValue_dec_22	-0.3642	0.719	-0.507	0.613	-1.779	1.051
tqwt_minValue_dec_23	1.5571	0.608	2.559	0.011	0.359	2.755
tqwt_minValue_dec_24	-0.6540	0.795	-0.823	0.411	-2.219	0.911
tqwt_minValue_dec_25	1.9933	0.773	2.579	0.010	0.471	3.515
tqwt_minValue_dec_26	-0.2028	0.652	-0.311	0.756	-1.487	1.081
tqwt_minValue_dec_27	0.1763	0.408	0.432	0.666	-0.627	0.979
tqwt_minValue_dec_28	0.3362	0.566	0.594	0.553	-0.778	1.451
tqwt_minValue_dec_29	0.3349	0.632	0.530	0.596	-0.909	1.579
tqwt_minValue_dec_30	-0.6501	1.471	-0.442	0.659	-3.547	2.247
tqwt_minValue_dec_31	-4.1184	1.525	-2.701	0.007	-7.121	-1.115



tqwt_minValue_dec_32	0.3005	1.319	0.228	0.820	-2.296	2.897
tqwt_minValue_dec_33	0.4785	1.528	0.313	0.754	-2.531	3.488
tqwt_minValue_dec_34	0.2753	1.335	0.206	0.837	-2.354	2.905
tqwt_minValue_dec_35	1.4848	1.155	1.285	0.200	-0.790	3.760
tqwt_minValue_dec_36	-0.0319	0.450	-0.071	0.943	-0.917	0.853
tqwt_maxValue_dec_1	4.9635	2.926	1.696	0.091	-0.798	10.725
tqwt_maxValue_dec_2	-4.4486	9.007	-0.494	0.622	-22.185	13.288
tqwt_maxValue_dec_3	-19.2187	7.214	-2.664	0.008	-33.424	-5.013
tqwt_maxValue_dec_4	-11.1008	5.128	-2.165	0.031	-21.200	-1.001
tqwt_maxValue_dec_5	4.6310	5.672	0.817	0.415	-6.538	15.800
tqwt_maxValue_dec_6	1.0811	3.685	0.293	0.769	-6.176	8.338
tqwt_maxValue_dec_7	-2.1908	3.302	-0.663	0.508	-8.693	4.312
tqwt_maxValue_dec_8	9.6824	3.896	2.485	0.014	2.011	17.354
tqwt_maxValue_dec_9	2.0459	2.917	0.701	0.484	-3.698	7.789
tqwt_maxValue_dec_10	0.3483	2.282	0.153	0.879	-4.146	4.843
tqwt_maxValue_dec_11	-0.4941	1.746	-0.283	0.777	-3.932	2.944
tqwt_maxValue_dec_12	2.0034	1.810	1.107	0.269	-1.560	5.567
tqwt_maxValue_dec_13	5.4229	1.393	3.893	0.000	2.679	8.166
tqwt_maxValue_dec_14	-0.5332	0.873	-0.611	0.542	-2.252	1.186
tqwt_maxValue_dec_15	0.9586	0.734	1.307	0.193	-0.486	2.403
tqwt_maxValue_dec_16	0.9149	0.731	1.252	0.212	-0.524	2.354
tqwt_maxValue_dec_17	0.9398	0.684	1.373	0.171	-0.408	2.287
tqwt_maxValue_dec_18	-0.2496	0.668	-0.374	0.709	-1.564	1.065
tqwt_maxValue_dec_19	-0.8615	0.531	-1.621	0.106	-1.908	0.185
tqwt_maxValue_dec_20	-0.4675	1.022	-0.458	0.648	-2.480	1.545
tqwt_maxValue_dec_21	-3.3068	0.856	-3.864	0.000	-4.992	-1.621
tqwt_maxValue_dec_22	0.4827	0.680	0.709	0.479	-0.857	1.823
tqwt_maxValue_dec_23	2.2152	0.595	3.725	0.000	1.044	3.386
tqwt_maxValue_dec_24	-0.5251	0.787	-0.668	0.505	-2.074	1.024
tqwt_maxValue_dec_25	0.7029	0.678	1.036	0.301	-0.633	2.039
tqwt_maxValue_dec_26	-0.0946	0.625	-0.151	0.880	-1.325	1.136
tqwt_maxValue_dec_27	0.1975	0.365	0.542	0.588	-0.520	0.915
tqwt_maxValue_dec_28	-0.4697	0.490	-0.958	0.339	-1.435	0.496
tqwt_maxValue_dec_29	-1.0632	0.786	-1.352	0.177	-2.612	0.485
tqwt_maxValue_dec_30	0.0896	1.364	0.066	0.948	-2.597	2.776
tqwt_maxValue_dec_31	-2.2602	1.280	-1.766	0.079	-4.781	0.260
tqwt_maxValue_dec_32	1.7010	1.495	1.138	0.256	-1.243	4.645
tqwt_maxValue_dec_33	-7.3103	1.480	-4.938	0.000	-10.226	-4.395
tqwt_maxValue_dec_34	2.9161	1.255	2.324	0.021	0.445	5.387
tqwt_maxValue_dec_35	3.8023	1.231	3.090	0.002	1.379	6.226
tqwt_maxValue_dec_36	0.4166	0.403	1.034	0.302	-0.377	1.210
tqwt_skewnessValue_dec_1	0.0020	0.004	0.527	0.599	-0.006	0.010
tqwt_skewnessValue_dec_2	-0.0271	0.015	-1.775	0.077	-0.057	0.003
tqwt_skewnessValue_dec_3	0.3453	0.220	1.570	0.118	-0.088	0.779
tqwt_skewnessValue_dec_4	0.0753	0.024	3.084	0.002	0.027	0.123
tqwt_skewnessValue_dec_5	-0.6021	0.325	-1.853	0.065	-1.242	0.038
tqwt_skewnessValue_dec_6	-0.1008	0.036	-2.831	0.005	-0.171	-0.031
tqwt_skewnessValue_dec_7	0.3072	0.136	2.254	0.025	0.039	0.576
tqwt_skewnessValue_dec_8	-3.2017	1.088	-2.944	0.004	-5.344	-1.060
tqwt_skewnessValue_dec_9	-1.9067	0.452	-4.219	0.000	-2.797	-1.017
tqwt_skewnessValue_dec_10	0.2375	0.378	0.629	0.530	-0.507	0.982
tqwt_skewnessValue_dec_11	-0.0378	0.180	-0.210	0.833	-0.392	0.316
tqwt_skewnessValue_dec_12	0.1643	0.447	0.367	0.714	-0.717	1.045
tqwt_skewnessValue_dec_13	-3.7586	1.840	-2.043	0.042	-7.382	-0.136

	tqwt_skewnessValue_dec_14	-0.2453	0.783	-0.313	0.754	-1.788	1.297
	tqwt_skewnessValue_dec_15	-0.2221	0.681	-0.326	0.745	-1.563	1.118
	tqwt_skewnessValue_dec_16	3.0023	2.610	1.150	0.251	-2.137	8.141
	tqwt_skewnessValue_dec_17	3.1607	1.524	2.074	0.039	0.160	6.162
	tqwt_skewnessValue_dec_18	0.8796	2.079	0.423	0.673	-3.215	4.974
	tqwt_skewnessValue_dec_19	-0.3159	0.652	-0.484	0.629	-1.600	0.969
	tqwt_skewnessValue_dec_20	1.8918	1.896	0.998	0.319	-1.842	5.625
	tqwt_skewnessValue_dec_21	-3.0448	1.873	-1.626	0.105	-6.733	0.643
	tqwt_skewnessValue_dec_22	1.3114	2.414	0.543	0.587	-3.441	6.064
	tqwt_skewnessValue_dec_23	1.5211	2.406	0.632	0.528	-3.218	6.260
	tqwt_skewnessValue_dec_24	0.3320	0.444	0.748	0.455	-0.542	1.206
	tqwt_skewnessValue_dec_25	-0.1727	0.064	-2.699	0.007	-0.299	-0.047
	tqwt_skewnessValue_dec_26	0.0801	0.045	1.790	0.075	-0.008	0.168
	tqwt_skewnessValue_dec_27	0.0042	0.015	0.283	0.778	-0.025	0.033
	tqwt_skewnessValue_dec_28	-0.0239	0.020	-1.224	0.222	-0.062	0.015
	tqwt_skewnessValue_dec_29	0.0769	0.026	2.979	0.003	0.026	0.128
	tqwt_skewnessValue_dec_30	0.0074	0.068	0.108	0.914	-0.127	0.142
	tqwt_skewnessValue_dec_31	0.0633	0.041	1.539	0.125	-0.018	0.144
	tqwt_skewnessValue_dec_32	-0.1455	0.056	-2.600	0.010	-0.256	-0.035
	tqwt_skewnessValue_dec_33	0.1556	0.049	3.190	0.002	0.060	0.252
	tqwt_skewnessValue_dec_34	-0.1892	0.059	-3.193	0.002	-0.306	-0.073
	tqwt_skewnessValue_dec_35	0.0651	0.059	1.094	0.275	-0.052	0.182
	tqwt_skewnessValue_dec_36	0.0166	0.011	1.539	0.125	-0.005	0.038
	tqwt_kurtosisValue_dec_1	5.127e-05	1.72e-05	2.975	0.003	1.73e-05	8.52e-05
	tqwt_kurtosisValue_dec_2	-9.258e-06	0.000	-0.086	0.932	-0.000	0.000
	tqwt_kurtosisValue_dec_3	-6.286e-05	0.000	-0.502	0.616	-0.000	0.000
	tqwt_kurtosisValue_dec_4	2.331e-05	0.000	0.187	0.852	-0.000	0.000
	tqwt_kurtosisValue_dec_5	6.04e-05	8e-05	0.755	0.451	-9.71e-05	0.000
	tqwt_kurtosisValue_dec_6	-0.0002	6.86e-05	-2.507	0.013	-0.000	-3.69e-05
	tqwt_kurtosisValue_dec_7	0.0005	0.000	2.509	0.013	0.000	0.001
	tqwt_kurtosisValue_dec_8	-0.0017	0.001	-1.771	0.078	-0.004	0.000
	tqwt_kurtosisValue_dec_9	0.0024	0.001	1.936	0.054	-4.11e-05	0.005
	tqwt_kurtosisValue_dec_10	-0.0026	0.001	-2.233	0.026	-0.005	-0.000
	tqwt_kurtosisValue_dec_11	0.0020	0.002	1.275	0.203	-0.001	0.005
	tqwt_kurtosisValue_dec_12	-0.0023	0.002	-1.449	0.149	-0.005	0.001
	tqwt_kurtosisValue_dec_13	0.0021	0.014	0.158	0.875	-0.025	0.029
	tqwt_kurtosisValue_dec_14	0.0718	0.067	1.065	0.288	-0.061	0.205
	tqwt_kurtosisValue_dec_15	-0.0014	0.070	-0.019	0.985	-0.140	0.137
	tqwt_kurtosisValue_dec_16	0.0009	0.060	0.015	0.988	-0.117	0.119
	tqwt_kurtosisValue_dec_17	0.2334	0.105	2.231	0.027	0.027	0.439
	tqwt_kurtosisValue_dec_18	-0.2634	0.095	-2.787	0.006	-0.449	-0.077
	tqwt_kurtosisValue_dec_19	-0.0315	0.090	-0.352	0.725	-0.208	0.145
	tqwt_kurtosisValue_dec_20	0.2235	0.098	2.279	0.023	0.030	0.417
	tqwt_kurtosisValue_dec_21	0.0221	0.106	0.207	0.836	-0.188	0.232
	tqwt_kurtosisValue_dec_22	-0.1707	0.066	-2.573	0.011	-0.301	-0.040
	tqwt_kurtosisValue_dec_23	0.1702	0.067	2.525	0.012	0.037	0.303
	tqwt_kurtosisValue_dec_24	-0.0092	0.012	-0.783	0.434	-0.032	0.014
	tqwt_kurtosisValue_dec_25	-0.0006	0.002	-0.410	0.682	-0.004	0.002
	tqwt_kurtosisValue_dec_26	-0.0015	0.001	-1.456	0.146	-0.004	0.001
	tqwt_kurtosisValue_dec_27	0.0010	0.001	0.905	0.366	-0.001	0.003
	tqwt_kurtosisValue_dec_28	0.0022	0.001	1.709	0.089	-0.000	0.005
	tqwt_kurtosisValue_dec_29	-0.0013	0.002	-0.643	0.520	-0.005	0.003
	tqwt_kurtosisValue_dec_30	0.0061	0.003	2.057	0.041	0.000	0.012
	tqwt_kurtosisValue_dec_31	-0.0120	0.006	-2.048	0.042	-0.024	-0.000

tqwt_kurtosisValue_dec_32	-0.0055	0.007	-0.835	0.404	-0.019	0.008
tqwt_kurtosisValue_dec_33	0.0101	0.006	1.790	0.075	-0.001	0.021
tqwt_kurtosisValue_dec_34	-0.0014	0.006	-0.238	0.812	-0.013	0.010
tqwt_kurtosisValue_dec_35	0.0043	0.006	0.755	0.451	-0.007	0.016
tqwt_kurtosisValue_dec_36	-0.0002	0.001	-0.190	0.850	-0.003	0.002

Omnibus:	21.722	Durbin-Watson:	2.183
Prob(Omnibus):	0.000	Jarque-Bera (JB):	47.404
Skew:	0.061	Prob(JB):	5.09e-11
Kurtosis:	4.221	Cond. No.	4.54e+16

Warnings:

[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.

[2] The smallest eigenvalue is 5.45e-11. This might indicate that there are strong multicollinearity problems or that the design matrix is singular.

Hence , There is no multicollinearity Problem in Independent Features. So can be used for prediction of Parkinson Disease(Dependent Features).

```
1> P Values < 0.05.
2> Standard Error is also less.
3> Coeffient Value is also less.
4> R-Squared : 0.96 ~ 1 . (Nearer to One)
```

## Data Preprocessing

Using parkinson\_data as the pd\_features.csv data read by pandas, declare the following variables:

- **X** as the **Feature Matrix** (data of my\_data)
- **y** as the **response vector (target)**

## Step 2 - Feature Engineering

1. Feature Encoding (if Catagorical Features)
2. Normalization Or Standardization
3. Count Frequency Encoding

### Handling Missing Values in Categorical Variable

1. Delete the rows.
2. Replace with most frequent values.
3. Apply Classifier/Clustering Algorithm to predict :-
  - KNN.
  - K means.
  - Hierarchical.....
4. Mean/Median/Mode Imputation

### Normalization or Standardization

In [20]:

```
from sklearn.preprocessing import MinMaxScaler , StandardScaler

scaler = StandardScaler()

scaler.fit(parkinsons_data)
parkinsons_data = scaler.transform(parkinsons_data)
```

In [21]:

```
parkinsons_data = pd.DataFrame(parkinsons_data)
```

In [22]:

parkinsons\_data

Out[22]:

	0	1	2	3	4	5	6	7	8	9	...	745	746
0	1.725191	0.968742	0.627644	0.256144	0.605835	0.846892	0.842373	0.933328	0.407251	0.054993	...	0.584822	0.619412
1	1.725191	0.968742	0.121620	0.080433	0.368415	0.907404	0.902773	1.040014	0.426092	0.142570	...	0.584895	0.589778
2	1.725191	0.968742	0.617950	0.349839	0.733609	0.927575	0.922907	1.084576	0.443557	0.214916	...	0.584767	0.629033
3	1.711445	1.032266	1.980560	1.382279	0.753631	1.472186	1.466513	2.464215	0.275316	0.710353	...	0.532242	0.591137
4	1.711445	1.032266	2.472989	1.398068	0.300123	0.887233	0.882640	0.987044	3.143597	1.152045	...	0.475545	0.521356
...	...	...	...	...	...	...	...	...	...	...	...	...	...
751	1.711445	1.032266	0.370878	1.964406	1.494032	0.938221	0.939445	0.949508	0.454833	0.641378	...	0.549067	0.607926
752	1.711445	1.032266	3.460449	1.943738	0.749044	0.918050	0.909245	0.991826	0.224083	0.340570	...	0.575143	0.646996
753	1.725191	1.032266	0.813362	0.329201	0.152220	0.575147	0.577042	0.707165	0.385449	0.595685	...	0.600185	0.663206
754	1.725191	1.032266	0.541051	0.695920	0.066780	0.161646	0.164304	0.373097	0.450845	0.534762	...	0.167720	0.306983
755	1.725191	1.032266	0.394581	0.922840	0.184327	0.161646	0.164304	0.374874	0.475599	0.588070	...	0.871132	0.031441

756 rows × 755 columns



### Step 3 - Feature Selection

- A. To Drop Constant Features Using Variance Threshold.
- B. With Correlation.
- C. Information gain - mutual information In Classification Problem Statements.
- D. Information gain - mutual information In Regression Problem Statements.
- E. Chisquare Test For Feature Selection.

### A. To Drop Constant Features Using Variance Threshold.

In [25]:

```
parkinsons_data = pd.read_csv('pd_speech_features.csv')
from sklearn.feature_selection import VarianceThreshold
var_thres=VarianceThreshold(threshold=0)
var_thres.fit(parkinsons_data)
```

Out[25]:

VarianceThreshold(threshold=0)

In [26]:

```
parkinsons_data.columns[var_thres.get_support()]
```

Out[26]:

```
Index(['id', 'gender', 'PPE', 'DFA', 'RPDE', 'numPulses', 'numPeriodsPulses',
      'meanPeriodPulses', 'stdDevPeriodPulses', 'locPctJitter',
      ...,
      'tqwt_kurtosisValue_dec_28', 'tqwt_kurtosisValue_dec_29',
      'tqwt_kurtosisValue_dec_30', 'tqwt_kurtosisValue_dec_31',
      'tqwt_kurtosisValue_dec_32', 'tqwt_kurtosisValue_dec_33',
      'tqwt_kurtosisValue_dec_34', 'tqwt_kurtosisValue_dec_35',
      'tqwt_kurtosisValue_dec_36', 'class'],
      dtype='object', length=755)
```

This represents that we don't have any column to remove wrt constant features.

### C. Information gain - mutual information In Classification Problem Statements.

In [13]:

```
from sklearn.feature_selection import mutual_info_classif
# determine the mutual information
mutual_info = mutual_info_classif(x, y)
mutual_info
```

Out[13]:

```
array([0.05183959, 0.0235984 , 0.06450753, 0.07039929,
0.06011155, 0.03207881, 0.04936939, 0.05956566, 0.05466966,
0.05711864, 0.04343297, 0.04722488, 0.04154798, 0.00260581,
0.03691212, 0.0634879 , 0.00212849, 0.02556572, 0.02989594,
0.02878623, 0.08559259, 0.07532987, 0.07532486, 0.03949091,
0.0061407 , 0.01656753, 0.00897782, 0.00739434, 0.00773877, 0.04908242, 0.00105293,
0.05741196, 0.0222133 , 0.03047438, 0.00061534,
0.01715257, 0.0249794 , 0.01202352, 0.0433277 , 0.02073498,
0.03879983, 0.05253456, 0.01641361,
0.02524134, 0.00382974, 0.04065375, 0.02423872, 0.0214314 ,
0.04712542, 0.04651336, 0.09735459, 0.04832661, 0.01858292,
0.0392962 , 0.03108145, 0.00650165, 0.01124014,
0.02721948, 0.01041422, 0.02582913, 0.02671813, 0.03449434,
0.00280517, 0.03127264, 0.027032 , 0.01013555, 0.01400326, 0.00169457, 0.030343 , 0.02204593, 0.00563377, 0.00299952,
0.01465955, 0.00967204, 0.00503485, 0.02025622,
0.01077603, 0.08235125, 0.01935606, 0.028034 , 0.00501677, 0.03182052, 0.01080701, 0.01001377, 0.03152669,
0.02324291, 0.02911094, 0.03470251, 0.00946917, 0.03463951,
0.08089077, 0.00482098, 0.0139354 , 0.02751629, 0.08191462,
0.04619485, 0.04566144, 0.07926211, 0.04972783, 0.07615332,
0.07750545, 0.05854617, 0.05295369, 0.04608641, 0.10606451,
0.01538277, 0.01115623, 0.00209098, 0.04971094, 0.07280428,
0.03785854, 0.08432979, 0.07948845, 0.09617984, 0.08727342,
0.05518041, 0.06412228, 0.04064521, 0.03344206,
0.04437851, 0.01341623, 0.03113046, 0.01576849, 0.02069775, 0.02973401, 0.00926626, 0.01452185, 0.01068234, 0.04250677,
0.0156155 , 0.00383246, 0.01762596, 0.03158831, 0.0309012 ,
0.01375927, 0.00985316, 0.00294554, 0.00094131, 0.00825347,
0.01609667, 0.02930248, 0.02365346, 0.00502165, 0.01235155, 0.04560914,
0.06140629, 0.07585345, 0.07890765, 0.08840124, 0.07651968,
0.07718999, 0.07097889, 0.07229162, 0.06801157, 0.04459244,
0.07229777, 0.07109236, 0.05240389, 0.0860146 , 0.073749 ,
0.06846443, 0.06508084, 0.06629662, 0.06560957, 0.06507163,
0.03929243, 0.0354404 , 0.04723759, 0.05373169, 0.04688247,
0.04071442, 0.05065353, 0.04660403, 0.0564685 , 0.04535116,
0.07297887, 0.03363636, 0.02272328, 0.05681792, 0.0530209 ,
0.06171148, 0.06295089, 0.06161094, 0.05429898, 0.01414186,
0.00212446, 0.02962226, 0.05316146, 0.01570838, 0.00039427,
0.00019621, 0.01199229, 0.02604206, 0.01896841, 0.01934004, 0.01877342, 0.02009315,
0.02251726, 0.02128871, 0.01134413, 0.00340982, 0.00592645, 0.02387435, 0.02369644, 0.03643433,
0.00922743, 0.01109199, 0.02020834, 0.00053492,
0.022423 , 0.03298364, 0.00835288, 0.01629371, 0.00252384,
0.01486014, 0.01682653, 0.00939119, 0.06681452, 0.06838972,
0.0488974 , 0.06070022, 0.07200985, 0.07387008, 0.07303113,
0.08712622, 0.08588353, 0.0748592 , 0.05593733, 0.07312429,
0.04643458, 0.06739722, 0.05780778, 0.06956746, 0.06918889,
0.08003046, 0.07011447, 0.07006349, 0.05353825, 0.03805892,
0.07156718, 0.04384897, 0.03564734, 0.06123364, 0.05058381,
0.04763954, 0.04076748, 0.05941331, 0.04742377, 0.07234478,
0.03719328, 0.06366088, 0.04640363, 0.04263676, 0.05236538,
0.06422459, 0.04854398, 0.08313536, 0.02626279, 0.04871456,
0.03534458, 0.01901872, 0.02065782, 0.00975105, 0.01683054,
0.04609967, 0.01151826, 0.02095041, 0.04076229, 0.04483374,
0.05251448, 0.06479957, 0.05926023, 0.00662943, 0.05939975, 0.04445279, 0.01240122, 0.04491599, 0.06844745,
0.01724647, 0.0151447 , 0.04387679, 0.03211947, 0.03204997,
0.07862763, 0.09115716, 0.0273164 , 0.02551882, 0.0023504 , 0.01954512, 0.02741815,
0.00116678, 0.0205971 , 0.05566762, 0.0687441 , 0.02758355,
0.02767145, 0.08449116, 0.05599706, 0.07285754, 0.08960708,
0.0664485 , 0.07764944, 0.04852042, 0.03939289, 0.05347844,
0.02217515, 0.02739548, 0.01253286, 0.00504987, 0.01163878,
0.00053134, 0.02437538, 0.05752489, 0.01381873, 0.02368075,
0.00708819, 0.0097943 , 0.03356302, 0.04407011, 0.03014245,
```

0.09470114, 0.07591304, 0.03015655, 0. , 0.03139539,  
0.04334138, 0.05139945, 0.06609985, 0.0312145 , 0.05746763,  
0.03300037, 0.0599389 , 0.09225811, 0.09007133, 0.07036402,  
0.05413675, 0.06364891, 0.07791661, 0.07877915, 0.03474816,  
0.05575594, 0.05187715, 0.02476948, 0.00534164, 0.00998359,  
0. , 0.01934522, 0.06335554, 0.06137755, 0.04451938,  
0.01377021, 0.00234082, 0. , 0.00923455, 0.03764308,  
0.04466645, 0.10791239, 0.04180084, 0.00342461, 0.00752926,  
0.01882232, 0.03483567, 0.03203914, 0.04849313, 0.0537527 ,  
0.06817429, 0.05754529, 0.04782619, 0.08839721, 0.09171164,  
0.08676271, 0.04427615, 0.04806912, 0.09586158, 0.06069864,  
0.04774476, 0.0340403 , 0.024302 , 0. , 0. ,  
0.00378227, 0. , 0. , 0.03739454, 0.02445862,  
0.02566789, 0. , 0.0406202 , 0. , 0.02983429,  
0.02589341, 0.03998519, 0.02321834, 0.05026892, 0.01398429,  
0.03836628, 0.04176516, 0.02304833, 0.01928732, 0.07481318,  
0.06913199, 0.06043225, 0.04044873, 0.04537864, 0.08234243,  
0.09333745, 0.0873143 , 0.06915493, 0.05587796, 0.05885818,  
0.03477852, 0.04813761, 0.04251143, 0.04077412, 0.01564059,  
0.02378386, 0.02297591, 0. , 0.0040201 , 0.02000953,  
0.0122557 , 0.01034268, 0. , 0. , 0.03222688,  
0.02898367, 0.00185103, 0.01778001, 0.01562253, 0.03263821,  
0.02054719, 0.00463964, 0.03489772, 0.01382554, 0.02492285,  
0.02954373, 0.03870429, 0.07624518, 0.0357251 , 0.07797995,  
0.02090173, 0.07112337, 0.05178055, 0.01154388, 0.02371671,  
0.05640794, 0.04125344, 0.0437283 , 0.01793366, 0.06019868,  
0.04081728, 0.04258484, 0.06009723, 0.04325872, 0.06693976,  
0.06438051, 0.047438 , 0. , 0.01430575, 0.05071706,  
0.04685405, 0.00721658, 0.02956971, 0.07336125, 0.02589626,  
0.04624276, 0. , 0. , 0.0078222 , 0.01055585,  
0. , 0.02721767, 0. , 0. , 0. ,  
0. , 0.01671906, 0.00451485, 0. , 0. ,  
0. , 0.02080257, 0. , 0.03553685, 0.00243601,  
0. , 0. , 0. , 0. , 0. ,  
0.01012425, 0. , 0.01146167, 0.01005034, 0. ,  
0. , 0.00023504, 0.00625431, 0.00601529, 0.0034978 ,  
0. , 0.01707864, 0.031455 , 0.00728578, 0.01438327,  
0.02663152, 0.03842944, 0.06350652, 0.05041147, 0.06138446,  
0.0347576 , 0.05379472, 0.06264463, 0.09051426, 0.07291686,  
0.06367629, 0.09016265, 0.07156263, 0.05290191, 0.04875254,  
0.05029605, 0.04340021, 0.0287235 , 0.01013684, 0.01247209,  
0.030972 , 0.02013929, 0.00899188, 0.02499085, 0.02579134,  
0.00333618, 0.04878987, 0.00508071, 0.04575228, 0.05552402,  
0.04195017, 0.04959341, 0.05984253, 0.00522341, 0.02935616,  
0.02742343, 0.01824838, 0.01303137, 0.05613975, 0.04859374,  
0.06061059, 0.06042887, 0.08520291, 0.0842812 , 0.07600808,  
0.07012383, 0.05245619, 0.06518281, 0.05225526, 0.06648707,  
0.03712495, 0.01845713, 0.03214332, 0.00379725, 0. ,  
0.03032956, 0. , 0.01462519, 0.00804928, 0.01167338,  
0.0161126 , 0.00912172, 0.00688748, 0.01192327, 0. ,  
0.04248916, 0.02835941, 0.02420612, 0.00090037, 0.04657835,  
0.02729072, 0.04098593, 0.02619311, 0.02930177, 0.02021704,  
0.05936235, 0.05206418, 0.05539075, 0.05316098, 0.08089838,  
0.0927742 , 0.05805381, 0.05173485, 0.034192 , 0.0544914 ,  
0.07610461, 0.02484886, 0.03315382, 0.00836458, 0.02834376,  
0.0203505 , 0.03091342, 0.01318847, 0.01118294, 0.01089058,  
0.01069756, 0.05549437, 0.01476562, 0.00300085, 0.00663623,  
0.01370951, 0.01979528, 0.031142 , 0.03337597, 0.02644989,  
0.00999861, 0.00423713, 0.03941742, 0. , 0.04685369,  
0.00093337, 0.00264325, 0.05335707, 0. , 0.00523598,  
0.04852905, 0.03765248, 0.06111787, 0. , 0. ,  
0.05125081, 0.04450464, 0.06683616, 0.01226309, 0.04065677,  
0.04088092, 0.05705499, 0.06734191, 0.0554818 , 0.06851754,  
0.06624162, 0.03343192, 0.03069359, 0.00618185, 0.07207503,  
0. , 0.01800614, 0.01420766, 0.00686921, 0.02949513,  
0.08706493, 0.03362054, 0.04339734, 0.00544136, 0.00741497,  
0.03916781, 0.05191769, 0.00258478, 0. , 0.00164662,  
0. , 0.00240275, 0.02645891, 0.01978122, 0. ,  
0.02358239, 0.03576466, 0.03367817, 0.05342179, 0.03398853,  
0.0314533 , 0.00192144, 0.04263156, 0.03287621, 0.01721614,  
0.02340094, 0.08245581, 0.04817844, 0.05117378, 0.00815583,  
0. , 0. , 0. , 0. , 0.02789896,  
0.04871372, 0.0719595 ])

In [14]:

```
mutual_info = pd.Series(mutual_info)
mutual_info.index = x.columns
mutual_info.sort_values(ascending=False)
```

Out[14]:

tqwt\_entropy\_log\_dec\_35 0.107912  
std\_delta\_delta\_log\_energy 0.106065  
mean\_MFCC\_2nd\_coef 0.097355  
std\_8th\_delta\_delta 0.096180  
tqwt\_MFCC\_mean\_dec\_16 0.095862



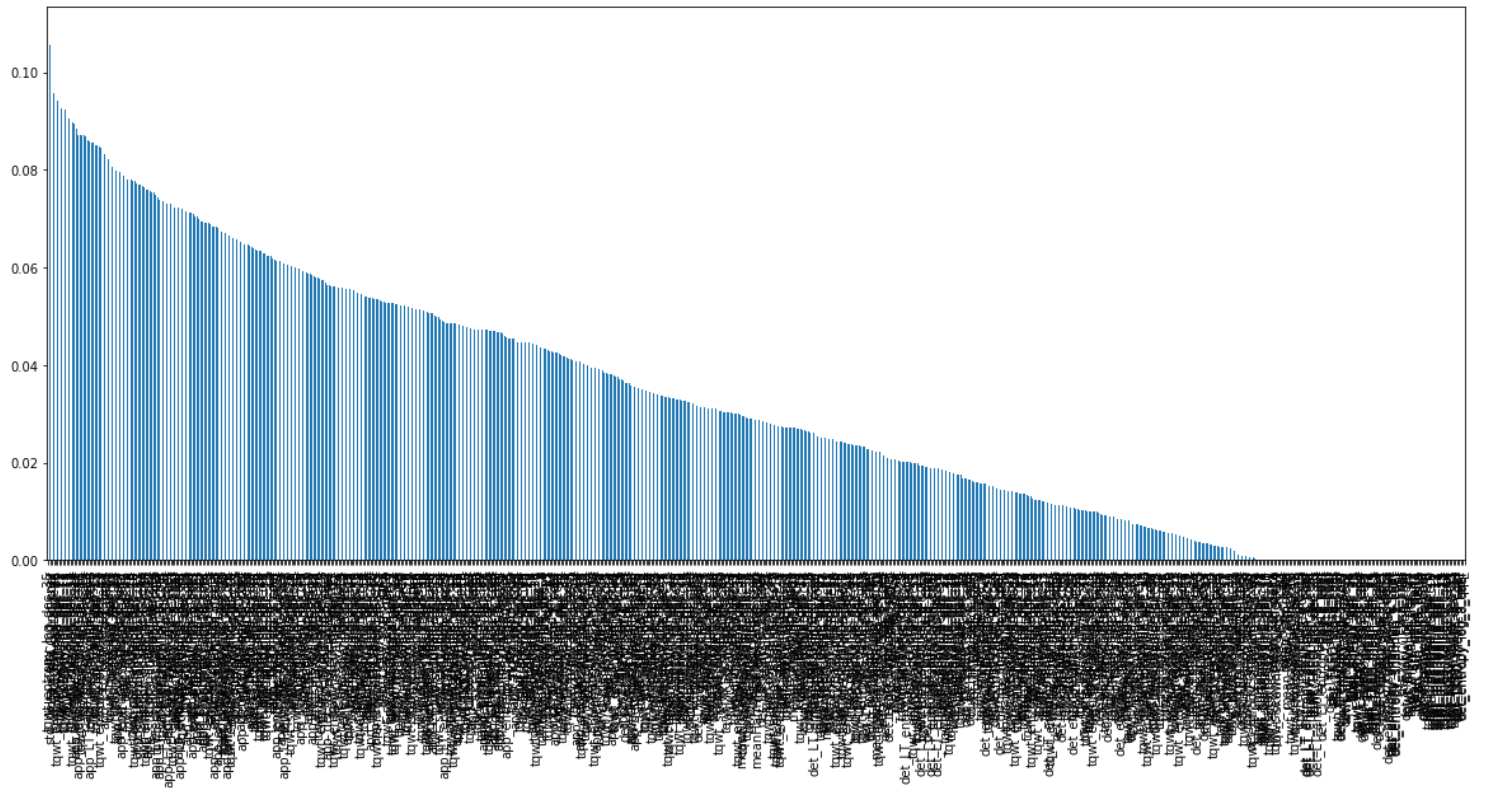
```
tqwt_TKEO_mean_dec_10      0.099862
...
det_TKEO_mean_4_coef        0.000000
det_TKEO_mean_3_coef        0.000000
det_entropy_log_9_coef      0.000000
det_entropy_log_8_coef      0.000000
PPE                          0.000000
Length: 752, dtype: float64
```

In [29]:

```
mutual_info.sort_values(ascending=False).plot.bar(figsize=(20, 8)) # Importance Graph Shows
--> Important features for this dataset.
```

Out[29]:

<matplotlib.axes.\_subplots.AxesSubplot at 0x2121f205d48>



In [15]:

```
from sklearn.feature_selection import SelectKBest
#Now we Will select the top 50 important features
sel_cols = SelectKBest(mutual_info_classif, k=50 )
sel_cols.fit(x, y)
col = x.columns[sel_cols.get_support()] # Thus this shows top 50 features can be used for pr
ediction of parkinson disease.
col
```

Out[15]:

```
Index(['minIntensity', 'mean_MFCC_2nd_coef', 'std_Log_energy',
      'std_delta_log_energy', 'std_3rd_delta', 'std_6th_delta',
      'std_8th_delta', 'std_9th_delta', 'std_delta_delta_log_energy',
      'std_6th_delta_delta', 'std_7th_delta_delta', 'std_8th_delta_delta',
      'std_9th_delta_delta', 'app_entropy_shannon_4_coef',
      'app_entropy_shannon_5_coef', 'app_entropy_shannon_6_coef',
      'app_entropy_shannon_7_coef', 'app_entropy_log_5_coef',
      'app_LT_entropy_shannon_6_coef', 'app_LT_entropy_shannon_7_coef',
      'app_LT_entropy_log_6_coef', 'app_LT_TKEO_std_8_coef',
      'tqwt_energy_dec_26', 'tqwt_energy_dec_27',
      'tqwt_entropy_shannon_dec_11', 'tqwt_entropy_shannon_dec_14',
      'tqwt_entropy_shannon_dec_16', 'tqwt_entropy_shannon_dec_35',
      'tqwt_entropy_log_dec_11', 'tqwt_entropy_log_dec_12',
      'tqwt_entropy_log_dec_16', 'tqwt_entropy_log_dec_17',
      'tqwt_entropy_log_dec_35', 'tqwt_TKEO_mean_dec_11',
      'tqwt_TKEO_mean_dec_12', 'tqwt_TKEO_mean_dec_13',
      'tqwt_TKEO_mean_dec_16', 'tqwt_TKEO_std_dec_11', 'tqwt_TKEO_std_dec_12',
      'tqwt_TKEO_std_dec_13', 'tqwt_medianValue_dec_8',
      'tqwt_stdValue_dec_12', 'tqwt_stdValue_dec_15', 'tqwt_minValue_dec_10',
      'tqwt_minValue_dec_11', 'tqwt_maxValue_dec_11', 'tqwt_maxValue_dec_12',
      'tqwt_maxValue_dec_17', 'tqwt_skewnessValue_dec_36',
      'tqwt_kurtosisValue_dec_26'],
      dtype='object')
```

In [16]:

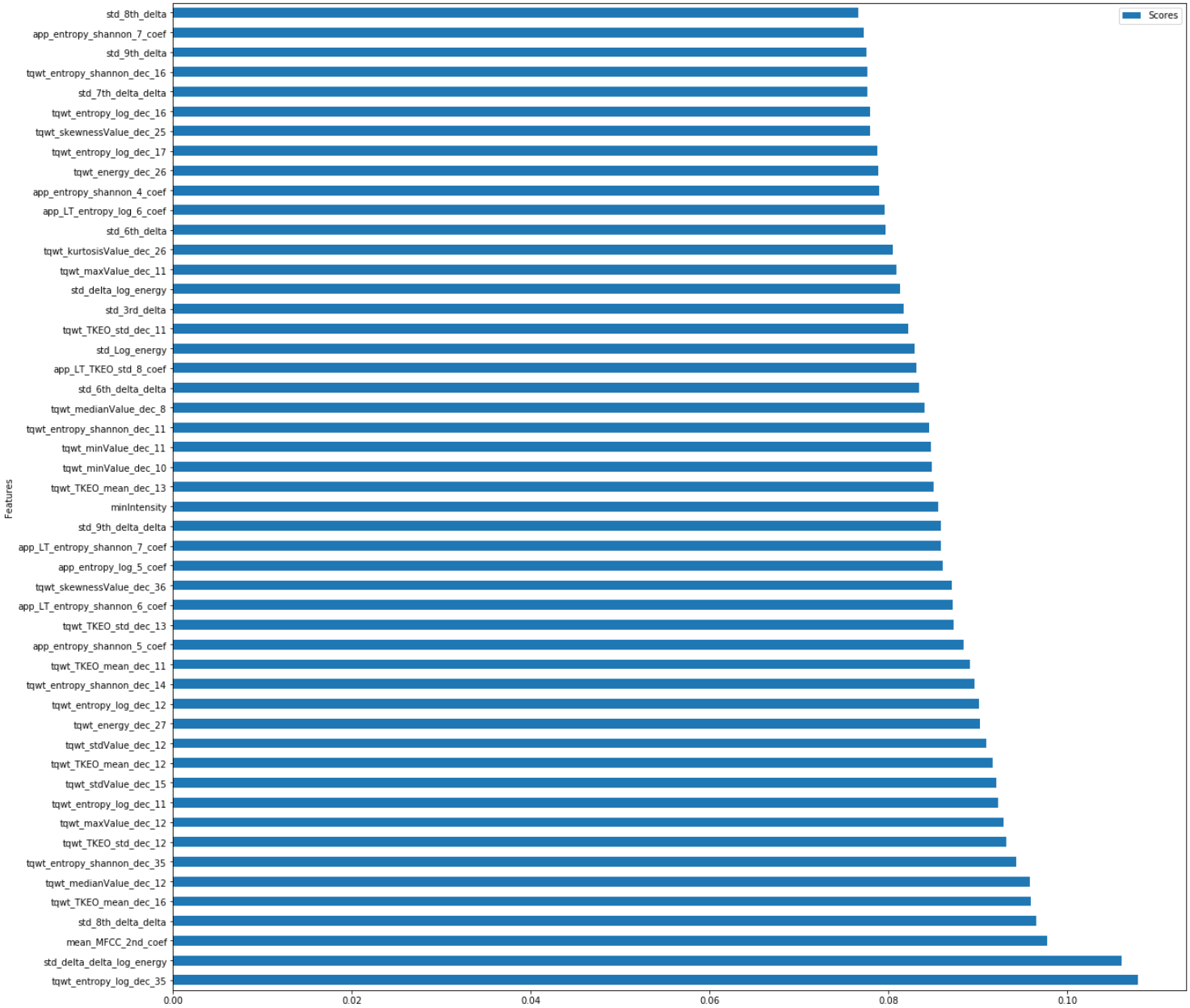
```
selected_features = pd.DataFrame({'Features': list(x.columns), 'Scores': sel_cols.scores_})
selected_features = selected_features.sort_values(by='Scores', ascending = False)
selected_features = selected_features[:50]
selected_features = selected_features.set_index('Features')
```

In [158]:

```
selected_features.sort_values(by = "Scores",ascending=False).plot.barh(figsize=(20, 20)) #
Importance Graph Shows --> Important features for this dataset.
```

Out[158]:

<matplotlib.axes.\_subplots.AxesSubplot at 0x217e193ac88>



In [32]:

```
Best_df = sel_cols.transform(x)
Best_df = pd.DataFrame(Best_df)
```

In [33]:

```
Best_df
```

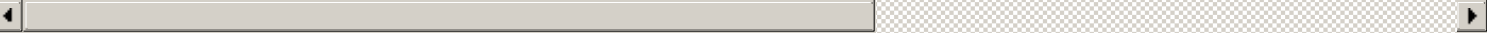
Out[33]:

	0	1	2	3	4	5	6	7	8	9	...	40	41
0	69.997496	2.48740	0.34158	0.049933	0.040231	0.028830	0.028115	0.047180	0.016392	0.014642	...	9.930000e-19	0.004324
1	67.415903	2.89860	0.22994	0.037774	0.045076	0.050259	0.022166	0.039071	0.014222	0.025500	...	5.290000e-18	0.004344
2	62.661706	3.22080	0.52574	0.109450	0.045403	0.054611	0.032326	0.047357	0.039709	0.024607	...	9.790000e-19	0.002657
3	76.306989	3.10230	0.21182	0.039296	0.046507	0.035774	0.032577	0.024291	0.015560	0.017274	...	1.620000e-06	0.016104
4	76.645686	2.94510	0.17405	0.028652	0.046887	0.029721	0.031989	0.026002	0.011037	0.013791	...	2.640000e-05	0.015422
...	...	...	...	...	...	...	...	...	...	...	...	...	...
751	79.991789	1.97830	0.12841	0.016270	0.036228	0.028405	0.032791	0.036182	0.004271	0.012046	...	5.302500e-04	0.116780



752	70.1913300	1.45210	0.47788	0.077975	0.096287	0.056871	0.041971	0.034773	0.035989	0.023391	...	3.450000e-05	0.095527
753	75.091300	1.13730	0.14207	0.019782	0.038681	0.026838	0.029193	0.031031	0.006292	0.013633	...	5.100000e-05	0.078863
754	76.168804	0.17925	0.14316	0.032064	0.043072	0.039557	0.027188	0.030468	0.010716	0.016464	...	4.960000e-05	0.059031
755	76.076331	0.71315	0.21130	0.024350	0.043717	0.049222	0.037214	0.031895	0.008183	0.022282	...	7.920000e-05	0.052834

756 rows x 50 columns



E. Chi-square Test For Feature Selection.

In [164]:

```
# Perform chi2 test
# chi2 returns 2 values
# Fscore and the pvalue

x = parkinsons_data.drop(columns=['id', 'gender', 'class'], axis=1)
x = x.abs()
y = parkinsons_data['class']
y=y.astype('int')
from sklearn.feature_selection import chi2
f_p_values = chi2(x,y)

import pandas as pd
p_values = pd.Series(f_p_values[1])
p_values.index = x.columns
p_values = pd.DataFrame(p_values.sort_values(ascending=False))
p_values = p_values[:50]# Thus we again get same results that -->Imporatanant Features ranked as below
p_values # Top 50 Features
```

Out[164]:

	0
tqwt_meanValue_dec_2	1.000000
tqwt_meanValue_dec_1	1.000000
tqwt_meanValue_dec_21	1.000000
tqwt_meanValue_dec_4	1.000000
tqwt_meanValue_dec_3	1.000000
tqwt_meanValue_dec_6	1.000000
tqwt_meanValue_dec_5	1.000000
tqwt_meanValue_dec_30	1.000000
tqwt_meanValue_dec_7	1.000000
tqwt_meanValue_dec_9	1.000000
tqwt_meanValue_dec_8	1.000000
tqwt_meanValue_dec_25	1.000000
tqwt_meanValue_dec_10	1.000000
tqwt_meanValue_dec_29	1.000000
tqwt_meanValue_dec_20	1.000000
tqwt_meanValue_dec_11	1.000000
tqwt_meanValue_dec_24	1.000000
tqwt_meanValue_dec_22	1.000000
tqwt_meanValue_dec_12	1.000000
tqwt_meanValue_dec_31	1.000000
tqwt_meanValue_dec_16	1.000000
tqwt_meanValue_dec_23	1.000000
tqwt_meanValue_dec_14	1.000000
tqwt_meanValue_dec_26	1.000000
tqwt_meanValue_dec_17	1.000000
tqwt_meanValue_dec_18	1.000000
tqwt_meanValue_dec_13	1.000000

tqwt_meanValue_dec_19	1.000000
tqwt_meanValue_dec_35	1.000000
tqwt_meanValue_dec_15	1.000000
tqwt_meanValue_dec_32	1.000000
tqwt_meanValue_dec_34	1.000000
tqwt_meanValue_dec_28	1.000000
tqwt_meanValue_dec_27	1.000000
tqwt_meanValue_dec_33	1.000000
det_LT_TKEO_mean_1_coef	0.999717
tqwt_medianValue_dec_2	0.999387
Ea2	0.998827
Ed2_4_coef	0.998339
tqwt_energy_dec_19	0.998109
tqwt_TKEO_mean_dec_4	0.997335
tqwt_medianValue_dec_1	0.997329
tqwt_energy_dec_23	0.997157
tqwt_energy_dec_30	0.996690
tqwt_TKEO_std_dec_3	0.996642
tqwt_medianValue_dec_4	0.996534
tqwt_medianValue_dec_3	0.996082
tqwt_TKEO_mean_dec_3	0.995720
Ed2_2_coef	0.995284
tqwt_TKEO_std_dec_4	0.993412

In [201]:

```
# Final Features are as follows :

X = parkinsons_data[col]
y = parkinsons_data['class']

from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)
```

In [123]:

X
---

Out[123]:

	minIntensity	mean_MFCC_2nd_coef	std_Log_energy	std_delta_log_energy	std_3rd_delta	std_6th_delta	std_8th_delta	std_9th_delta
0	69.997496	2.48740	0.34158	0.049933	0.040231	0.028830	0.028115	0.028115
1	67.415903	2.89860	0.22994	0.037774	0.045076	0.050259	0.022166	0.022166
2	62.661706	3.22080	0.52574	0.109450	0.045403	0.054611	0.032326	0.032326
3	76.306989	3.10230	0.21182	0.039296	0.046507	0.035774	0.032577	0.032577
4	76.645686	2.94510	0.17405	0.028652	0.046887	0.029721	0.031989	0.031989
...	...	...	...	...	...	...	...	...
751	79.991789	-1.97830	0.12841	0.016270	0.036228	0.028405	0.032791	0.032791
752	70.191330	-1.45210	0.47788	0.077975	0.096287	0.056871	0.041971	0.041971
753	75.091300	-1.13730	0.14207	0.019782	0.038681	0.026838	0.029193	0.029193
754	76.168804	-0.17925	0.14316	0.032064	0.043072	0.039557	0.027188	0.027188
755	76.076331	0.71315	0.21130	0.024350	0.043717	0.049222	0.037214	0.037214

756 rows x 50 columns

◀		▶
---	--	---

In [124]:

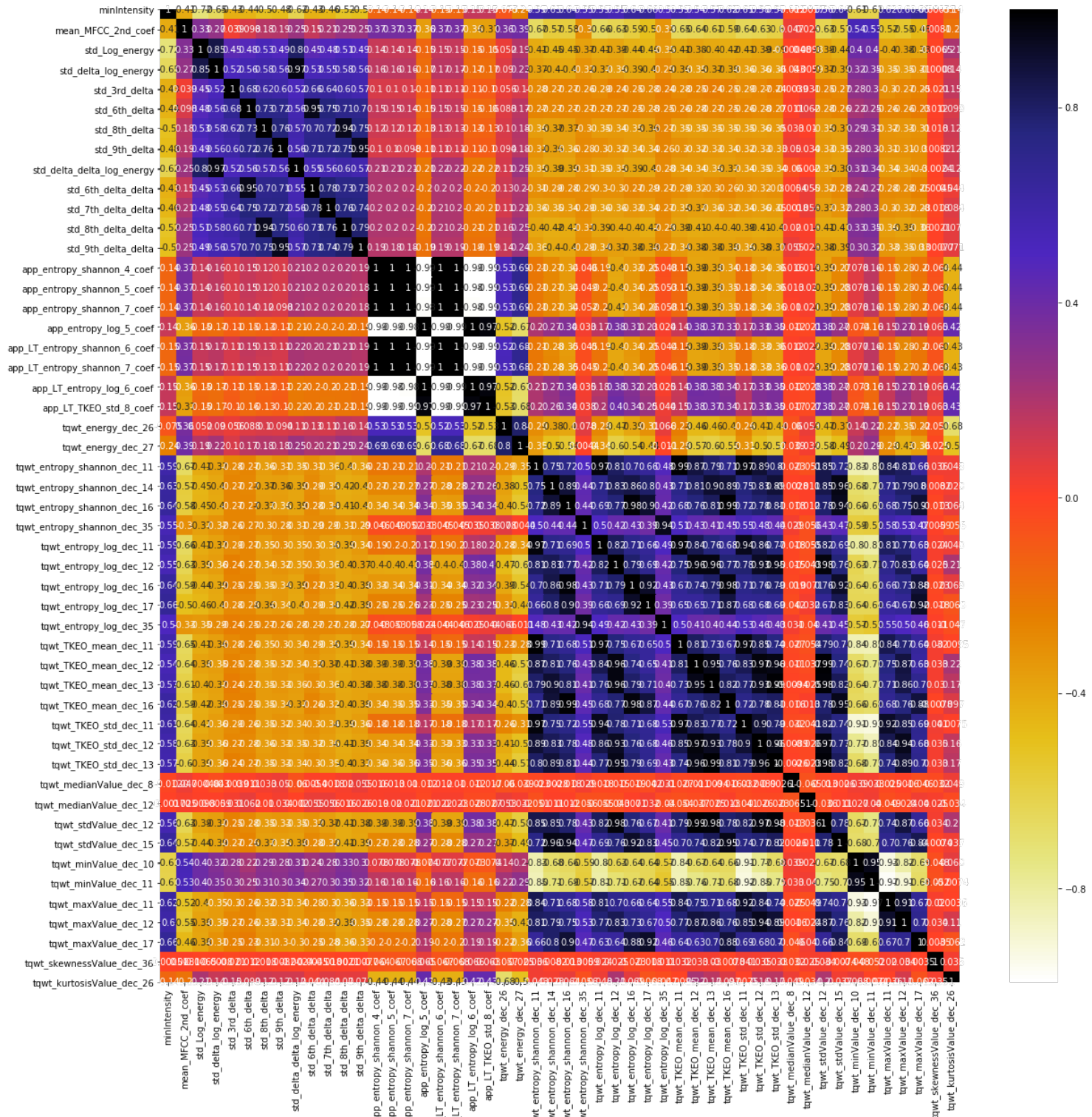
y
---

Out[124]:

0 1  
1 1  
2 1  
3 1  
4 1  
  
..  
751 0  
752 0  
753 0  
754 0  
755 0  
Name: class, Length: 756, dtype: int64

In [206]:

```
import seaborn as sns
#Using Spearman Correlation
plt.figure(figsize=(20,20))
cor = X.corr('spearman')
sns.heatmap(cor, annot=True, cmap=plt.cm.CMRmap_r)
plt.show()
```



In [125]:

```
print("X Training Set: ",X_train.shape)
print("Y Training Set: ",y_train.shape)
print("\n")
print("X Testing Set: ",X_test.shape)
print("Y Testing Set: ",y_test.shape)
```

X Training Set: (604, 50)  
Y Training Set: (604,)

X Testing Set: (152, 50)

Y Testing Set: (152,)

# Step 4 - Applying Machine Learning & Deep Learning Algorithms

## Classification Algorithms:

- Top 5 Classification Algorithms in Machine Learning
- Logistic Regression.
- Naive Bayes.
- K-Nearest Neighbors.
- Decision Tree.
- Support Vector Machines.
- MultiLayer Perceptron.

## ### Ensemble Learning

- Random Forest Classifier.
- Adaboost Classifier.
- Extra Tree Classifier.

## Reduce The Curse Of Dimensionality

- a. Principal Component Analysis.(PCA)
- b. Kernel Principal Component Analysis.(KPCA)
- c. Linear Discriminant Analysis.(LDA)
- d. Quadratic Discriminant Analysis.(QDA)

## ### Regularization Techniques:

- a. L1 : Lasso Regression.
- b. L2 : Ridge Regression.
- c. Elastic-Net Regression ( Lasso + Ridge )

In [135]:

```
#Feature Scaling

from sklearn.preprocessing import StandardScaler
sc = StandardScaler()
X_train = sc.fit_transform(X_train)
X_test = sc.fit_transform(X_test)
```

## A. Logistic Regression Algorithm

In [129]:

```
# Load libraries
from sklearn.linear_model import LogisticRegression
# Create one-vs-rest logistic regression object
mind = LogisticRegression(random_state=0)
# Train model
mind.fit(X_train,y_train)
#Prediction part
y_pred = mind.predict(X_test)
```

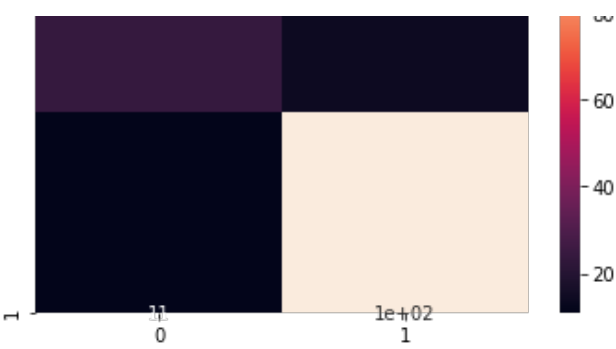
C:\Users\Lenovo\Anaconda3\lib\site-packages\sklearn\linear\_model\logistic.py:432: FutureWarning: Default solver will be changed to 'lbfgs' in 0.22. Specify a solver to silence this warning.  
FutureWarning)

In [130]:

```
#Making a confusion matrix
from sklearn.metrics import confusion_matrix
cm = confusion_matrix(y_test, y_pred)
print(cm)
sns.heatmap(cm, annot=True)
print('Accuracy: ' +str(accuracy_score(y_test, y_pred)))
```

[[ 24 14]  
 [ 11 103]]  
Accuracy: 0.8355263157894737





## B. Naive Bayes Algorithm

In [136]:

```
from sklearn.naive_bayes import GaussianNB , BernoulliNB ,MultinomialNB # GaussianNB : For Continuous distribution of data , BernoulliNB: For the dataset having only two classes i.e 0 & 1 , MultinomialNB: For the dataset having count or we can say how many times word repeated ..mostly used for NLP .

mind2 = GaussianNB()

mind2.fit(X_train,y_train)

#Prediction part
y_pred_gnb = mind2.predict(X_test)
```

In [137]:

```
mind2b = BernoulliNB()

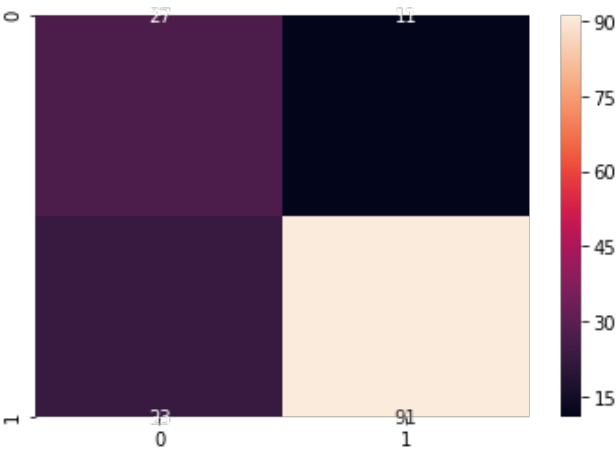
mind2b.fit(X_train,y_train)

#Prediction part
y_pred_bnb = mind2b.predict(X_test)
```

In [138]:

```
#Making a confusion matrix
from sklearn.metrics import confusion_matrix
cm = confusion_matrix(y_test, y_pred_gnb)
print(cm)
sns.heatmap(cm, annot=True)
print('Accuracy: ' +str(accuracy_score(y_test, y_pred_gnb)))
```

```
[[27 11]
 [23 91]]
Accuracy: 0.7763157894736842
```

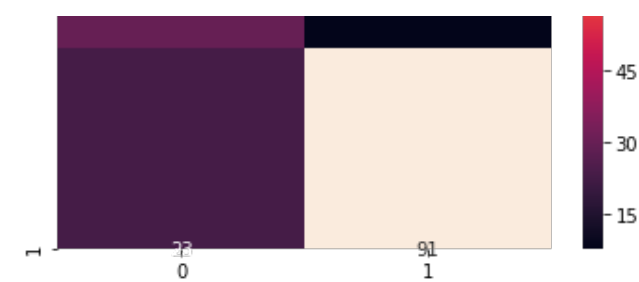


In [139]:

```
#Making a confusion matrix
from sklearn.metrics import confusion_matrix
cm = confusion_matrix(y_test, y_pred_bnb)
print(cm)
sns.heatmap(cm, annot=True)
print('Accuracy: ' +str(accuracy_score(y_test, y_pred_bnb)))
```

```
[[30  8]
 [23 91]]
Accuracy: 0.7960526315789473
```





## C. K-Nearest Neighbors Algorithm

In [140]:

```
from sklearn.neighbors import KNeighborsClassifier

# Choosing correct value of K
error_rate = []

# Will take some time
for i in range(1,40):

    knn = KNeighborsClassifier(n_neighbors=i)

    knn.fit(X_train,y_train)

    pred_i = knn.predict(X_test)

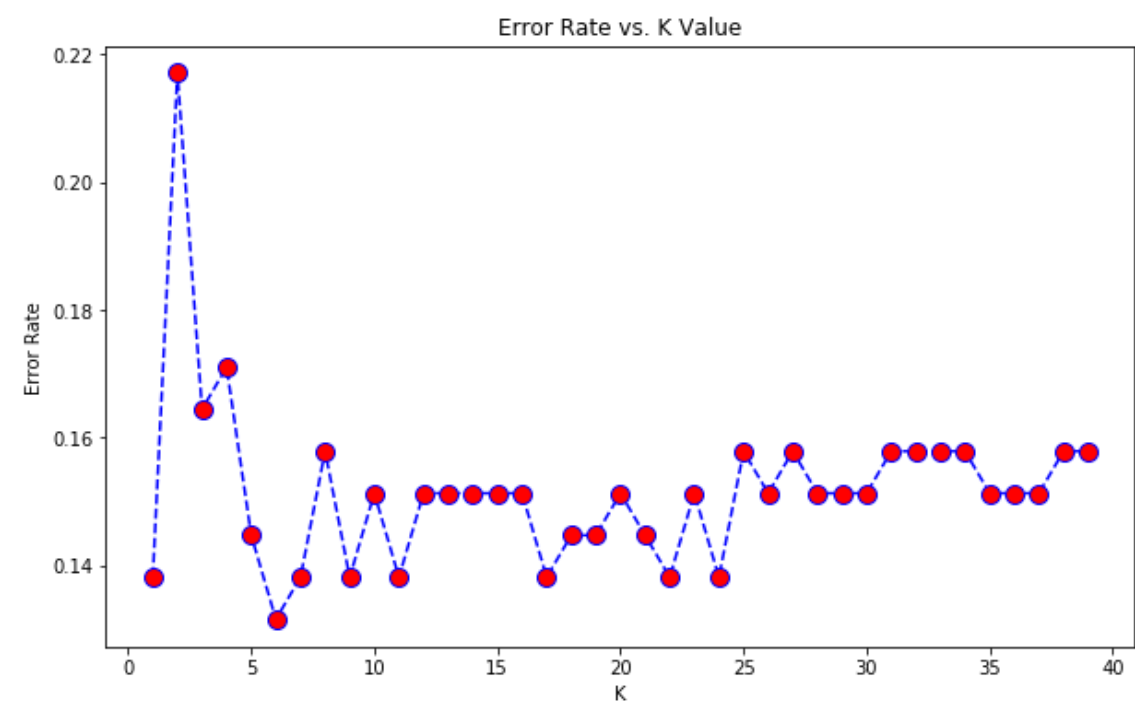
    error_rate.append(np.mean(pred_i != y_test))
```

In [141]:

```
plt.figure(figsize=(10,6))
plt.plot(range(1,40),error_rate,color='blue', linestyle='dashed', marker='o',
         markerfacecolor='red', markersize=10)
plt.title('Error Rate vs. K Value')
plt.xlabel('K')
plt.ylabel('Error Rate')
```

Out[141]:

Text(0, 0.5, 'Error Rate')



In [142]:

```
# NOW WITH K=5
from sklearn.metrics import classification_report,confusion_matrix
from sklearn.neighbors import KNeighborsClassifier

knn = KNeighborsClassifier(n_neighbors=5)

knn.fit(X_train,y_train)
pred = knn.predict(X_test)

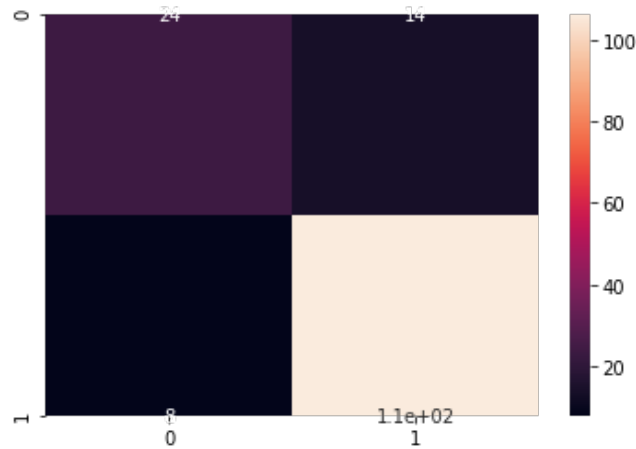
print('WITH K=5')
print('\n')
print(confusion_matrix(y_test,pred))
sns.heatmap(confusion_matrix(y_test,pred), annot=True)
print('\n')
print(classification_report(y_test,pred))
print('Accuracy: ' +str(accuracy_score(y_test,pred)))
```

WITH K=5

```
[[ 24  14]
 [  8 106]]
```

	precision	recall	f1-score	support
0	0.75	0.63	0.69	38
1	0.88	0.93	0.91	114
accuracy			0.86	152
macro avg	0.82	0.78	0.80	152
weighted avg	0.85	0.86	0.85	152

Accuracy: 0.8552631578947368



D. Decision Tree Algorithm

In [143]:

```
from sklearn.tree import DecisionTreeClassifier
drugTree = DecisionTreeClassifier(criterion="entropy", max_depth = 4)
drugTree # it shows the default parameters
drugTree.fit(X_train,y_train)
predTree = drugTree.predict(X_test)
```

In [144]:

```
print("DecisionTrees's Accuracy: ", metrics.accuracy_score(y_test, predTree))
```

DecisionTrees's Accuracy: 0.7763157894736842

In [145]:

```
print('\n')
print(confusion_matrix(y_test,predTree))
sns.heatmap(confusion_matrix(y_test,predTree), annot=True)
print('\n')
print(classification_report(y_test,predTree))
print('Accuracy: ' +str(metrics.accuracy_score(y_test,predTree)))
```

```
[[19 19]
 [15 99]]
```

	precision	recall	f1-score	support
0	0.56	0.50	0.53	38
1	0.84	0.87	0.85	114
accuracy			0.78	152
macro avg	0.70	0.68	0.69	152
weighted avg	0.77	0.78	0.77	152

Accuracy: 0.7763157894736842







## E. Support Vector Machines

### Linear Kernel

In [146]:

```
from sklearn.svm import SVC
classifier = SVC(kernel='linear', gamma='auto', C=2)
classifier.fit(X_train, y_train)
y_linearPred= classifier.predict(X_test)
```

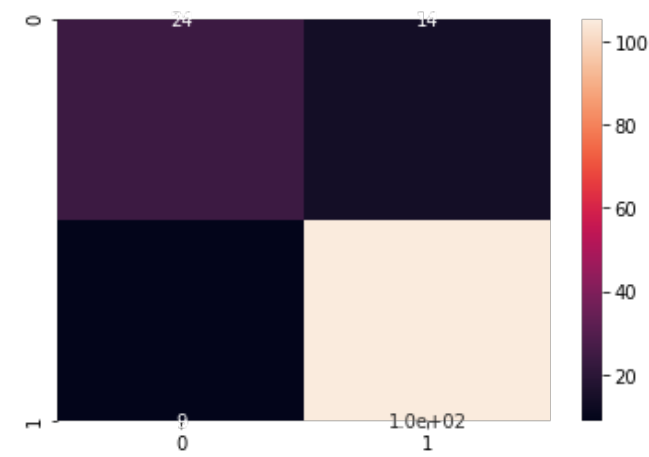
In [147]:

```
from sklearn.metrics import classification_report, confusion_matrix
cm = confusion_matrix(y_test, y_linearPred)
print(cm)
sns.heatmap(cm, annot=True)
print('\n')
print(classification_report(y_test, y_linearPred))
print('Accuracy: ' +str(accuracy_score(y_test, y_linearPred)))
```

```
[[ 24  14]
 [   9 105]]
```

	precision	recall	f1-score	support
0	0.73	0.63	0.68	38
1	0.88	0.92	0.90	114
accuracy			0.85	152
macro avg	0.80	0.78	0.79	152
weighted avg	0.84	0.85	0.84	152

Accuracy: 0.8486842105263158



### Polynomial Kernel

In [148]:

```
from sklearn.svm import SVC
classifier = SVC(kernel='poly', gamma='auto', C=2)
classifier.fit(X_train, y_train)
y_polyPred= classifier.predict(X_test)
```

In [149]:

```
from sklearn.metrics import classification_report, confusion_matrix
cm = confusion_matrix(y_test, y_polyPred)
print(cm)
sns.heatmap(cm, annot=True)
print('\n')
print(classification_report(y_test, y_polyPred))
print('Accuracy: ' +str(accuracy_score(y_test, y_polyPred)))
```

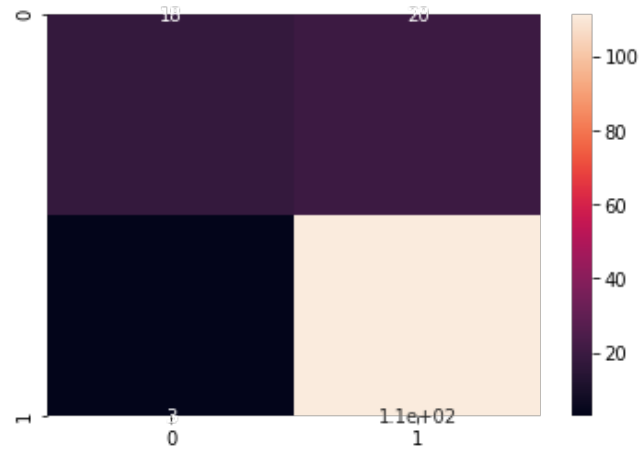
```
[[ 18  20]
 [   3 111]]
```

	precision	recall	f1-score	support
--	-----------	--------	----------	---------



	0	0.86	0.47	0.61	38
	1	0.85	0.97	0.91	114
accuracy				0.85	152
macro avg		0.85	0.72	0.76	152
weighted avg		0.85	0.85	0.83	152

Accuracy: 0.8486842105263158



### RBF : Radial Basis Function Kernel

In [150]:

```
from sklearn.svm import SVC
classifier = SVC(kernel='rbf', gamma='auto', C=2)
classifier.fit(X_train,y_train)
y_rbfPred= classifier.predict(X_test)
```

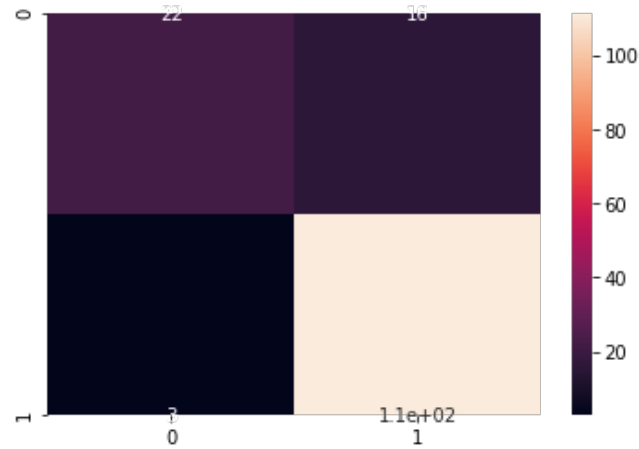
In [151]:

```
from sklearn.metrics import classification_report,confusion_matrix
cm = confusion_matrix(y_test,y_rbfPred)
print(cm)
sns.heatmap(cm, annot=True)
print('\n')
print(classification_report(y_test,y_rbfPred))
print('Accuracy: ' +str(accuracy_score(y_test,y_rbfPred)))
```

```
[[ 22  16]
 [   3 111]]
```

		precision	recall	f1-score	support
	0	0.88	0.58	0.70	38
	1	0.87	0.97	0.92	114
accuracy				0.88	152
macro avg		0.88	0.78	0.81	152
weighted avg		0.88	0.88	0.87	152

Accuracy: 0.875



### Random Forest Classifier - Ensemble Technique [Bagging ]

In [152]:

```
from sklearn import tree
from sklearn.ensemble import RandomForestClassifier
```

```
clf = RandomForestClassifier(n_estimators=20,random_state=0)
clf.fit(X_train,y_train)
```

Out[152]:

```
RandomForestClassifier(bootstrap=True, class_weight=None, criterion='gini',
                        max_depth=None, max_features='auto', max_leaf_nodes=None,
                        min_impurity_decrease=0.0, min_impurity_split=None,
                        min_samples_leaf=1, min_samples_split=2,
                        min_weight_fraction_leaf=0.0, n_estimators=20,
                        n_jobs=None, oob_score=False, random_state=0, verbose=0,
                        warm_start=False)
```

In [153]:

```
clf.estimators_
```

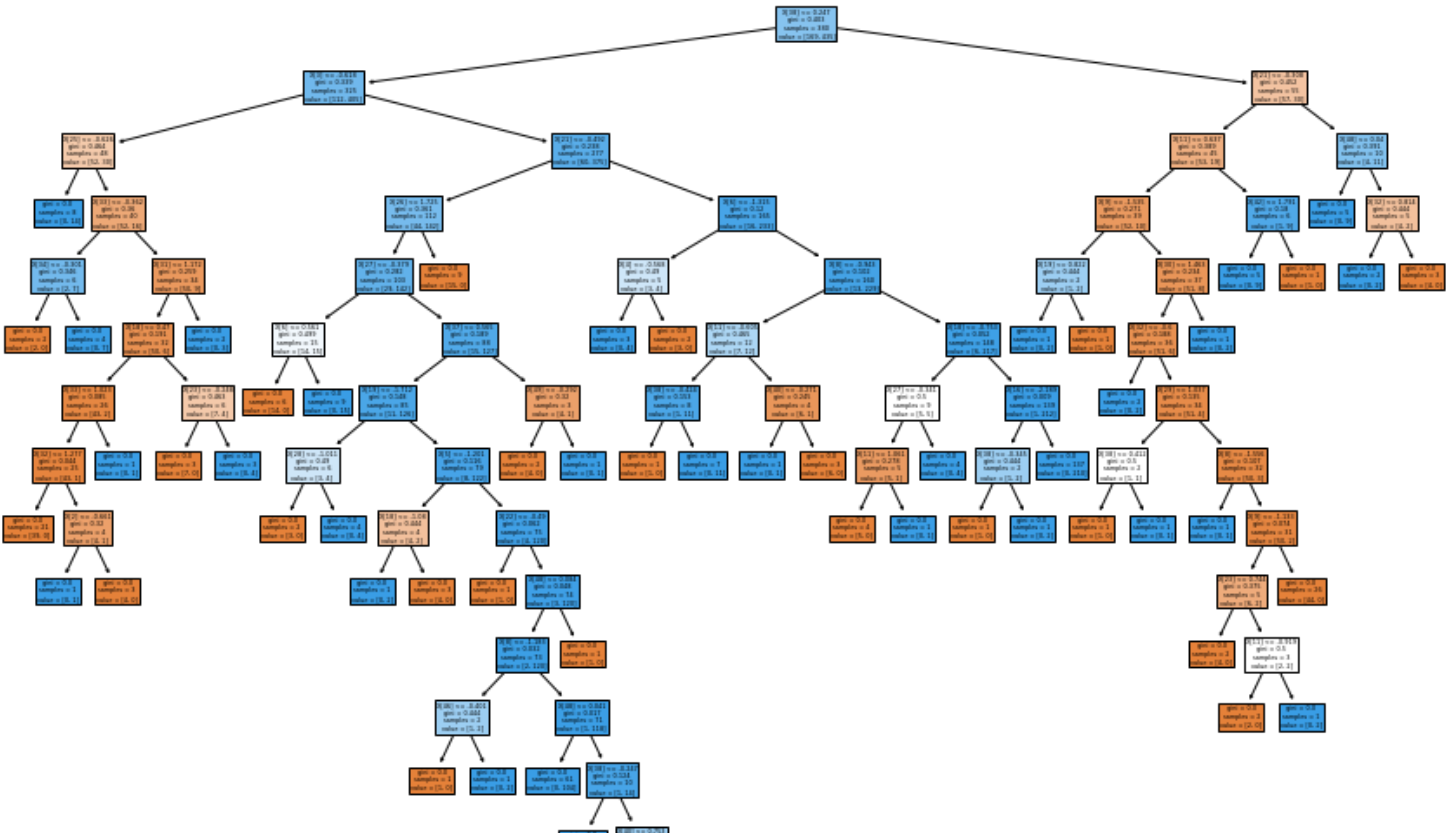
Out[153]:

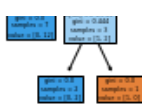
```
[DecisionTreeClassifier(class_weight=None, criterion='gini', max_depth=None,
                        max_features='auto', max_leaf_nodes=None,
                        min_impurity_decrease=0.0, min_impurity_split=None,
                        min_samples_leaf=1, min_samples_split=2,
                        min_weight_fraction_leaf=0.0, presort=False,
                        random_state=209652396, splitter='best'),
 DecisionTreeClassifier(class_weight=None, criterion='gini', max_depth=None,
                        max_features='auto', max_leaf_nodes=None,
                        min_impurity_decrease=0.0, min_impurity_split=None,
                        min_samples_leaf=1, min_samples_split=2,
                        min_weight_fraction_leaf=0.0, presort=False,
                        random_state=398764591, splitter='best'),
 DecisionTreeClassifier(class_weight=None, criterion='gini', max_depth=None,
                        max_features='auto', max_leaf_nodes=None,
                        min_impurity_decrease=0.0, min_impurity_split=None,
                        min_samples_leaf=1, min_samples_split=2,
                        min_weight_fraction_leaf=0.0, presort=False,
                        random_state=924231285, splitter='best'),
 DecisionTreeClassifier(class_weight=None, criterion='gini', max_depth=None,
                        max_features='auto', max_leaf_nodes=None,
                        min_impurity_decrease=0.0, min_impurity_split=None,
                        min_samples_leaf=1, min_samples_split=2,
                        min_weight_fraction_leaf=0.0, presort=False,
                        random_state=1478610112, splitter='best'),
 DecisionTreeClassifier(class_weight=None, criterion='gini', max_depth=None,
                        max_features='auto', max_leaf_nodes=None,
                        min_impurity_decrease=0.0, min_impurity_split=None,
                        min_samples_leaf=1, min_samples_split=2,
                        min_weight_fraction_leaf=0.0, presort=False,
                        random_state=441365315, splitter='best'),
 DecisionTreeClassifier(class_weight=None, criterion='gini', max_depth=None,
                        max_features='auto', max_leaf_nodes=None,
                        min_impurity_decrease=0.0, min_impurity_split=None,
                        min_samples_leaf=1, min_samples_split=2,
                        min_weight_fraction_leaf=0.0, presort=False,
                        random_state=1537364731, splitter='best'),
 DecisionTreeClassifier(class_weight=None, criterion='gini', max_depth=None,
                        max_features='auto', max_leaf_nodes=None,
                        min_impurity_decrease=0.0, min_impurity_split=None,
                        min_samples_leaf=1, min_samples_split=2,
                        min_weight_fraction_leaf=0.0, presort=False,
                        random_state=192771779, splitter='best'),
 DecisionTreeClassifier(class_weight=None, criterion='gini', max_depth=None,
                        max_features='auto', max_leaf_nodes=None,
                        min_impurity_decrease=0.0, min_impurity_split=None,
                        min_samples_leaf=1, min_samples_split=2,
                        min_weight_fraction_leaf=0.0, presort=False,
                        random_state=1491434855, splitter='best'),
 DecisionTreeClassifier(class_weight=None, criterion='gini', max_depth=None,
                        max_features='auto', max_leaf_nodes=None,
                        min_impurity_decrease=0.0, min_impurity_split=None,
                        min_samples_leaf=1, min_samples_split=2,
                        min_weight_fraction_leaf=0.0, presort=False,
                        random_state=1819583497, splitter='best'),
 DecisionTreeClassifier(class_weight=None, criterion='gini', max_depth=None,
                        max_features='auto', max_leaf_nodes=None,
                        min_impurity_decrease=0.0, min_impurity_split=None,
                        min_samples_leaf=1, min_samples_split=2,
                        min_weight_fraction_leaf=0.0, presort=False,
                        random_state=530702035, splitter='best'),
 DecisionTreeClassifier(class_weight=None, criterion='gini', max_depth=None,
                        max_features='auto', max_leaf_nodes=None,
                        min_impurity_decrease=0.0, min_impurity_split=None,
                        min_samples_leaf=1, min_samples_split=2,
                        min_weight_fraction_leaf=0.0, presort=False,
                        random_state=626610453, splitter='best'),
 DecisionTreeClassifier(class_weight=None, criterion='gini', max_depth=None,
                        max_features='auto', max_leaf_nodes=None,
```

```
min_impurity_decrease=0.0, min_impurity_split=None,
min_samples_leaf=1, min_samples_split=2,
min_weight_fraction_leaf=0.0, presort=False,
random_state=1650906866, splitter='best'),
DecisionTreeClassifier(class_weight=None, criterion='gini', max_depth=None,
max_features='auto', max_leaf_nodes=None,
min_impurity_decrease=0.0, min_impurity_split=None,
min_samples_leaf=1, min_samples_split=2,
min_weight_fraction_leaf=0.0, presort=False,
random_state=1879422756, splitter='best'),
DecisionTreeClassifier(class_weight=None, criterion='gini', max_depth=None,
max_features='auto', max_leaf_nodes=None,
min_impurity_decrease=0.0, min_impurity_split=None,
min_samples_leaf=1, min_samples_split=2,
min_weight_fraction_leaf=0.0, presort=False,
random_state=1277901399, splitter='best'),
DecisionTreeClassifier(class_weight=None, criterion='gini', max_depth=None,
max_features='auto', max_leaf_nodes=None,
min_impurity_decrease=0.0, min_impurity_split=None,
min_samples_leaf=1, min_samples_split=2,
min_weight_fraction_leaf=0.0, presort=False,
random_state=1682652230, splitter='best'),
DecisionTreeClassifier(class_weight=None, criterion='gini', max_depth=None,
max_features='auto', max_leaf_nodes=None,
min_impurity_decrease=0.0, min_impurity_split=None,
min_samples_leaf=1, min_samples_split=2,
min_weight_fraction_leaf=0.0, presort=False,
random_state=243580376, splitter='best'),
DecisionTreeClassifier(class_weight=None, criterion='gini', max_depth=None,
max_features='auto', max_leaf_nodes=None,
min_impurity_decrease=0.0, min_impurity_split=None,
min_samples_leaf=1, min_samples_split=2,
min_weight_fraction_leaf=0.0, presort=False,
random_state=1991416408, splitter='best'),
DecisionTreeClassifier(class_weight=None, criterion='gini', max_depth=None,
max_features='auto', max_leaf_nodes=None,
min_impurity_decrease=0.0, min_impurity_split=None,
min_samples_leaf=1, min_samples_split=2,
min_weight_fraction_leaf=0.0, presort=False,
random_state=1171049868, splitter='best'),
DecisionTreeClassifier(class_weight=None, criterion='gini', max_depth=None,
max_features='auto', max_leaf_nodes=None,
min_impurity_decrease=0.0, min_impurity_split=None,
min_samples_leaf=1, min_samples_split=2,
min_weight_fraction_leaf=0.0, presort=False,
random_state=1646868794, splitter='best'),
DecisionTreeClassifier(class_weight=None, criterion='gini', max_depth=None,
max_features='auto', max_leaf_nodes=None,
min_impurity_decrease=0.0, min_impurity_split=None,
min_samples_leaf=1, min_samples_split=2,
min_weight_fraction_leaf=0.0, presort=False,
random_state=2051556033, splitter='best')]
```

In [207]:

```
plt.figure(figsize=(15,10))
for i in range(len(clf.estimators_)):
    tree.plot_tree(clf.estimators_[i],filled=True)
```





In [208]:

```
plt.figure(figsize=(15,10))
for i in range(len(clf.estimators_)):
    print(tree.export_text(clf.estimators_[i]))
```

```
|--- feature_15 <= -0.42
|   |--- feature_11 <= -0.42
|   |   |--- feature_44 <= 0.72
|   |   |   |--- feature_8 <= -0.55
|   |   |   |   |--- feature_16 <= 0.73
|   |   |   |   |   |--- feature_2 <= -0.50
|   |   |   |   |   |   |--- class: 1.0
|   |   |   |   |   |   |--- feature_2 > -0.50
|   |   |   |   |   |   |   |--- class: 0.0
|   |   |   |   |   |--- feature_16 > 0.73
|   |   |   |   |   |   |--- class: 0.0
|   |   |   |   |--- feature_8 > -0.55
|   |   |   |   |   |--- feature_14 <= -1.32
|   |   |   |   |   |   |--- feature_4 <= -0.24
|   |   |   |   |   |   |   |--- class: 1.0
|   |   |   |   |   |   |   |--- feature_4 > -0.24
|   |   |   |   |   |   |   |   |--- class: 0.0
|   |   |   |   |   |   |--- feature_14 > -1.32
|   |   |   |   |   |   |   |--- class: 1.0
|   |   |   |--- feature_44 > 0.72
|   |   |   |   |--- class: 1.0
|   |--- feature_11 > -0.42
|   |   |--- feature_48 <= -0.06
|   |   |   |--- class: 0.0
|   |   |--- feature_48 > -0.06
|   |   |   |--- feature_21 <= -0.03
|   |   |   |   |--- feature_36 <= 0.95
|   |   |   |   |   |--- feature_37 <= -0.42
|   |   |   |   |   |   |--- feature_30 <= -1.06
|   |   |   |   |   |   |   |--- class: 1.0
|   |   |   |   |   |   |   |--- feature_30 > -1.06
|   |   |   |   |   |   |   |   |--- feature_49 <= -0.13
|   |   |   |   |   |   |   |   |   |--- class: 0.0
|   |   |   |   |   |   |   |   |   |--- feature_49 > -0.13
|   |   |   |   |   |   |   |   |   |   |--- feature_42 <= -0.36
|   |   |   |   |   |   |   |   |   |   |   |--- class: 1.0
|   |   |   |   |   |   |   |   |   |   |   |--- feature_42 > -0.36
|   |   |   |   |   |   |   |   |   |   |   |   |--- class: 0.0
|   |   |   |   |   |   |   |--- feature_37 > -0.42
|   |   |   |   |   |   |   |   |--- class: 1.0
|   |   |   |--- feature_36 > 0.95
|   |   |   |   |--- feature_29 <= 1.18
|   |   |   |   |   |--- feature_0 <= 1.34
|   |   |   |   |   |   |--- class: 0.0
|   |   |   |   |   |   |--- feature_0 > 1.34
|   |   |   |   |   |   |   |--- class: 1.0
|   |   |   |   |--- feature_29 > 1.18
|   |   |   |   |   |--- class: 1.0
|   |   |--- feature_21 > -0.03
|   |   |   |--- class: 0.0
|--- feature_15 > -0.42
|   |--- feature_28 <= 0.81
|   |   |--- feature_2 <= -0.42
|   |   |   |--- feature_30 <= 0.04
|   |   |   |   |--- feature_27 <= 2.08
|   |   |   |   |   |--- class: 1.0
|   |   |   |   |   |--- feature_27 > 2.08
|   |   |   |   |   |   |--- class: 0.0
|   |   |   |--- feature_30 > 0.04
|   |   |   |   |--- feature_6 <= -0.43
|   |   |   |   |   |--- feature_22 <= 0.11
|   |   |   |   |   |   |--- feature_35 <= 0.25
|   |   |   |   |   |   |   |--- feature_45 <= -0.40
|   |   |   |   |   |   |   |   |--- class: 1.0
|   |   |   |   |   |   |   |   |--- feature_45 > -0.40
|   |   |   |   |   |   |   |   |   |--- feature_23 <= -0.35
|   |   |   |   |   |   |   |   |   |   |--- feature_43 <= 0.16
|   |   |   |   |   |   |   |   |   |   |   |--- class: 0.0
|   |   |   |   |   |   |   |   |   |   |   |--- feature_43 > 0.16
|   |   |   |   |   |   |   |   |   |   |   |   |--- class: 1.0
|   |   |   |   |   |   |   |   |   |   |   |   |--- feature_23 > -0.35
|   |   |   |   |   |   |   |   |   |   |   |   |   |--- class: 0.0
|   |   |   |   |   |   |   |--- feature_35 > 0.25
|   |   |   |   |   |   |   |   |--- class: 1.0
|   |   |   |--- feature_22 > 0.11
|   |   |   |   |--- class: 1.0
```

```
class: 1.0
|---- feature_6 > -0.43
|    |---- feature_20 <= 0.40
|    |    |---- feature_14 <= 1.00
|    |    |    |---- feature_43 <= 0.33
|    |    |    |    |---- class: 1.0
|    |    |    |---- feature_43 > 0.33
|    |    |    |    |---- feature_3 <= -0.53
|    |    |    |    |    |---- class: 0.0
|    |    |    |    |---- feature_3 > -0.53
|    |    |    |    |    |---- class: 1.0
|    |    |---- feature_14 > 1.00
|    |    |    |---- class: 0.0
|    |---- feature_20 > 0.40
|    |    |---- class: 0.0
|---- feature_2 > -0.42
|    |---- feature_21 <= 1.96
|    |    |---- feature_48 <= -0.02
|    |    |    |---- feature_21 <= -0.61
|    |    |    |    |---- class: 0.0
|    |    |    |---- feature_21 > -0.61
|    |    |    |    |---- class: 1.0
|    |    |---- feature_48 > -0.02
|    |    |    |---- feature_40 <= -1.59
|    |    |    |    |---- class: 0.0
|    |    |    |---- feature_40 > -1.59
|    |    |    |    |---- feature_42 <= 1.59
|    |    |    |    |    |---- feature_45 <= 1.08
|    |    |    |    |    |    |---- feature_19 <= -1.77
|    |    |    |    |    |    |    |---- feature_21 <= -0.74
|    |    |    |    |    |    |    |    |---- class: 0.0
|    |    |    |    |    |    |    |---- feature_21 > -0.74
|    |    |    |    |    |    |    |    |---- class: 1.0
|    |    |    |    |    |---- feature_19 > -1.77
|    |    |    |    |    |---- feature_10 <= -0.76
|    |    |    |    |    |    |---- feature_45 <= 0.28
|    |    |    |    |    |    |    |---- class: 1.0
|    |    |    |    |    |    |---- feature_45 > 0.28
|    |    |    |    |    |    |    |---- truncated branch of depth 2
|    |    |    |    |    |---- feature_10 > -0.76
|    |    |    |    |    |    |---- class: 1.0
|    |    |    |---- feature_45 > 1.08
|    |    |    |    |---- feature_43 <= -2.09
|    |    |    |    |    |---- feature_20 <= -0.56
|    |    |    |    |    |    |---- class: 0.0
|    |    |    |    |    |---- feature_20 > -0.56
|    |    |    |    |    |    |---- class: 1.0
|    |    |    |    |---- feature_43 > -2.09
|    |    |    |    |    |---- class: 1.0
|    |    |---- feature_42 > 1.59
|    |    |    |---- feature_28 <= 0.28
|    |    |    |    |---- class: 1.0
|    |    |---- feature_28 > 0.28
|    |    |    |---- class: 0.0
|---- feature_21 > 1.96
|    |---- feature_39 <= -0.39
|    |    |---- class: 1.0
|    |---- feature_39 > -0.39
|    |    |---- feature_7 <= -0.34
|    |    |    |---- class: 0.0
|    |---- feature_7 > -0.34
|    |    |---- class: 1.0
|---- feature_28 > 0.81
|    |---- feature_38 <= 0.38
|    |    |---- feature_8 <= -1.24
|    |    |    |---- class: 0.0
|    |---- feature_8 > -1.24
|    |    |---- feature_37 <= -0.28
|    |    |    |---- class: 0.0
|    |---- feature_37 > -0.28
|    |    |---- feature_27 <= 1.37
|    |    |    |---- feature_28 <= 0.86
|    |    |    |    |---- class: 0.0
|    |    |---- feature_28 > 0.86
|    |    |    |---- feature_11 <= -1.25
|    |    |    |    |---- class: 0.0
|    |    |---- feature_11 > -1.25
|    |    |    |---- class: 1.0
|    |---- feature_27 > 1.37
|    |    |---- class: 0.0
|---- feature_38 > 0.38
|    |---- feature_35 <= 1.65
|    |    |---- feature_24 <= -0.47
|    |    |    |---- class: 1.0
|    |---- feature_24 > -0.47
|    |    |---- feature_12 <= -0.08
|    |    |    |---- feature_18 <= -0.44
```

```
| | | | | | | |---- class: 0.0
| | | | | | | |---- feature_18 > -0.44
| | | | | | | |---- class: 1.0
| | | | | | | |---- feature_12 > -0.08
| | | | | | | |---- class: 0.0
| | | | |---- feature_35 > 1.65
| | | | |---- class: 1.0

|---- feature_3 <= -0.50
| |---- feature_49 <= -0.28
| | |---- feature_47 <= -0.24
| | | |---- feature_26 <= 0.57
| | | |---- feature_29 <= -1.95
| | | | |---- class: 0.0
| | | |---- feature_29 > -1.95
| | | | |---- class: 1.0
| | | |---- feature_26 > 0.57
| | | | |---- class: 0.0
| | |---- feature_47 > -0.24
| | | |---- feature_40 <= 0.10
| | | |---- feature_29 <= 1.00
| | | | |---- feature_38 <= -0.40
| | | | |---- class: 0.0
| | | | |---- feature_38 > -0.40
| | | | |---- feature_0 <= -0.77
| | | | |---- feature_5 <= 0.19
| | | | |---- class: 0.0
| | | | |---- feature_5 > 0.19
| | | | |---- class: 1.0
| | | | |---- feature_0 > -0.77
| | | | |---- feature_23 <= 1.81
| | | | |---- class: 1.0
| | | | |---- feature_23 > 1.81
| | | | |---- class: 0.0
| | | |---- feature_29 > 1.00
| | | |---- feature_15 <= -0.35
| | | |---- feature_0 <= 0.67
| | | | |---- class: 0.0
| | | |---- feature_0 > 0.67
| | | | |---- class: 1.0
| | | |---- feature_15 > -0.35
| | | | |---- class: 0.0
| | | |---- feature_40 > 0.10
| | | |---- feature_49 <= -0.30
| | | |---- feature_31 <= 0.84
| | | | |---- feature_7 <= -0.62
| | | | |---- class: 0.0
| | | | |---- feature_7 > -0.62
| | | | |---- class: 1.0
| | | |---- feature_31 > 0.84
| | | | |---- class: 1.0
| | | |---- feature_49 > -0.30
| | | | |---- class: 0.0
| |---- feature_49 > -0.28
| | |---- feature_24 <= -0.79
| | | |---- class: 1.0
| | |---- feature_24 > -0.79
| | | |---- feature_5 <= 0.28
| | | |---- feature_35 <= -0.28
| | | |---- feature_2 <= -0.52
| | | | |---- class: 1.0
| | | |---- feature_2 > -0.52
| | | | |---- class: 0.0
| | | |---- feature_35 > -0.28
| | | |---- feature_31 <= 1.17
| | | | |---- class: 0.0
| | | |---- feature_31 > 1.17
| | | | |---- feature_21 <= -0.74
| | | | |---- class: 1.0
| | | | |---- feature_21 > -0.74
| | | | |---- class: 0.0
| | | |---- feature_5 > 0.28
| | | | |---- class: 1.0
|---- feature_3 > -0.50
| |---- feature_38 <= 1.14
| | |---- feature_27 <= 2.60
| | | |---- feature_16 <= 0.67
| | | |---- feature_13 <= 1.07
| | | |---- feature_22 <= -0.49
| | | |---- feature_36 <= 1.81
| | | | |---- class: 1.0
| | | |---- feature_36 > 1.81
| | | | |---- class: 0.0
| | | |---- feature_22 > -0.49
| | | |---- feature_32 <= 1.88
| | | |---- feature_14 <= 0.97
| | | | |---- class: 1.0
```



```
| | | | | | | | | |--- feature_10 > 0.33
| | | | | | | | | |--- feature_9 <= 0.41
| | | | | | | | | |--- class: 0.0
| | | | | | | | | |--- feature_9 > 0.41
| | | | | | | | | |--- class: 1.0
| | | | | | | | | |--- feature_29 > 0.37
| | | | | | | | | |--- class: 0.0
| | | | | | | | | |--- feature_26 > 0.62
| | | | | | | | | |--- class: 0.0
| | | | | | | | | |--- feature_28 > 1.06
| | | | | | | | | |--- feature_10 <= -0.77
| | | | | | | | | |--- class: 0.0
| | | | | | | | | |--- feature_10 > -0.77
| | | | | | | | | |--- feature_9 <= -0.88
| | | | | | | | | |--- class: 1.0
| | | | | | | | | |--- feature_9 > -0.88
| | | | | | | | | |--- class: 0.0
| |--- feature_49 > -0.29
| | |--- feature_45 <= -0.87
| | | |--- feature_8 <= -0.16
| | | | |--- class: 1.0
| | | |--- feature_8 > -0.16
| | | | |--- class: 0.0
| | |--- feature_45 > -0.87
| | | |--- feature_47 <= 1.43
| | | |--- feature_32 <= -0.75
| | | | |--- feature_13 <= -1.18
| | | | | |--- feature_40 <= -0.19
| | | | | | |--- class: 0.0
| | | | | | |--- feature_40 > -0.19
| | | | | | | |--- class: 1.0
| | | | | | |--- feature_13 > -1.18
| | | | | | | |--- class: 0.0
| | | | | | |--- feature_32 > -0.75
| | | | | | |--- feature_15 <= -0.41
| | | | | | | |--- feature_5 <= 0.09
| | | | | | | | |--- class: 0.0
| | | | | | | |--- feature_5 > 0.09
| | | | | | | |--- feature_45 <= 0.51
| | | | | | | | |--- class: 1.0
| | | | | | | |--- feature_45 > 0.51
| | | | | | | | |--- class: 0.0
| | | | | | |--- feature_15 > -0.41
| | | | | | |--- feature_13 <= -0.34
| | | | | | | |--- class: 1.0
| | | | | | |--- feature_13 > -0.34
| | | | | | | |--- feature_39 <= -0.17
| | | | | | | |--- feature_49 <= -0.29
| | | | | | | | |--- feature_29 <= 0.30
| | | | | | | | | |--- class: 1.0
| | | | | | | | |--- feature_29 > 0.30
| | | | | | | | | |--- class: 0.0
| | | | | | | |--- feature_49 > -0.29
| | | | | | | | |--- class: 1.0
| | | | | | | |--- feature_39 > -0.17
| | | | | | | | |--- class: 0.0
| | | | | | |--- feature_47 > 1.43
| | | | | | | |--- class: 1.0
|--- feature_7 > -0.56
| |--- feature_34 <= 0.21
| | |--- feature_9 <= -0.55
| | | |--- feature_21 <= 0.08
| | | |--- feature_30 <= 0.04
| | | |--- feature_4 <= -0.79
| | | | |--- class: 1.0
| | | |--- feature_4 > -0.79
| | | | |--- feature_46 <= -0.82
| | | | |--- feature_21 <= -0.21
| | | | | |--- class: 0.0
| | | | | |--- feature_21 > -0.21
| | | | | | |--- class: 1.0
| | | | | |--- feature_46 > -0.82
| | | | | | | |--- class: 0.0
| | | | | |--- feature_30 > 0.04
| | | | | |--- feature_41 <= 0.15
| | | | | |--- feature_17 <= -0.29
| | | | | | |--- feature_42 <= -0.51
| | | | | | | |--- class: 1.0
| | | | | | |--- feature_42 > -0.51
| | | | | | | |--- class: 0.0
| | | | | |--- feature_17 > -0.29
| | | | | |--- feature_46 <= 0.60
| | | | | | |--- class: 1.0
| | | | | |--- feature_46 > 0.60
| | | | | | |--- feature_11 <= -0.84
| | | | | | | |--- class: 1.0
```



```
| | | | | | | |-- feature_11 > -0.84  
| | | | | | | | |-- class: 0.0  
| | | | | | | | |-- feature_41 > 0.15  
| | | | | | | | | |-- class: 1.0  
|-- feature_21 > 0.08  
| |-- class: 1.0  
--- feature_9 > -0.55  
|-- feature_43 <= -2.52  
| |-- class: 0.0  
--- feature_43 > -2.52  
| |-- feature_27 <= 1.99  
| | |-- feature_27 <= -1.27  
| | | |-- feature_27 <= -8.81  
| | | | |-- class: 1.0  
| | | | |-- feature_27 > -8.81  
| | | | | |-- class: 0.0  
| |-- feature_27 > -1.27  
| | |-- feature_9 <= -0.39  
| | | |-- feature_14 <= 1.07  
| | | | |-- class: 1.0  
| | | | |-- feature_14 > 1.07  
| | | | | |-- feature_38 <= -0.30  
| | | | | | |-- class: 0.0  
| | | | | | |-- feature_38 > -0.30  
| | | | | | | |-- class: 1.0  
| | |-- feature_9 > -0.39  
| | | |-- feature_33 <= -0.38  
| | | | |-- feature_41 <= -0.66  
| | | | | |-- feature_13 <= -1.26  
| | | | | | |-- feature_25 <= -1.12  
| | | | | | | |-- class: 1.0  
| | | | | | | |-- feature_25 > -1.12  
| | | | | | | | |-- class: 0.0  
| | | | | |-- feature_13 > -1.26  
| | | | | | |-- class: 1.0  
| | | |-- feature_41 > -0.66  
| | | | |-- feature_33 <= -0.38  
| | | | | |-- feature_12 <= 0.74  
| | | | | | |-- class: 1.0  
| | | | | | |-- feature_12 > 0.74  
| | | | | | | |-- class: 0.0  
| | | | |-- feature_33 > -0.38  
| | | | | |-- class: 0.0  
| | |-- feature_33 > -0.38  
| | | |-- feature_18 <= 1.14  
| | | | |-- class: 1.0  
| | | | |-- feature_18 > 1.14  
| | | | | |-- feature_19 <= -0.96  
| | | | | | |-- class: 1.0  
| | | | | | |-- feature_19 > -0.96  
| | | | | | | |-- class: 0.0  
| |-- feature_27 > 1.99  
| | |-- feature_41 <= -0.24  
| | | |-- class: 0.0  
| | | |-- feature_41 > -0.24  
| | | | |-- class: 1.0  
--- feature_34 > 0.21  
|-- feature_16 <= -0.21  
| |-- class: 1.0  
--- feature_16 > -0.21  
| |-- feature_33 <= 0.07  
| | |-- feature_28 <= 1.34  
| | | |-- class: 1.0  
| | | |-- feature_28 > 1.34  
| | | | |-- class: 0.0  
|-- feature_33 > 0.07  
| |-- class: 0.0  
  
--- feature_9 <= -0.24  
|-- feature_14 <= -0.40  
| |-- feature_26 <= -0.32  
| | |-- feature_32 <= -0.48  
| | | |-- feature_20 <= 2.85  
| | | | |-- feature_30 <= -0.50  
| | | | | |-- class: 0.0  
| | | | |-- feature_30 > -0.50  
| | | | | |-- feature_43 <= -0.55  
| | | | | | |-- class: 0.0  
| | | | | | |-- feature_43 > -0.55  
| | | | | | | |-- feature_23 <= -0.44  
| | | | | | | | |-- feature_41 <= -0.35  
| | | | | | | | | |-- class: 1.0  
| | | | | | | | |-- feature_41 > -0.35  
| | | | | | | | | |-- class: 0.0  
| | | | | |-- feature_23 > -0.44  
| | | | | | |-- class: 1.0  
| |-- feature_20 > 2.85
```

```
feature_26 > -0.32
|---- class: 0.0
|---- feature_32 > -0.48
|---- feature_49 <= -0.28
|---- feature_49 <= -0.30
|---- class: 0.0
|---- feature_49 > -0.30
|---- class: 1.0
|---- feature_49 > -0.28
|---- class: 0.0
|---- feature_26 > -0.32
|---- feature_6 <= 0.02
|---- feature_5 <= -1.73
|---- class: 1.0
|---- feature_5 > -1.73
|---- class: 0.0
|---- feature_6 > 0.02
|---- feature_28 <= 0.42
|---- class: 1.0
|---- feature_28 > 0.42
|---- class: 0.0
|---- feature_14 > -0.40
|---- feature_46 <= 0.97
|---- feature_7 <= -1.03
|---- feature_36 <= -0.56
|---- class: 1.0
|---- feature_36 > -0.56
|---- class: 0.0
|---- feature_7 > -1.03
|---- feature_14 <= 0.96
|---- feature_22 <= -0.49
|---- feature_23 <= 0.89
|---- feature_4 <= -0.94
|---- class: 0.0
|---- feature_4 > -0.94
|---- feature_36 <= 1.85
|---- class: 1.0
|---- feature_36 > 1.85
|---- class: 0.0
|---- feature_23 > 0.89
|---- class: 0.0
|---- feature_22 > -0.49
|---- feature_16 <= -1.64
|---- class: 0.0
|---- feature_16 > -1.64
|---- feature_6 <= -1.38
|---- feature_31 <= 0.78
|---- class: 1.0
|---- feature_31 > 0.78
|---- class: 0.0
|---- feature_6 > -1.38
|---- feature_40 <= -0.77
|---- feature_5 <= -0.86
|---- class: 1.0
|---- feature_5 > -0.86
|---- class: 0.0
|---- feature_40 > -0.77
|---- feature_27 <= 0.03
|---- class: 1.0
|---- feature_27 > 0.03
|---- feature_34 <= -0.29
|---- class: 0.0
|---- feature_34 > -0.29
|---- class: 1.0
|---- feature_14 > 0.96
|---- feature_10 <= -0.30
|---- feature_0 <= -0.87
|---- feature_48 <= 0.04
|---- class: 0.0
|---- feature_48 > 0.04
|---- class: 1.0
|---- feature_0 > -0.87
|---- class: 0.0
|---- feature_10 > -0.30
|---- feature_41 <= -0.68
|---- class: 1.0
|---- feature_41 > -0.68
|---- class: 0.0
|---- feature_46 > 0.97
|---- feature_47 <= 1.22
|---- feature_14 <= -0.30
|---- class: 1.0
|---- feature_14 > -0.30
|---- feature_45 <= 0.58
|---- class: 1.0
|---- feature_45 > 0.58
|---- feature_39 <= -0.14
```

```
| | | | | | | |---- class: 1.0
| | | | | | | |---- feature_39 > -0.14
| | | | | | | |---- class: 0.0
| | | | |---- feature_47 > 1.22
| | | | |---- class: 1.0
|---- feature_9 > -0.24
| |---- feature_0 <= 1.38
| | |---- feature_44 <= 0.00
| | | |---- feature_36 <= 0.92
| | | | |---- feature_47 <= -0.77
| | | | |---- feature_46 <= 0.98
| | | | |---- class: 0.0
| | | | |---- feature_46 > 0.98
| | | | |---- class: 1.0
| | | | |---- feature_47 > -0.77
| | | | |---- feature_2 <= -0.61
| | | | |---- feature_18 <= 1.04
| | | | |---- class: 1.0
| | | | |---- feature_18 > 1.04
| | | | |---- class: 0.0
| | | | |---- feature_2 > -0.61
| | | | |---- feature_37 <= -0.37
| | | | |---- class: 0.0
| | | | |---- feature_37 > -0.37
| | | | |---- feature_7 <= -0.60
| | | | |---- feature_48 <= 0.04
| | | | |---- class: 1.0
| | | | |---- feature_48 > 0.04
| | | | |---- class: 0.0
| | | | |---- feature_7 > -0.60
| | | | |---- class: 1.0
| | | |---- feature_36 > 0.92
| | | |---- feature_33 <= 0.42
| | | |---- feature_21 <= -0.74
| | | |---- class: 1.0
| | | |---- feature_21 > -0.74
| | | |---- feature_40 <= 0.02
| | | |---- class: 1.0
| | | |---- feature_40 > 0.02
| | | |---- class: 0.0
| | | |---- feature_33 > 0.42
| | | |---- class: 0.0
| | |---- feature_44 > 0.00
| | |---- class: 1.0
| |---- feature_0 > 1.38
| | |---- feature_4 <= 0.19
| | |---- feature_8 <= 1.39
| | |---- class: 0.0
| | |---- feature_8 > 1.39
| | |---- class: 1.0
| | |---- feature_4 > 0.19
| | |---- class: 1.0
|---- feature_3 <= -0.50
| |---- feature_31 <= 0.20
| | |---- feature_35 <= -0.13
| | | |---- feature_28 <= -1.58
| | | |---- class: 0.0
| | | |---- feature_28 > -1.58
| | | |---- feature_15 <= -0.23
| | | |---- feature_17 <= -0.51
| | | |---- class: 1.0
| | | |---- feature_17 > -0.51
| | | |---- class: 0.0
| | | |---- feature_15 > -0.23
| | | |---- class: 1.0
| | |---- feature_35 > -0.13
| | |---- class: 0.0
| |---- feature_31 > 0.20
| | |---- feature_15 <= -0.41
| | | |---- feature_32 <= -0.42
| | | |---- feature_0 <= 1.04
| | | |---- class: 0.0
| | | |---- feature_0 > 1.04
| | | |---- class: 1.0
| | | |---- feature_32 > -0.42
| | | |---- class: 0.0
| | |---- feature_15 > -0.41
| | |---- feature_47 <= 0.79
| | | |---- feature_3 <= -0.66
| | | |---- feature_30 <= 0.18
| | | |---- feature_6 <= -0.71
| | | |---- class: 0.0
| | | |---- feature_6 > -0.71
| | | |---- class: 1.0
| | | |---- feature_30 > 0.18
| | | |---- class: 0.0
```

```

|--- class: 0.0
|--- feature_3 > -0.66
|--- feature_5 <= -0.91
|--- feature_37 <= 0.67
|--- class: 1.0
|--- feature_37 > 0.67
|--- class: 0.0
|--- feature_5 > -0.91
|--- feature_37 <= -0.32
|--- class: 1.0
|--- feature_37 > -0.32
|--- class: 0.0
|--- feature_47 > 0.79
|--- feature_9 <= -1.05
|--- feature_16 <= 0.34
|--- class: 0.0
|--- feature_16 > 0.34
|--- class: 1.0
|--- feature_9 > -1.05
|--- feature_36 <= -0.11
|--- class: 0.0
|--- feature_36 > -0.11
|--- feature_15 <= -0.29
|--- class: 0.0
|--- feature_15 > -0.29
|--- class: 1.0
|--- feature_3 > -0.50
|--- feature_27 <= 2.05
|--- feature_12 <= -0.38
|--- feature_22 <= -0.18
|--- feature_33 <= 0.15
|--- feature_8 <= -1.22
|--- class: 0.0
|--- feature_8 > -1.22
|--- feature_26 <= -0.35
|--- class: 0.0
|--- feature_26 > -0.35
|--- feature_0 <= 0.71
|--- feature_31 <= 0.79
|--- feature_17 <= -0.65
|--- class: 1.0
|--- feature_17 > -0.65
|--- class: 0.0
|--- feature_31 > 0.79
|--- class: 0.0
|--- feature_0 > 0.71
|--- feature_6 <= -0.96
|--- class: 0.0
|--- feature_6 > -0.96
|--- feature_0 <= 1.66
|--- class: 1.0
|--- feature_0 > 1.66
|--- feature_19 <= 1.33
|--- class: 0.0
|--- feature_19 > 1.33
|--- class: 1.0
|--- feature_33 > 0.15
|--- feature_1 <= 0.78
|--- class: 0.0
|--- feature_1 > 0.78
|--- class: 1.0
|--- feature_22 > -0.18
|--- class: 0.0
|--- feature_12 > -0.38
|--- feature_40 <= -1.58
|--- feature_11 <= 1.01
|--- class: 0.0
|--- feature_11 > 1.01
|--- class: 1.0
|--- feature_40 > -1.58
|--- feature_45 <= 1.07
|--- feature_42 <= 1.70
|--- feature_40 <= -1.46
|--- feature_11 <= 0.39
|--- class: 0.0
|--- feature_11 > 0.39
|--- class: 1.0
|--- feature_40 > -1.46
|--- feature_3 <= 4.70
|--- feature_4 <= -0.80
|--- feature_21 <= 1.88
|--- class: 1.0
|--- feature_21 > 1.88
|--- class: 0.0
|--- feature_4 > -0.80
|--- feature_12 <= 1.11
|--- class: 1.0

```



```
| | | |--- class: 0.0  
| | | |--- feature_10 > -1.28  
| | | |--- feature_7 <= -1.01  
| | | |--- feature_15 <= 0.11  
| | | |--- class: 1.0  
| | | |--- feature_15 > 0.11  
| | | |--- class: 0.0  
| | | |--- feature_7 > -1.01  
| | | |--- feature_33 <= 0.11  
| | | |--- feature_23 <= -0.50  
| | | |--- feature_45 <= -0.93  
| | | |--- class: 1.0  
| | | |--- feature_45 > -0.93  
| | | |--- class: 0.0  
| | | |--- feature_23 > -0.50  
| | | |--- feature_4 <= -1.28  
| | | |--- class: 0.0  
| | | |--- feature_4 > -1.28  
| | | |--- feature_32 <= -1.04  
| | | |--- class: 0.0  
| | | |--- feature_32 > -1.04  
| | | |--- feature_22 <= -0.44  
| | | |--- feature_10 <= -1.02  
| | | |--- truncated branch of depth 2  
| | | |--- feature_10 > -1.02  
| | | |--- class: 1.0  
| | | |--- feature_22 > -0.44  
| | | |--- feature_13 <= -0.39  
| | | |--- class: 0.0  
| | | |--- feature_13 > -0.39  
| | | |--- truncated branch of depth 5  
| | | |--- feature_33 > 0.11  
| | | |--- feature_7 <= -0.49  
| | | |--- class: 0.0  
| | | |--- feature_7 > -0.49  
| | | |--- feature_4 <= -0.08  
| | | |--- class: 1.0  
| | | |--- feature_4 > -0.08  
| | | |--- class: 0.0  
| | | |--- feature_27 > 2.29  
| | | |--- class: 0.0  
|--- feature_11 > -0.43  
|--- feature_33 <= 1.00  
|--- feature_8 <= 0.39  
|--- feature_28 <= 1.23  
|--- feature_4 <= -0.38  
|--- feature_48 <= 0.07  
|--- feature_20 <= 0.73  
|--- class: 1.0  
|--- feature_20 > 0.73  
|--- feature_22 <= 0.29  
|--- class: 1.0  
|--- feature_22 > 0.29  
|--- class: 0.0  
|--- feature_48 > 0.07  
|--- feature_34 <= -0.22  
|--- class: 1.0  
|--- feature_34 > -0.22  
|--- class: 0.0  
|--- feature_4 > -0.38  
|--- feature_3 <= -0.39  
|--- feature_7 <= -0.75  
|--- class: 0.0  
|--- feature_7 > -0.75  
|--- feature_3 <= -0.53  
|--- feature_42 <= 0.36  
|--- class: 1.0  
|--- feature_42 > 0.36  
|--- class: 0.0  
|--- feature_3 > -0.53  
|--- class: 0.0  
|--- feature_3 > -0.39  
|--- feature_48 <= 0.04  
|--- feature_42 <= -0.71  
|--- class: 0.0  
|--- feature_42 > -0.71  
|--- class: 1.0  
|--- feature_48 > 0.04  
|--- feature_49 <= -0.25  
|--- feature_48 <= 0.06  
|--- class: 1.0  
|--- feature_48 > 0.06  
|--- class: 0.0  
|--- feature_49 > -0.25  
|--- feature_24 <= -0.71  
|--- class: 0.0  
|--- feature_24 > -0.71
```

```
| | | | | | feature_21 <= -0.72  
| | | | | | |--- class: 1.0  
| | | | | | |--- feature_28 > 1.23  
| | | | | | |--- class: 0.0  
| | | | | | |--- feature_8 > 0.39  
| | | | | | |--- class: 1.0  
| | | | | |--- feature_33 > 1.00  
| | | | | | |--- feature_41 <= 2.26  
| | | | | | |--- class: 0.0  
| | | | | | |--- feature_41 > 2.26  
| | | | | | |--- class: 1.0  
  
|--- feature_22 <= -0.49  
| |--- feature_8 <= 0.81  
| | |--- feature_31 <= 0.96  
| | | |--- feature_25 <= 0.86  
| | | | |--- feature_5 <= -1.16  
| | | | |--- class: 0.0  
| | | | |--- feature_5 > -1.16  
| | | | | |--- feature_34 <= 0.35  
| | | | | |--- class: 1.0  
| | | | | |--- feature_34 > 0.35  
| | | | | |--- class: 0.0  
| | | |--- feature_25 > 0.86  
| | | | |--- feature_20 <= 0.24  
| | | | |--- class: 1.0  
| | | | |--- feature_20 > 0.24  
| | | | | |--- feature_22 <= -0.49  
| | | | | |--- class: 0.0  
| | | | | |--- feature_22 > -0.49  
| | | | | | |--- feature_7 <= -0.27  
| | | | | | |--- class: 0.0  
| | | | | | |--- feature_7 > -0.27  
| | | | | | |--- class: 1.0  
| |--- feature_31 > 0.96  
| | |--- feature_11 <= -0.67  
| | | |--- feature_31 <= 1.07  
| | | |--- class: 1.0  
| | | |--- feature_31 > 1.07  
| | | |--- class: 0.0  
| | |--- feature_11 > -0.67  
| | | |--- feature_15 <= -2.26  
| | | |--- class: 0.0  
| | | |--- feature_15 > -2.26  
| | | |--- class: 1.0  
|--- feature_8 > 0.81  
| |--- class: 1.0  
|--- feature_22 > -0.49  
| |--- feature_9 <= -0.54  
| | |--- feature_40 <= 0.10  
| | | |--- feature_35 <= 0.31  
| | | | |--- feature_10 <= -0.21  
| | | | | |--- feature_14 <= -1.45  
| | | | | |--- class: 0.0  
| | | | | |--- feature_14 > -1.45  
| | | | | | |--- feature_5 <= -1.03  
| | | | | | |--- feature_8 <= -1.15  
| | | | | | |--- class: 1.0  
| | | | | | |--- feature_8 > -1.15  
| | | | | | |--- feature_40 <= -0.03  
| | | | | | |--- class: 1.0  
| | | | | | |--- feature_40 > -0.03  
| | | | | | |--- feature_18 <= -1.07  
| | | | | | |--- class: 1.0  
| | | | | | |--- feature_18 > -1.07  
| | | | | | |--- class: 0.0  
| | | | |--- feature_5 > -1.03  
| | | | | |--- feature_12 <= 1.07  
| | | | | |--- class: 1.0  
| | | | | |--- feature_12 > 1.07  
| | | | | | |--- feature_13 <= 1.14  
| | | | | | |--- class: 0.0  
| | | | | | |--- feature_13 > 1.14  
| | | | | | |--- class: 1.0  
| | |--- feature_10 > -0.21  
| | | |--- feature_38 <= -0.41  
| | | |--- class: 1.0  
| | | |--- feature_38 > -0.41  
| | | | |--- feature_36 <= 0.24  
| | | | | |--- feature_5 <= 0.17  
| | | | | |--- class: 0.0  
| | | | | |--- feature_5 > 0.17  
| | | | | |--- class: 1.0  
| | | | |--- feature_36 > 0.24  
| | | | |--- class: 1.0  
| |--- feature_35 > 0.31  
| | |--- feature_42 <= 1.02
```

```
| | | | |--- class: 0.0
| | | | |--- feature_42 > 1.02
| | | | |--- class: 1.0
|--- feature_40 > 0.10
| | | |--- feature_22 <= -0.48
| | | | |--- feature_13 <= -0.40
| | | | |--- class: 0.0
| | | | |--- feature_13 > -0.40
| | | | |--- feature_1 <= 0.36
| | | | |--- class: 0.0
| | | | |--- feature_1 > 0.36
| | | | |--- class: 1.0
|--- feature_22 > -0.48
| | | |--- feature_40 <= 3.02
| | | | |--- class: 0.0
| | | | |--- feature_40 > 3.02
| | | | |--- class: 1.0
|--- feature_9 > -0.54
| | | |--- feature_43 <= -2.59
| | | | |--- feature_46 <= -0.04
| | | | |--- class: 1.0
| | | | |--- feature_46 > -0.04
| | | | |--- class: 0.0
|--- feature_43 > -2.59
| | | |--- feature_7 <= -0.54
| | | | |--- feature_46 <= 0.05
| | | | | |--- feature_32 <= 0.85
| | | | | | |--- feature_13 <= -1.04
| | | | | | |--- class: 0.0
| | | | | | |--- feature_13 > -1.04
| | | | | | |--- class: 1.0
| | | | | |--- feature_32 > 0.85
| | | | | | |--- feature_32 <= 1.27
| | | | | | |--- class: 0.0
| | | | | | |--- feature_32 > 1.27
| | | | | | |--- class: 1.0
| | | | |--- feature_46 > 0.05
| | | | |--- feature_44 <= 0.22
| | | | | |--- feature_36 <= -0.51
| | | | | |--- class: 1.0
| | | | | |--- feature_36 > -0.51
| | | | | |--- class: 0.0
| | | | |--- feature_44 > 0.22
| | | | |--- class: 1.0
|--- feature_7 > -0.54
| | | |--- feature_18 <= -1.31
| | | | |--- feature_13 <= -1.75
| | | | |--- class: 1.0
| | | | |--- feature_13 > -1.75
| | | | |--- class: 0.0
|--- feature_18 > -1.31
| | | |--- feature_17 <= 1.97
| | | | |--- feature_27 <= -1.27
| | | | | |--- feature_14 <= 0.52
| | | | | |--- class: 1.0
| | | | | |--- feature_14 > 0.52
| | | | | |--- class: 0.0
| | | | |--- feature_27 > -1.27
| | | | | |--- feature_49 <= -0.30
| | | | | |--- class: 0.0
| | | | | |--- feature_49 > -0.30
| | | | | | |--- feature_9 <= -0.42
| | | | | | | |--- feature_39 <= -0.42
| | | | | | | |--- class: 0.0
| | | | | | | |--- feature_39 > -0.42
| | | | | | | |--- class: 1.0
| | | | | | |--- feature_9 > -0.42
| | | | | | | |--- feature_21 <= -0.68
| | | | | | | |--- feature_42 <= -1.11
| | | | | | | |--- truncated branch of depth 2
| | | | | | | |--- feature_42 > -1.11
| | | | | | | |--- class: 1.0
| | | | | | |--- feature_21 > -0.68
| | | | | | |--- class: 1.0
| | | | |--- feature_17 > 1.97
| | | | |--- feature_7 <= 2.96
| | | | |--- class: 1.0
| | | | |--- feature_7 > 2.96
| | | | |--- class: 0.0
|--- feature_3 <= -0.57
| |--- feature_29 <= 0.68
| | |--- feature_31 <= 0.14
| | | |--- feature_4 <= -0.89
| | | |--- feature_1 <= 0.91
| | | |--- class: 1.0
| | | |--- feature_1 > 0.91
```



```
| | | | |--- feature_1 > 0.91  
| | | | |--- class: 0.0  
| | | |--- feature_4 > -0.89  
| | | | |--- class: 1.0  
| | |--- feature_31 > 0.14  
| | |--- feature_26 <= -0.33  
| | | |--- feature_37 <= -0.37  
| | | | |--- class: 0.0  
| | | |--- feature_37 > -0.37  
| | | | |--- class: 1.0  
| | |--- feature_26 > -0.33  
| | |--- feature_0 <= 0.01  
| | | |--- class: 0.0  
| | |--- feature_0 > 0.01  
| | | |--- feature_17 <= -1.00  
| | | | |--- class: 0.0  
| | | |--- feature_17 > -1.00  
| | | | |--- feature_17 <= -0.27  
| | | | | |--- class: 1.0  
| | | | |--- feature_17 > -0.27  
| | | | | |--- feature_32 <= 0.34  
| | | | | | |--- class: 1.0  
| | | | | |--- feature_32 > 0.34  
| | | | | | |--- class: 0.0  
|--- feature_29 > 0.68  
| |--- feature_25 <= 2.42  
| | |--- feature_1 <= 0.46  
| | | |--- class: 1.0  
| | |--- feature_1 > 0.46  
| | |--- feature_27 <= -0.36  
| | | |--- class: 1.0  
| | |--- feature_27 > -0.36  
| | |--- feature_5 <= -1.69  
| | | |--- class: 1.0  
| | |--- feature_5 > -1.69  
| | | |--- feature_39 <= -0.10  
| | | | |--- feature_15 <= 0.01  
| | | | | |--- feature_1 <= 0.69  
| | | | | | |--- class: 0.0  
| | | | | |--- feature_1 > 0.69  
| | | | | | |--- class: 1.0  
| | | | | |--- feature_15 > 0.01  
| | | | | | |--- class: 0.0  
| | | | |--- feature_39 > -0.10  
| | | | |--- class: 0.0  
| |--- feature_25 > 2.42  
| | |--- class: 1.0  
|--- feature_3 > -0.57  
| |--- feature_37 <= 0.59  
| | |--- feature_9 <= -0.36  
| | |--- feature_19 <= 0.66  
| | |--- feature_48 <= 0.04  
| | | |--- feature_13 <= 0.31  
| | | | |--- class: 1.0  
| | | |--- feature_13 > 0.31  
| | | | |--- feature_10 <= 0.08  
| | | | |--- feature_47 <= 0.70  
| | | | | |--- feature_40 <= -2.28  
| | | | | | |--- class: 0.0  
| | | | | |--- feature_40 > -2.28  
| | | | | | |--- class: 1.0  
| | | | |--- feature_47 > 0.70  
| | | | |--- feature_7 <= -0.28  
| | | | | |--- feature_4 <= -0.83  
| | | | | | |--- feature_6 <= -0.21  
| | | | | | | |--- class: 0.0  
| | | | | | |--- feature_6 > -0.21  
| | | | | | | |--- class: 1.0  
| | | | | |--- feature_4 > -0.83  
| | | | | | |--- class: 0.0  
| | | | |--- feature_7 > -0.28  
| | | | |--- class: 1.0  
| | |--- feature_10 > 0.08  
| | | |--- feature_29 <= -0.61  
| | | | |--- class: 1.0  
| | | |--- feature_29 > -0.61  
| | | | |--- class: 0.0  
| |--- feature_48 > 0.04  
| | |--- feature_4 <= -0.81  
| | | |--- class: 1.0  
| | |--- feature_4 > -0.81  
| | | |--- class: 0.0  
| |--- feature_19 > 0.66  
| | |--- feature_27 <= -0.34  
| | | |--- class: 0.0  
| | |--- feature_27 > -0.34  
| | |--- feature_33 <= -0.21
```

```
| | | | | | |--- feature_15 <= -0.64  
| | | | | | |   |-- class: 1.0  
| | | | | | |--- feature_15 > -0.64  
| | | | | | |   |-- class: 0.0  
| | | | | | |--- feature_33 > -0.21  
| | | | | | |   |-- feature_35 <= 0.53  
| | | | | | |     |-- class: 0.0  
| | | | | | |   |-- feature_35 > 0.53  
| | | | | | |     |-- feature_13 <= -1.68  
| | | | | | |       |-- class: 0.0  
| | | | | | |     |-- feature_13 > -1.68  
| | | | | | |       |-- class: 1.0  
| | |--- feature_9 > -0.36  
| | |   |-- feature_17 <= -1.26  
| | |     |-- feature_26 <= 0.31  
| | |       |-- class: 1.0  
| | |     |-- feature_26 > 0.31  
| | |       |-- class: 0.0  
| | |--- feature_17 > -1.26  
| | |   |-- feature_37 <= -0.12  
| | |     |-- feature_2 <= -0.50  
| | |       |-- feature_18 <= -0.71  
| | |         |-- class: 1.0  
| | |       |-- feature_18 > -0.71  
| | |         |-- class: 0.0  
| | |     |-- feature_2 > -0.50  
| | |       |-- feature_1 <= -3.76  
| | |         |-- feature_27 <= -0.34  
| | |           |-- class: 1.0  
| | |         |-- feature_27 > -0.34  
| | |           |-- class: 0.0  
| | |       |-- feature_1 > -3.76  
| | |         |-- feature_21 <= -0.42  
| | |           |-- feature_49 <= -0.30  
| | |             |-- class: 0.0  
| | |           |-- feature_49 > -0.30  
| | |             |-- feature_27 <= -0.38  
| | |               |-- feature_10 <= 0.41  
| | |                 |-- class: 0.0  
| | |               |-- feature_10 > 0.41  
| | |                 |-- class: 1.0  
| | |             |-- feature_27 > -0.38  
| | |               |-- class: 1.0  
| | |         |-- feature_21 > -0.42  
| | |           |-- class: 1.0  
| | |     |-- feature_37 > -0.12  
| | |       |-- feature_6 <= -1.07  
| | |         |-- class: 0.0  
| | |       |-- feature_6 > -1.07  
| | |         |-- feature_15 <= -0.93  
| | |           |-- class: 0.0  
| | |         |-- feature_15 > -0.93  
| | |           |-- feature_24 <= -0.22  
| | |             |-- feature_7 <= 0.46  
| | |               |-- class: 0.0  
| | |             |-- feature_7 > 0.46  
| | |               |-- class: 1.0  
| | |           |-- feature_24 > -0.22  
| | |             |-- class: 1.0  
| |--- feature_37 > 0.59  
| |   |-- feature_27 <= -0.17  
| |     |-- feature_29 <= 1.70  
| |       |-- feature_9 <= -0.88  
| |         |-- class: 1.0  
| |       |-- feature_9 > -0.88  
| |         |-- class: 0.0  
| |     |-- feature_29 > 1.70  
| |       |-- class: 1.0  
| |--- feature_27 > -0.17  
| |   |-- class: 0.0  
  
|-- feature_34 <= 0.32  
| |-- feature_18 <= -0.68  
| | |-- feature_11 <= -0.52  
| | | |-- feature_43 <= 0.79  
| | | | |-- feature_8 <= -0.34  
| | | | | |-- feature_35 <= 0.55  
| | | | | | |-- class: 0.0  
| | | | | |-- feature_35 > 0.55  
| | | | | | |-- feature_31 <= 0.94  
| | | | | | | |-- class: 0.0  
| | | | | |-- feature_31 > 0.94  
| | | | | | |-- class: 1.0  
| | | |-- feature_8 > -0.34  
| | | |-- feature_44 <= -0.49  
| | | | |-- class: 0.0
```

```
| | | |--- feature_44 > -0.49  
| | | |--- class: 1.0  
| | |--- feature_43 > 0.79  
| | | |--- feature_17 <= -0.81  
| | | |--- class: 1.0  
| | | |--- feature_17 > -0.81  
| | | |--- class: 0.0  
| |--- feature_11 > -0.52  
| | |--- feature_8 <= 0.25  
| | | |--- feature_27 <= -0.34  
| | | |--- class: 0.0  
| | | |--- feature_27 > -0.34  
| | | | |--- feature_48 <= 0.07  
| | | | | |--- feature_33 <= -0.11  
| | | | | | |--- class: 1.0  
| | | | | |--- feature_33 > -0.11  
| | | | | | |--- class: 0.0  
| | | | |--- feature_48 > 0.07  
| | | | | |--- feature_31 <= 1.17  
| | | | | | |--- class: 0.0  
| | | | | |--- feature_31 > 1.17  
| | | | | | |--- class: 1.0  
| | |--- feature_8 > 0.25  
| | |--- class: 1.0  
|--- feature_18 > -0.68  
| |--- feature_6 <= -0.68  
| | |--- feature_31 <= 0.37  
| | | |--- feature_16 <= -1.35  
| | | |--- class: 0.0  
| | | |--- feature_16 > -1.35  
| | | |--- class: 1.0  
| | |--- feature_31 > 0.37  
| | | |--- feature_11 <= -0.71  
| | | | |--- feature_20 <= -0.05  
| | | | | |--- feature_16 <= -0.27  
| | | | | | |--- class: 1.0  
| | | | | |--- feature_16 > -0.27  
| | | | | | |--- feature_33 <= 0.59  
| | | | | | | |--- feature_1 <= 0.58  
| | | | | | | |--- class: 1.0  
| | | | | | | |--- feature_1 > 0.58  
| | | | | | | |--- class: 0.0  
| | | | | | |--- feature_33 > 0.59  
| | | | | | |--- class: 1.0  
| | | |--- feature_20 > -0.05  
| | | | |--- feature_42 <= 1.59  
| | | | | |--- feature_23 <= 0.77  
| | | | | | |--- class: 1.0  
| | | | | |--- feature_23 > 0.77  
| | | | | | |--- feature_15 <= -0.09  
| | | | | | |--- class: 1.0  
| | | | | | |--- feature_15 > -0.09  
| | | | | | |--- class: 0.0  
| | | | |--- feature_42 > 1.59  
| | | | |--- class: 0.0  
| | |--- feature_11 > -0.71  
| | | |--- feature_9 <= -0.72  
| | | | |--- feature_33 <= 1.07  
| | | | | |--- class: 1.0  
| | | | |--- feature_33 > 1.07  
| | | | | |--- class: 0.0  
| | | |--- feature_9 > -0.72  
| | | |--- class: 0.0  
|--- feature_6 > -0.68  
| |--- feature_2 <= -0.44  
| | |--- feature_48 <= 0.04  
| | | |--- feature_0 <= -1.39  
| | | |--- class: 0.0  
| | | |--- feature_0 > -1.39  
| | | | |--- feature_5 <= -1.21  
| | | | | |--- class: 0.0  
| | | | |--- feature_5 > -1.21  
| | | | | |--- feature_15 <= 0.96  
| | | | | | |--- class: 1.0  
| | | | | |--- feature_15 > 0.96  
| | | | | | |--- feature_30 <= 0.12  
| | | | | | |--- class: 1.0  
| | | | | | |--- feature_30 > 0.12  
| | | | | | |--- class: 0.0  
| | |--- feature_48 > 0.04  
| | | |--- feature_41 <= -0.40  
| | | | |--- feature_37 <= -0.31  
| | | | | |--- class: 0.0  
| | | | |--- feature_37 > -0.31  
| | | | | |--- class: 1.0  
| | | |--- feature_41 > -0.40  
| | | |--- class: 0.0
```

```
|--- feature_2 > -0.44  
|   |--- feature_4 <= 0.37  
|       |--- feature_17 <= -0.61  
|           |--- feature_44 <= 0.94  
|               |--- class: 1.0  
|                   |--- feature_44 > 0.94  
|                       |--- class: 0.0  
|   |--- feature_17 > -0.61  
|       |--- feature_21 <= -0.70  
|           |--- feature_42 <= -0.67  
|               |--- class: 0.0  
|                   |--- feature_42 > -0.67  
|                       |--- class: 1.0  
|   |--- feature_21 > -0.70  
|       |--- feature_20 <= 0.03  
|           |--- class: 1.0  
|               |--- feature_20 > 0.03  
|                   |--- feature_15 <= 0.21  
|                       |--- class: 1.0  
|                           |--- feature_15 > 0.21  
|                               |--- class: 0.0  
|   |--- feature_4 > 0.37  
|       |--- feature_23 <= 0.41  
|           |--- class: 1.0  
|               |--- feature_23 > 0.41  
|                   |--- class: 0.0  
|--- feature_34 > 0.32  
|   |--- feature_11 <= 0.64  
|       |--- feature_27 <= -0.35  
|           |--- class: 1.0  
|               |--- feature_27 > -0.35  
|                   |--- feature_5 <= -1.53  
|                       |--- class: 1.0  
|                           |--- feature_5 > -1.53  
|                               |--- feature_24 <= 2.98  
|                                   |--- feature_37 <= 0.84  
|                                       |--- feature_37 <= 0.81  
|                                           |--- feature_20 <= 0.07  
|                                               |--- class: 1.0  
|                                                   |--- feature_20 > 0.07  
|                                                       |--- class: 0.0  
|                                                           |--- feature_37 > 0.81  
|                                                               |--- class: 1.0  
|                                                                   |--- feature_37 > 0.84  
|                                                                       |--- class: 0.0  
|   |--- feature_24 > 2.98  
|       |--- feature_15 <= -1.89  
|           |--- class: 0.0  
|               |--- feature_15 > -1.89  
|                   |--- class: 1.0  
|--- feature_11 > 0.64  
|   |--- class: 1.0  
  
|--- feature_14 <= -0.37  
|   |--- feature_8 <= 0.81  
|       |--- feature_29 <= 0.94  
|           |--- feature_32 <= 1.71  
|               |--- feature_26 <= -0.35  
|                   |--- class: 0.0  
|                       |--- feature_26 > -0.35  
|                           |--- feature_21 <= -0.74  
|                               |--- feature_42 <= 0.71  
|                                   |--- class: 0.0  
|                                       |--- feature_42 > 0.71  
|                                           |--- feature_1 <= 0.54  
|                                               |--- class: 1.0  
|                                                   |--- feature_1 > 0.54  
|                                                       |--- class: 0.0  
|   |--- feature_21 > -0.74  
|       |--- feature_9 <= -0.56  
|           |--- feature_3 <= -0.14  
|               |--- feature_3 <= -0.58  
|                   |--- class: 0.0  
|                       |--- feature_3 > -0.58  
|                           |--- class: 1.0  
|                               |--- feature_3 > -0.14  
|                                   |--- class: 0.0  
|   |--- feature_9 > -0.56  
|       |--- feature_27 <= -0.36  
|           |--- feature_13 <= -0.93  
|               |--- class: 0.0  
|                   |--- feature_13 > -0.93  
|                       |--- class: 1.0  
|                           |--- feature_27 > -0.36  
|                               |--- class: 1.0  
|--- feature_32 > 1.71
```

```
| | | |---- class: 0.0
| | | |---- feature_29 > 0.94
| | | |---- feature_25 <= 2.42
| | | |---- feature_8 <= -1.63
| | | |---- class: 1.0
| | | |---- feature_8 > -1.63
| | | |---- feature_32 <= -0.96
| | | |---- class: 1.0
| | | |---- feature_32 > -0.96
| | | |---- feature_48 <= 0.04
| | | |---- feature_4 <= -0.91
| | | |---- class: 1.0
| | | |---- feature_4 > -0.91
| | | |---- class: 0.0
| | | |---- feature_48 > 0.04
| | | |---- class: 0.0
| | | |---- feature_25 > 2.42
| | | |---- class: 1.0
| | | |---- feature_8 > 0.81
| | | |---- class: 1.0
|---- feature_14 > -0.37
| |---- feature_10 <= -0.69
| | |---- feature_28 <= 1.00
| | | |---- feature_14 <= 0.96
| | | |---- feature_42 <= 1.36
| | | |---- feature_26 <= -0.15
| | | |---- class: 1.0
| | | |---- feature_26 > -0.15
| | | |---- feature_26 <= -0.00
| | | |---- class: 0.0
| | | |---- feature_26 > -0.00
| | | |---- feature_7 <= -0.98
| | | |---- class: 0.0
| | | |---- feature_7 > -0.98
| | | |---- class: 1.0
| | | |---- feature_42 > 1.36
| | | |---- class: 0.0
| | | |---- feature_14 > 0.96
| | | |---- class: 0.0
| | |---- feature_28 > 1.00
| | | |---- feature_17 <= -0.51
| | | |---- class: 1.0
| | | |---- feature_17 > -0.51
| | | |---- feature_31 <= 0.94
| | | |---- class: 0.0
| | | |---- feature_31 > 0.94
| | | |---- feature_0 <= -0.33
| | | |---- class: 0.0
| | | |---- feature_0 > -0.33
| | | |---- class: 1.0
|---- feature_10 > -0.69
| |---- feature_47 <= 0.59
| | |---- feature_17 <= 1.48
| | | |---- feature_7 <= -0.87
| | | |---- feature_36 <= -0.55
| | | |---- class: 1.0
| | | |---- feature_36 > -0.55
| | | |---- class: 0.0
| | | |---- feature_7 > -0.87
| | | |---- class: 1.0
| | |---- feature_17 > 1.48
| | | |---- feature_16 <= -1.56
| | | |---- feature_10 <= -0.22
| | | |---- feature_28 <= -1.09
| | | |---- class: 0.0
| | | |---- feature_28 > -1.09
| | | |---- class: 1.0
| | | |---- feature_10 > -0.22
| | | |---- class: 1.0
| | | |---- feature_16 > -1.56
| | | |---- class: 0.0
|---- feature_47 > 0.59
| |---- feature_36 <= -0.17
| | |---- feature_27 <= 0.86
| | | |---- feature_47 <= 1.03
| | | |---- class: 0.0
| | | |---- feature_47 > 1.03
| | | |---- class: 1.0
| | | |---- feature_27 > 0.86
| | | |---- class: 1.0
| | |---- feature_36 > -0.17
| | | |---- feature_39 <= 0.65
| | | |---- feature_17 <= -0.44
| | | |---- feature_48 <= 0.04
| | | |---- class: 1.0
| | | |---- feature_48 > 0.04
| | | |---- class: 0.0
```

```

|--- class: 0.0
|--- feature_17 > -0.44
|--- feature_43 <= 0.38
|--- class: 1.0
|--- feature_43 > 0.38
|--- feature_41 <= -0.48
|--- class: 1.0
|--- feature_41 > -0.48
|--- class: 0.0
|--- feature_39 > 0.65
|--- feature_8 <= -0.05
|--- feature_13 <= 0.34
|--- class: 0.0
|--- feature_13 > 0.34
|--- class: 1.0
|--- feature_8 > -0.05
|--- feature_31 <= 0.78
|--- class: 0.0
|--- feature_31 > 0.78
|--- class: 1.0
|--- feature_37 <= 0.59
|--- feature_22 <= -0.49
|--- feature_9 <= -0.25
|--- feature_19 <= -0.42
|--- class: 1.0
|--- feature_19 > -0.42
|--- feature_25 <= 2.42
|--- feature_5 <= 0.14
|--- feature_3 <= -0.58
|--- class: 0.0
|--- feature_3 > -0.58
|--- feature_26 <= -0.26
|--- feature_29 <= 0.86
|--- class: 0.0
|--- feature_29 > 0.86
|--- feature_24 <= 2.57
|--- class: 1.0
|--- feature_24 > 2.57
|--- class: 0.0
|--- feature_26 > -0.26
|--- class: 1.0
|--- feature_5 > 0.14
|--- class: 1.0
|--- feature_25 > 2.42
|--- class: 1.0
|--- feature_9 > -0.25
|--- feature_3 <= -0.65
|--- feature_4 <= 0.19
|--- class: 0.0
|--- feature_4 > 0.19
|--- class: 1.0
|--- feature_3 > -0.65
|--- feature_40 <= 4.52
|--- class: 1.0
|--- feature_40 > 4.52
|--- class: 0.0
|--- feature_22 > -0.49
|--- feature_7 <= -1.02
|--- feature_32 <= 0.58
|--- class: 1.0
|--- feature_32 > 0.58
|--- class: 0.0
|--- feature_7 > -1.02
|--- feature_17 <= -0.63
|--- feature_26 <= 1.74
|--- feature_5 <= -1.02
|--- feature_20 <= 0.85
|--- class: 0.0
|--- feature_20 > 0.85
|--- class: 1.0
|--- feature_5 > -1.02
|--- feature_22 <= 0.91
|--- feature_16 <= 0.70
|--- feature_27 <= -0.38
|--- class: 0.0
|--- feature_27 > -0.38
|--- class: 1.0
|--- feature_16 > 0.70
|--- feature_11 <= -0.89
|--- class: 0.0
|--- feature_11 > -0.89
|--- feature_46 <= 0.84
|--- feature_21 <= -0.74
|--- class: 0.0
|--- feature_21 > -0.74
|--- class: 1.0

```

```
| | | | | | | | | |--- feature_46 > 0.84
| | | | | | | | | |--- class: 0.0
| | | | | | | | | |--- feature_22 > 0.91
| | | | | | | | | |--- class: 0.0
| | | | | | | | | |--- feature_26 > 1.74
| | | | | | | | | |--- class: 0.0
| | | | | | | | |--- feature_17 > -0.63
| | | | | | | | |--- feature_26 <= 2.64
| | | | | | | | |--- feature_47 <= 0.49
| | | | | | | | |--- feature_38 <= -0.22
| | | | | | | | |--- feature_27 <= -0.38
| | | | | | | | |--- feature_39 <= -0.32
| | | | | | | | |--- class: 1.0
| | | | | | | | |--- feature_39 > -0.32
| | | | | | | | |--- feature_23 <= -0.37
| | | | | | | | |--- class: 0.0
| | | | | | | | |--- feature_23 > -0.37
| | | | | | | | |--- class: 1.0
| | | | | | | | |--- feature_27 > -0.38
| | | | | | | | |--- class: 1.0
| | | | | | | | |--- feature_38 > -0.22
| | | | | | | | |--- feature_25 <= -0.77
| | | | | | | | |--- class: 0.0
| | | | | | | | |--- feature_25 > -0.77
| | | | | | | | |--- feature_9 <= 0.28
| | | | | | | | |--- class: 1.0
| | | | | | | | |--- feature_9 > 0.28
| | | | | | | | |--- feature_13 <= 0.29
| | | | | | | | |--- class: 0.0
| | | | | | | | |--- feature_13 > 0.29
| | | | | | | | |--- class: 1.0
| | | | | | | | |--- feature_47 > 0.49
| | | | | | | | |--- feature_9 <= 0.14
| | | | | | | | |--- feature_42 <= -0.08
| | | | | | | | |--- feature_14 <= 0.39
| | | | | | | | |--- class: 1.0
| | | | | | | | |--- feature_14 > 0.39
| | | | | | | | |--- class: 0.0
| | | | | | | | |--- feature_42 > -0.08
| | | | | | | | |--- feature_25 <= -0.27
| | | | | | | | |--- class: 0.0
| | | | | | | | |--- feature_25 > -0.27
| | | | | | | | |--- feature_13 <= 0.30
| | | | | | | | |--- class: 1.0
| | | | | | | | |--- feature_13 > 0.30
| | | | | | | | |--- feature_19 <= -0.01
| | | | | | | | |--- truncated branch of depth 6
| | | | | | | | |--- feature_19 > -0.01
| | | | | | | | |--- class: 0.0
| | | | | | | | |--- feature_9 > 0.14
| | | | | | | | |--- class: 1.0
| | | | | | | | |--- feature_26 > 2.64
| | | | | | | | |--- feature_11 <= -0.14
| | | | | | | | |--- class: 0.0
| | | | | | | | |--- feature_11 > -0.14
| | | | | | | | |--- class: 1.0
|--- feature_37 > 0.59
| |--- feature_31 <= 0.95
| | |--- feature_41 <= 0.55
| | | |--- feature_28 <= 0.99
| | | |--- class: 0.0
| | | |--- feature_28 > 0.99
| | | |--- feature_25 <= -0.72
| | | |--- class: 0.0
| | | |--- feature_25 > -0.72
| | | |--- class: 1.0
| | |--- feature_41 > 0.55
| | | |--- feature_8 <= -1.60
| | | |--- class: 1.0
| | | |--- feature_8 > -1.60
| | | |--- feature_35 <= 2.10
| | | |--- class: 0.0
| | | |--- feature_35 > 2.10
| | | |--- feature_15 <= -0.26
| | | |--- class: 0.0
| | | |--- feature_15 > -0.26
| | | |--- class: 1.0
|--- feature_31 > 0.95
| |--- feature_40 <= -0.04
| | |--- feature_31 <= 1.05
| | | |--- class: 1.0
| | | |--- feature_31 > 1.05
| | | |--- class: 0.0
| | |--- feature_40 > -0.04
| | | |--- class: 1.0
```

```
|--- feature_19 <= 0.61
|   |--- feature_45 <= 0.20
|   |   |--- feature_6 <= -1.08
|   |   |   |--- feature_47 <= 0.00
|   |   |   |   |--- feature_28 <= -0.96
|   |   |   |   |   |--- class: 0.0
|   |   |   |   |   |--- feature_28 > -0.96
|   |   |   |   |   |   |--- class: 1.0
|   |   |   |   |--- feature_47 > 0.00
|   |   |   |   |   |--- class: 0.0
|   |   |--- feature_6 > -1.08
|   |   |   |--- feature_9 <= -0.38
|   |   |   |   |--- feature_27 <= 2.60
|   |   |   |   |   |--- feature_40 <= -1.47
|   |   |   |   |   |   |--- class: 0.0
|   |   |   |   |   |--- feature_40 > -1.47
|   |   |   |   |   |   |--- feature_16 <= -1.34
|   |   |   |   |   |   |   |--- feature_22 <= -0.14
|   |   |   |   |   |   |   |   |--- class: 0.0
|   |   |   |   |   |   |   |   |--- feature_22 > -0.14
|   |   |   |   |   |   |   |   |   |--- class: 1.0
|   |   |   |   |   |   |--- feature_16 > -1.34
|   |   |   |   |   |   |   |--- feature_4 <= -0.23
|   |   |   |   |   |   |   |   |--- feature_49 <= -0.29
|   |   |   |   |   |   |   |   |   |--- class: 1.0
|   |   |   |   |   |   |   |   |--- feature_49 > -0.29
|   |   |   |   |   |   |   |   |   |--- feature_9 <= -0.39
|   |   |   |   |   |   |   |   |   |   |--- class: 1.0
|   |   |   |   |   |   |   |   |   |   |--- feature_9 > -0.39
|   |   |   |   |   |   |   |   |   |   |   |--- class: 0.0
|   |   |   |   |   |   |   |--- feature_4 > -0.23
|   |   |   |   |   |   |   |   |--- feature_3 <= -0.37
|   |   |   |   |   |   |   |   |   |--- feature_11 <= -0.85
|   |   |   |   |   |   |   |   |   |   |--- class: 1.0
|   |   |   |   |   |   |   |   |   |   |--- feature_11 > -0.85
|   |   |   |   |   |   |   |   |   |   |   |--- class: 0.0
|   |   |   |   |   |   |   |   |--- feature_3 > -0.37
|   |   |   |   |   |   |   |   |   |--- class: 1.0
|   |   |   |--- feature_27 > 2.60
|   |   |   |   |--- class: 0.0
|   |   |--- feature_9 > -0.38
|   |   |   |--- feature_25 <= 0.06
|   |   |   |   |--- class: 1.0
|   |   |   |--- feature_25 > 0.06
|   |   |   |   |--- feature_42 <= -0.13
|   |   |   |   |   |--- class: 0.0
|   |   |   |   |--- feature_42 > -0.13
|   |   |   |   |   |--- feature_36 <= -0.21
|   |   |   |   |   |   |--- class: 0.0
|   |   |   |   |   |--- feature_36 > -0.21
|   |   |   |   |   |   |--- class: 1.0
|   |--- feature_45 > 0.20
|   |   |--- feature_41 <= -0.49
|   |   |   |--- feature_10 <= 0.40
|   |   |   |   |--- feature_10 <= -1.28
|   |   |   |   |   |--- class: 1.0
|   |   |   |   |--- feature_10 > -1.28
|   |   |   |   |   |--- class: 0.0
|   |   |   |--- feature_10 > 0.40
|   |   |   |   |--- class: 1.0
|   |   |--- feature_41 > -0.49
|   |   |   |--- feature_35 <= -0.26
|   |   |   |   |--- feature_40 <= 0.99
|   |   |   |   |   |--- class: 1.0
|   |   |   |   |--- feature_40 > 0.99
|   |   |   |   |   |--- feature_6 <= -0.76
|   |   |   |   |   |   |--- class: 0.0
|   |   |   |   |   |--- feature_6 > -0.76
|   |   |   |   |   |   |--- class: 1.0
|   |   |--- feature_35 > -0.26
|   |   |   |--- feature_43 <= -1.95
|   |   |   |   |--- feature_29 <= 1.60
|   |   |   |   |   |--- class: 0.0
|   |   |   |   |--- feature_29 > 1.60
|   |   |   |   |   |--- class: 1.0
|   |   |   |--- feature_43 > -1.95
|   |   |   |   |--- feature_41 <= 1.02
|   |   |   |   |   |--- feature_5 <= -1.13
|   |   |   |   |   |   |--- class: 0.0
|   |   |   |   |   |--- feature_5 > -1.13
|   |   |   |   |   |   |--- feature_44 <= -0.30
|   |   |   |   |   |   |   |--- feature_30 <= 0.14
|   |   |   |   |   |   |   |   |--- feature_41 <= 0.73
|   |   |   |   |   |   |   |   |   |--- class: 1.0
|   |   |   |   |   |   |   |   |--- feature_41 > 0.73
|   |   |   |   |   |   |   |   |   |--- class: 0.0
|   |   |   |--- feature_30 > 0.14
```



```
| | | | | feature_8 > -0.71  
| | | | | --- class: 1.0  
| | | | | --- feature_44 > -0.30  
| | | | | --- feature_1 <= 0.72  
| | | | | | --- feature_42 <= 1.47  
| | | | | | --- class: 1.0  
| | | | | | --- feature_42 > 1.47  
| | | | | | --- class: 0.0  
| | | | | --- feature_1 > 0.72  
| | | | | --- class: 0.0  
| | | --- feature_41 > 1.02  
| | | | --- feature_1 <= 0.66  
| | | | | --- feature_47 <= 0.58  
| | | | | | --- feature_15 <= -0.19  
| | | | | | --- feature_10 <= -0.21  
| | | | | | --- class: 1.0  
| | | | | | --- feature_10 > -0.21  
| | | | | | --- class: 0.0  
| | | | | --- feature_15 > -0.19  
| | | | | --- class: 1.0  
| | | | --- feature_47 > 0.58  
| | | | | --- feature_3 <= 0.20  
| | | | | --- class: 0.0  
| | | | | --- feature_3 > 0.20  
| | | | | --- class: 1.0  
| | | | --- feature_1 > 0.66  
| | | | | --- class: 0.0  
--- feature_19 > 0.61  
| --- feature_3 <= -0.50  
| | --- feature_30 <= 1.41  
| | | --- feature_49 <= -0.29  
| | | --- class: 1.0  
| | | --- feature_49 > -0.29  
| | | | --- feature_32 <= -0.75  
| | | | | --- feature_22 <= -0.49  
| | | | | --- class: 1.0  
| | | | | --- feature_22 > -0.49  
| | | | | --- class: 0.0  
| | | | --- feature_32 > -0.75  
| | | | | --- class: 0.0  
| | --- feature_30 > 1.41  
| | | --- class: 1.0  
--- feature_3 > -0.50  
| --- feature_28 <= 0.44  
| | --- feature_42 <= -0.99  
| | | --- feature_28 <= -1.31  
| | | --- feature_25 <= -1.09  
| | | --- class: 1.0  
| | | --- feature_25 > -1.09  
| | | --- class: 0.0  
| | | --- feature_28 > -1.31  
| | | | --- feature_6 <= 0.47  
| | | | | --- feature_3 <= -0.45  
| | | | | --- class: 1.0  
| | | | | --- feature_3 > -0.45  
| | | | | --- class: 0.0  
| | | | --- feature_6 > 0.47  
| | | | | --- class: 1.0  
| | | --- feature_42 > -0.99  
| | | | --- feature_37 <= -0.42  
| | | | | --- feature_21 <= -0.74  
| | | | | --- class: 0.0  
| | | | | --- feature_21 > -0.74  
| | | | | --- class: 1.0  
| | | | --- feature_37 > -0.42  
| | | | | --- class: 1.0  
| | --- feature_28 > 0.44  
| | | --- feature_24 <= 1.78  
| | | --- feature_9 <= 0.16  
| | | --- class: 0.0  
| | | --- feature_9 > 0.16  
| | | | --- feature_49 <= 0.14  
| | | | | --- class: 1.0  
| | | | | --- feature_49 > 0.14  
| | | | | --- class: 0.0  
| | | --- feature_24 > 1.78  
| | | | --- class: 1.0  
  
--- feature_22 <= -0.49  
--- feature_9 <= 0.42  
| --- feature_49 <= -0.28  
| | --- feature_3 <= -0.56  
| | | --- feature_45 <= 1.62  
| | | --- feature_4 <= -0.06  
| | | --- class: 1.0  
| | | --- feature_4 > -0.06  
| | | --- class: 0.0
```

```
| | | | |---- feature_45 > 1.62
| | | | |---- class: 0.0
| | | |---- feature_3 > -0.56
| | | |---- feature_27 <= -0.23
| | | |---- class: 1.0
| | | |---- feature_27 > -0.23
| | | |---- class: 0.0
| | |---- feature_49 > -0.28
| | |---- feature_25 <= 2.30
| | |---- feature_22 <= -0.49
| | |---- feature_3 <= -0.48
| | |---- class: 0.0
| | |---- feature_3 > -0.48
| | |---- feature_2 <= -0.39
| | |---- feature_49 <= 0.14
| | |---- class: 1.0
| | |---- feature_49 > 0.14
| | |---- class: 0.0
| | |---- feature_2 > -0.39
| | |---- class: 0.0
| | |---- feature_22 > -0.49
| | |---- feature_35 <= -0.04
| | |---- class: 0.0
| | |---- feature_35 > -0.04
| | |---- feature_29 <= 1.03
| | |---- class: 1.0
| | |---- feature_29 > 1.03
| | |---- class: 0.0
| | |---- feature_25 > 2.30
| | |---- feature_5 <= -0.01
| | |---- class: 0.0
| | |---- feature_5 > -0.01
| | |---- class: 1.0
| |---- feature_9 > 0.42
| |---- class: 1.0
|---- feature_22 > -0.49
|---- feature_9 <= -0.25
|---- feature_4 <= -0.66
|---- feature_44 <= -2.06
|---- class: 0.0
|---- feature_44 > -2.06
|---- feature_42 <= -1.22
|---- class: 0.0
|---- feature_42 > -1.22
|---- feature_32 <= 1.32
|---- feature_1 <= 0.69
|---- class: 1.0
|---- feature_1 > 0.69
|---- feature_35 <= -0.28
|---- class: 1.0
|---- feature_35 > -0.28
|---- feature_29 <= -0.16
|---- class: 0.0
|---- feature_29 > -0.16
|---- class: 1.0
|---- feature_32 > 1.32
|---- feature_35 <= -0.18
|---- class: 0.0
|---- feature_35 > -0.18
|---- class: 1.0
|---- feature_4 > -0.66
|---- feature_45 <= 0.26
|---- feature_39 <= -0.44
|---- feature_18 <= 0.18
|---- class: 0.0
|---- feature_18 > 0.18
|---- feature_40 <= 0.01
|---- class: 1.0
|---- feature_40 > 0.01
|---- class: 0.0
|---- feature_39 > -0.44
|---- feature_1 <= 0.75
|---- feature_9 <= -0.62
|---- feature_18 <= 0.74
|---- feature_22 <= -0.47
|---- feature_45 <= -0.17
|---- class: 1.0
|---- feature_45 > -0.17
|---- feature_36 <= -0.30
|---- class: 0.0
|---- feature_36 > -0.30
|---- class: 1.0
|---- feature_22 > -0.47
|---- feature_2 <= -0.09
|---- class: 1.0
|---- feature_2 > -0.09
|---- class: 0.0
```

[illegible]

```
| | | | |--- class: 0.0
| | | |--- feature_41 > -0.19
| | | |--- feature_32 <= -0.92
| | | |--- class: 1.0
| | | |--- feature_32 > -0.92
| | | |--- feature_10 <= -0.34
| | | |--- feature_5 <= -1.66
| | | |--- class: 1.0
| | | |--- feature_5 > -1.66
| | | |--- class: 0.0
| | | |--- feature_10 > -0.34
| | | |--- feature_31 <= 0.82
| | | |--- class: 0.0
| | | |--- feature_31 > 0.82
| | | |--- class: 1.0
| | |--- feature_8 > 0.55
| | |--- class: 1.0
|--- feature_7 > -0.76
|--- feature_28 <= 1.02
|--- feature_16 <= 1.25
|--- feature_41 <= 1.13
|--- feature_0 <= 0.47
|--- feature_43 <= -2.52
|--- class: 0.0
|--- feature_43 > -2.52
|--- feature_22 <= -0.49
|--- feature_25 <= 0.12
|--- feature_27 <= -0.34
|--- class: 1.0
|--- feature_27 > -0.34
|--- class: 0.0
|--- feature_25 > 0.12
|--- class: 1.0
|--- feature_22 > -0.49
|--- feature_49 <= -0.30
|--- feature_19 <= -0.51
|--- class: 0.0
|--- feature_19 > -0.51
|--- class: 1.0
|--- feature_49 > -0.30
|--- feature_33 <= -0.20
|--- feature_32 <= 0.83
|--- class: 1.0
|--- feature_32 > 0.83
|--- feature_46 <= -0.69
|--- class: 0.0
|--- feature_46 > -0.69
|--- class: 1.0
|--- feature_33 > -0.20
|--- feature_8 <= -0.42
|--- feature_1 <= 0.17
|--- truncated branch of depth 2
|--- feature_1 > 0.17
|--- truncated branch of depth 3
|--- feature_8 > -0.42
|--- feature_6 <= -1.16
|--- class: 0.0
|--- feature_6 > -1.16
|--- class: 1.0
|--- feature_0 > 0.47
|--- feature_5 <= -0.96
|--- feature_48 <= 0.04
|--- class: 1.0
|--- feature_48 > 0.04
|--- class: 0.0
|--- feature_5 > -0.96
|--- feature_42 <= 1.54
|--- feature_1 <= -0.60
|--- class: 1.0
|--- feature_1 > -0.60
|--- feature_33 <= -0.37
|--- feature_4 <= 0.76
|--- class: 0.0
|--- feature_4 > 0.76
|--- class: 1.0
|--- feature_33 > -0.37
|--- feature_11 <= 1.06
|--- class: 1.0
|--- feature_11 > 1.06
|--- feature_47 <= 0.64
|--- class: 1.0
|--- feature_47 > 0.64
|--- class: 0.0
|--- feature_42 > 1.54
|--- class: 0.0
|--- feature_41 > 1.13
```

```
| | | | |---- feature_12 <= 0.26
| | | | |---- feature_46 <= 1.03
| | | | |---- class: 1.0
| | | | |---- feature_46 > 1.03
| | | | |---- class: 0.0
| | | | |---- feature_12 > 0.26
| | | | |---- class: 1.0
| | |---- feature_16 > 1.25
| | | |---- feature_10 <= -0.38
| | | |---- feature_43 <= 0.93
| | | |---- class: 0.0
| | | |---- feature_43 > 0.93
| | | |---- class: 1.0
| | | |---- feature_10 > -0.38
| | | |---- feature_48 <= 0.04
| | | |---- class: 0.0
| | | |---- feature_48 > 0.04
| | | |---- class: 1.0
|---- feature_28 > 1.02
| |---- feature_26 <= -0.19
| | |---- feature_24 <= 1.32
| | |---- feature_14 <= 0.93
| | |---- class: 1.0
| | |---- feature_14 > 0.93
| | |---- class: 0.0
| | |---- feature_24 > 1.32
| | |---- feature_33 <= 1.34
| | |---- class: 0.0
| | |---- feature_33 > 1.34
| | |---- class: 1.0
| |---- feature_26 > -0.19
| | |---- feature_8 <= 0.31
| | |---- class: 0.0
| | |---- feature_8 > 0.31
| | |---- class: 1.0

|---- feature_7 <= -0.57
| |---- feature_29 <= 0.75
| | |---- feature_19 <= 0.71
| | | |---- feature_7 <= -0.94
| | | |---- feature_4 <= -0.60
| | | |---- feature_7 <= -1.18
| | | |---- class: 0.0
| | | |---- feature_7 > -1.18
| | | |---- class: 1.0
| | | |---- feature_4 > -0.60
| | | |---- feature_38 <= -0.35
| | | |---- class: 0.0
| | | |---- feature_38 > -0.35
| | | |---- class: 1.0
| | | |---- feature_7 > -0.94
| | | |---- feature_45 <= 0.24
| | | |---- feature_27 <= 2.03
| | | |---- feature_6 <= -1.36
| | | |---- class: 0.0
| | | |---- feature_6 > -1.36
| | | |---- class: 1.0
| | | |---- feature_27 > 2.03
| | | |---- class: 0.0
| | | |---- feature_45 > 0.24
| | | |---- feature_30 <= 0.89
| | | |---- feature_41 <= -0.15
| | | |---- class: 1.0
| | | |---- feature_41 > -0.15
| | | |---- feature_37 <= 0.80
| | | |---- class: 0.0
| | | |---- feature_37 > 0.80
| | | |---- class: 1.0
| | | |---- feature_30 > 0.89
| | | |---- class: 1.0
| |---- feature_19 > 0.71
| | |---- feature_5 <= 0.10
| | |---- feature_24 <= -0.69
| | |---- class: 1.0
| | |---- feature_24 > -0.69
| | |---- class: 0.0
| | |---- feature_5 > 0.10
| | |---- class: 1.0
|---- feature_29 > 0.75
| |---- feature_4 <= -1.47
| |---- class: 1.0
| |---- feature_4 > -1.47
| |---- feature_25 <= 2.42
| |---- feature_49 <= -0.30
| |---- feature_4 <= -1.16
| |---- class: 1.0
| |---- feature_4 > -1.16
```

```
feature_4 <= 0.47
|---- class: 0.0
|---- feature_4 > 0.47
|---- class: 1.0
|---- feature_49 > -0.30
|---- class: 0.0
|---- feature_25 > 2.42
|---- class: 1.0
|---- feature_7 > -0.57
|---- feature_26 <= 2.21
|---- feature_45 <= 0.80
|---- feature_49 <= 6.16
|---- feature_5 <= -1.05
|---- feature_5 <= -1.07
|---- feature_11 <= -1.14
|---- feature_25 <= -0.82
|---- class: 0.0
|---- feature_25 > -0.82
|---- class: 1.0
|---- feature_11 > -1.14
|---- class: 1.0
|---- feature_5 > -1.07
|---- class: 0.0
|---- feature_5 > -1.05
|---- feature_18 <= 1.89
|---- feature_34 <= 0.22
|---- feature_12 <= -0.25
|---- feature_30 <= 1.05
|---- feature_49 <= -0.30
|---- feature_2 <= -0.07
|---- class: 1.0
|---- feature_2 > -0.07
|---- class: 0.0
|---- feature_49 > -0.30
|---- feature_20 <= 0.68
|---- truncated branch of depth 2
|---- feature_20 > 0.68
|---- class: 1.0
|---- feature_30 > 1.05
|---- class: 0.0
|---- feature_12 > -0.25
|---- feature_13 <= 1.10
|---- class: 1.0
|---- feature_13 > 1.10
|---- feature_18 <= 1.57
|---- class: 0.0
|---- feature_18 > 1.57
|---- class: 1.0
|---- feature_34 > 0.22
|---- feature_1 <= 0.55
|---- class: 1.0
|---- feature_1 > 0.55
|---- class: 0.0
|---- feature_18 > 1.89
|---- feature_14 <= 1.27
|---- feature_9 <= 0.55
|---- class: 0.0
|---- feature_9 > 0.55
|---- class: 1.0
|---- feature_14 > 1.27
|---- class: 1.0
|---- feature_49 > 6.16
|---- class: 0.0
|---- feature_45 > 0.80
|---- feature_23 <= 0.36
|---- feature_45 <= 1.15
|---- feature_9 <= -0.18
|---- class: 0.0
|---- feature_9 > -0.18
|---- class: 1.0
|---- feature_45 > 1.15
|---- feature_6 <= 1.11
|---- class: 1.0
|---- feature_6 > 1.11
|---- class: 0.0
|---- feature_23 > 0.36
|---- feature_10 <= -0.63
|---- class: 0.0
|---- feature_10 > -0.63
|---- feature_28 <= 1.11
|---- class: 0.0
|---- feature_28 > 1.11
|---- class: 1.0
|---- feature_26 > 2.21
|---- feature_9 <= -0.44
|---- class: 0.0
```

```

| | | |---- feature_9 > -0.44
| | | |---- feature_23 <= 0.02
| | | |---- feature_20 <= 0.64
| | | |---- class: 1.0
| | | |---- feature_20 > 0.64
| | | |---- class: 0.0
| | | |---- feature_23 > 0.02
| | | |---- class: 1.0

|---- feature_3 <= -0.50
| |---- feature_34 <= -0.24
| | |---- feature_4 <= -0.53
| | | |---- feature_16 <= -1.00
| | | |---- class: 0.0
| | | |---- feature_16 > -1.00
| | | |---- class: 1.0
| | |---- feature_4 > -0.53
| | | |---- feature_25 <= -0.54
| | | |---- class: 1.0
| | | |---- feature_25 > -0.54
| | | |---- feature_49 <= -0.30
| | | |---- class: 1.0
| | | |---- feature_49 > -0.30
| | | |---- feature_22 <= -0.43
| | | |---- feature_19 <= 1.12
| | | |---- class: 1.0
| | | |---- feature_19 > 1.12
| | | |---- class: 0.0
| | | |---- feature_22 > -0.43
| | | |---- class: 0.0
| |---- feature_34 > -0.24
| | |---- feature_25 <= 2.42
| | | |---- feature_5 <= 0.24
| | | |---- feature_37 <= -0.40
| | | |---- class: 1.0
| | | |---- feature_37 > -0.40
| | | |---- feature_1 <= 0.48
| | | |---- feature_34 <= 0.28
| | | |---- feature_14 <= -0.33
| | | |---- class: 0.0
| | | |---- feature_14 > -0.33
| | | |---- class: 1.0
| | | |---- feature_34 > 0.28
| | | |---- class: 0.0
| | | |---- feature_1 > 0.48
| | | |---- feature_44 <= 0.47
| | | |---- feature_49 <= -0.30
| | | |---- feature_12 <= -0.28
| | | |---- class: 1.0
| | | |---- feature_12 > -0.28
| | | |---- feature_40 <= 0.83
| | | |---- class: 0.0
| | | |---- feature_40 > 0.83
| | | |---- class: 1.0
| | | |---- feature_49 > -0.30
| | | |---- class: 0.0
| | | |---- feature_44 > 0.47
| | | |---- feature_11 <= -0.78
| | | |---- class: 0.0
| | | |---- feature_11 > -0.78
| | | |---- class: 1.0
| | |---- feature_5 > 0.24
| | | |---- feature_49 <= 3.64
| | | |---- feature_45 <= 1.51
| | | |---- class: 1.0
| | | |---- feature_45 > 1.51
| | | |---- class: 0.0
| | | |---- feature_49 > 3.64
| | | |---- class: 0.0
| | |---- feature_25 > 2.42
| | |---- class: 1.0
|---- feature_3 > -0.50
| |---- feature_14 <= -0.37
| | |---- feature_26 <= 0.76
| | | |---- feature_6 <= 0.07
| | | |---- feature_9 <= -0.29
| | | |---- feature_2 <= -0.38
| | | |---- class: 1.0
| | | |---- feature_2 > -0.38
| | | |---- feature_2 <= 0.68
| | | |---- feature_7 <= -0.53
| | | |---- feature_39 <= -0.38
| | | |---- class: 0.0
| | | |---- feature_39 > -0.38
| | | |---- class: 1.0
| | | |---- feature_7 > -0.53
| | | |---- feature_49 <= 0.72

```

[illegible]



```
| | | |--- feature_32 <= -0.76
| | | |--- feature_9 <= -0.92
| | | |--- class: 0.0
| | | |--- feature_9 > -0.92
| | | |--- class: 1.0
| | | |--- feature_32 > -0.76
| | | |--- feature_16 <= 0.73
| | | |--- feature_27 <= -0.29
| | | |--- class: 0.0
| | | |--- feature_27 > -0.29
| | | |--- feature_33 <= 4.96
| | | |--- class: 1.0
| | | |--- feature_33 > 4.96
| | | |--- class: 0.0
| | | |--- feature_16 > 0.73
| | | |--- class: 0.0
| | | |--- feature_5 > -0.30
| | | |--- feature_19 <= 0.85
| | | |--- class: 0.0
| | | |--- feature_19 > 0.85
| | | |--- class: 1.0
| | | |--- feature_9 > -0.43
| | | |--- feature_20 <= 1.94
| | | |--- feature_17 <= 0.96
| | | |--- feature_35 <= 0.01
| | | |--- class: 1.0
| | | |--- feature_35 > 0.01
| | | |--- feature_10 <= -0.01
| | | |--- feature_43 <= -0.29
| | | |--- feature_30 <= 1.32
| | | |--- class: 0.0
| | | |--- feature_30 > 1.32
| | | |--- class: 1.0
| | | |--- feature_43 > -0.29
| | | |--- class: 1.0
| | | |--- feature_10 > -0.01
| | | |--- class: 1.0
| | | |--- feature_17 > 0.96
| | | |--- class: 0.0
| | | |--- feature_20 > 1.94
| | | |--- class: 0.0
| | | |--- feature_21 > -0.73
| | | |--- feature_39 <= 1.11
| | | |--- feature_23 <= 1.12
| | | |--- feature_12 <= -0.44
| | | |--- feature_9 <= -0.07
| | | |--- feature_22 <= -0.42
| | | |--- feature_17 <= -0.78
| | | |--- class: 1.0
| | | |--- feature_17 > -0.78
| | | |--- class: 0.0
| | | |--- feature_22 > -0.42
| | | |--- feature_19 <= 0.71
| | | |--- class: 1.0
| | | |--- feature_19 > 0.71
| | | |--- class: 0.0
| | | |--- feature_9 > -0.07
| | | |--- class: 1.0
| | | |--- feature_12 > -0.44
| | | |--- feature_3 <= -0.74
| | | |--- feature_16 <= -0.04
| | | |--- feature_1 <= 0.85
| | | |--- class: 0.0
| | | |--- feature_1 > 0.85
| | | |--- class: 1.0
| | | |--- feature_16 > -0.04
| | | |--- class: 1.0
| | | |--- feature_3 > -0.74
| | | |--- feature_11 <= -0.36
| | | |--- feature_32 <= 1.44
| | | |--- feature_27 <= 0.05
| | | |--- feature_40 <= 0.02
| | | |--- feature_31 <= 0.83
| | | |--- class: 1.0
| | | |--- feature_31 > 0.83
| | | |--- feature_30 <= 0.71
| | | |--- class: 0.0
| | | |--- feature_30 > 0.71
| | | |--- class: 1.0
| | | |--- feature_40 > 0.02
| | | |--- feature_8 <= -0.26
| | | |--- feature_27 <= -0.03
| | | |--- class: 1.0
| | | |--- feature_27 > -0.03
| | | |--- class: 0.0
| | | |--- feature_8 > -0.26
```

```
| | | | | | | | |--- class: 0.0
| | | | | | | |--- feature_27 > 0.05
| | | | | | | |--- class: 1.0
| | | | | | |--- feature_32 > 1.44
| | | | | | |--- feature_23 <= 0.52
| | | | | | |--- class: 0.0
| | | | | | |--- feature_23 > 0.52
| | | | | | |--- class: 1.0
| | | | |--- feature_11 > -0.36
| | | | |--- feature_43 <= -2.14
| | | | |--- feature_1 <= 0.79
| | | | |--- class: 0.0
| | | | |--- feature_1 > 0.79
| | | | |--- class: 1.0
| | | |--- feature_43 > -2.14
| | | |--- feature_5 <= 0.13
| | | |--- feature_19 <= -2.97
| | | |--- class: 0.0
| | | |--- feature_19 > -2.97
| | | |--- feature_40 <= -2.44
| | | |--- class: 0.0
| | | |--- feature_40 > -2.44
| | | |--- feature_17 <= -0.54
| | | |--- truncated branch of depth 3
| | | |--- feature_17 > -0.54
| | | |--- class: 1.0
| | |--- feature_5 > 0.13
| | |--- class: 1.0
|--- feature_23 > 1.12
|   --- feature_9 <= -1.34
|     --- class: 1.0
|     --- feature_9 > -1.34
|       --- class: 0.0
|--- feature_39 > 1.11
|   --- feature_19 <= 0.08
|     --- class: 1.0
|     --- feature_19 > 0.08
|       --- class: 0.0

|--- feature_16 <= 0.66
|   --- feature_23 <= 0.80
|     --- feature_31 <= -0.04
|       --- feature_15 <= -0.37
|         --- feature_9 <= 0.57
|           --- class: 1.0
|           --- feature_9 > 0.57
|             --- class: 0.0
|       --- feature_15 > -0.37
|         --- feature_27 <= 3.31
|           --- class: 1.0
|           --- feature_27 > 3.31
|             --- class: 0.0
|     --- feature_31 > -0.04
|       --- feature_37 <= 0.66
|         --- feature_2 <= -0.63
|           --- feature_27 <= 0.83
|             --- feature_2 <= -0.74
|               --- class: 1.0
|               --- feature_2 > -0.74
|                 --- class: 0.0
|           --- feature_27 > 0.83
|             --- class: 1.0
|         --- feature_2 > -0.63
|           --- feature_3 <= -0.73
|             --- class: 0.0
|           --- feature_3 > -0.73
|             --- feature_25 <= -0.80
|               --- feature_20 <= -1.40
|                 --- class: 0.0
|                 --- feature_20 > -1.40
|                   --- class: 1.0
|             --- feature_25 > -0.80
|               --- feature_4 <= -0.54
|                 --- feature_24 <= 2.22
|                   --- feature_1 <= -0.07
|                     --- feature_31 <= 1.01
|                       --- class: 1.0
|                       --- feature_31 > 1.01
|                         --- class: 0.0
|                     --- feature_1 > -0.07
|                       --- class: 1.0
|                   --- feature_24 > 2.22
|                     --- class: 0.0
|                 --- feature_4 > -0.54
|                   --- feature_27 <= -0.33
|                     --- class: 1.0
|                   --- feature_27 > -0.33
```

```
|--- feature_47 <= 0.49
|   |--- class: 1.0
|   |--- feature_47 > 0.49
|       |--- feature_7 <= 0.18
|           |--- truncated branch of depth 5
|               |--- feature_7 > 0.18
|                   |--- class: 1.0
|       |--- feature_37 > 0.66
|           |--- class: 0.0
|--- feature_23 > 0.80
|   |--- feature_31 <= 0.81
|       |--- feature_25 <= -0.48
|           |--- class: 1.0
|       |--- feature_25 > -0.48
|           |--- class: 0.0
|       |--- feature_31 > 0.81
|           |--- feature_1 <= 0.86
|               |--- class: 0.0
|               |--- feature_1 > 0.86
|                   |--- class: 1.0
|--- feature_16 > 0.66
|   |--- feature_11 <= -0.41
|       |--- feature_44 <= 0.83
|           |--- feature_25 <= 2.39
|               |--- feature_7 <= -0.51
|                   |--- feature_8 <= -1.63
|                       |--- class: 1.0
|                       |--- feature_8 > -1.63
|                           |--- class: 0.0
|                           |--- feature_7 > -0.51
|                               |--- feature_4 <= -0.68
|                                   |--- class: 1.0
|                                   |--- feature_4 > -0.68
|                                       |--- feature_12 <= -1.85
|                                           |--- class: 0.0
|                                           |--- feature_12 > -1.85
|                                               |--- feature_44 <= 0.18
|                                                   |--- class: 1.0
|                                                   |--- feature_44 > 0.18
|                                                       |--- class: 0.0
|               |--- feature_25 > 2.39
|                   |--- class: 1.0
|       |--- feature_44 > 0.83
|           |--- feature_5 <= -0.99
|               |--- class: 0.0
|               |--- feature_5 > -0.99
|                   |--- class: 1.0
|--- feature_11 > -0.41
|   |--- feature_35 <= -0.33
|       |--- class: 0.0
|       |--- feature_35 > -0.33
|           |--- feature_33 <= -0.10
|               |--- feature_3 <= -0.59
|                   |--- feature_45 <= -0.25
|                       |--- class: 1.0
|                       |--- feature_45 > -0.25
|                           |--- class: 0.0
|                           |--- feature_3 > -0.59
|                               |--- feature_20 <= 0.70
|                                   |--- feature_20 <= 0.65
|                                       |--- class: 1.0
|                                       |--- feature_20 > 0.65
|                                           |--- class: 0.0
|                                           |--- feature_20 > 0.70
|                                               |--- feature_22 <= -0.49
|                                                   |--- feature_22 <= -0.49
|                                                       |--- class: 1.0
|                                                       |--- feature_22 > -0.49
|                                                           |--- class: 0.0
|                                                           |--- feature_22 > -0.49
|                                                               |--- feature_17 <= -1.43
|                                                                   |--- feature_48 <= 0.03
|                                                                       |--- class: 0.0
|                                                                       |--- feature_48 > 0.03
|                                                                           |--- class: 1.0
|                                                                           |--- feature_17 > -1.43
|                                                                               |--- class: 1.0
|       |--- feature_33 > -0.10
|           |--- feature_6 <= 0.57
|               |--- class: 0.0
|               |--- feature_6 > 0.57
|                   |--- feature_5 <= -0.31
|                       |--- class: 0.0
|                       |--- feature_5 > -0.31
|                           |--- class: 1.0
```



```
| | | | | feature_20 > 1.15  
| | | | | |---- feature_46 <= 1.20  
| | | | | | |---- class: 1.0  
| | | | | |---- feature_46 > 1.20  
| | | | | | |---- class: 0.0  
| | | | |---- feature_42 > 0.77  
| | | | | |---- feature_40 <= -0.23  
| | | | | | |---- class: 0.0  
| | | | | |---- feature_40 > -0.23  
| | | | | | |---- class: 1.0  
| | | |---- feature_11 > 0.45  
| | | |---- class: 1.0  
|---- feature_20 > 0.64  
| |---- feature_6 <= 0.07  
| | |---- feature_22 <= -0.49  
| | | |---- feature_3 <= -0.29  
| | | | |---- feature_25 <= 2.42  
| | | | | |---- feature_4 <= -0.92  
| | | | | | |---- feature_17 <= -0.68  
| | | | | | | |---- feature_35 <= 0.63  
| | | | | | | |---- class: 0.0  
| | | | | | | |---- feature_35 > 0.63  
| | | | | | | |---- feature_6 <= -1.28  
| | | | | | | |---- class: 0.0  
| | | | | | | |---- feature_6 > -1.28  
| | | | | | | |---- class: 1.0  
| | | | | |---- feature_17 > -0.68  
| | | | | | |---- class: 1.0  
| | | | | |---- feature_4 > -0.92  
| | | | | | |---- class: 0.0  
| | | | |---- feature_25 > 2.42  
| | | | | |---- class: 1.0  
| | | |---- feature_3 > -0.29  
| | | | |---- feature_13 <= -1.43  
| | | | | |---- class: 0.0  
| | | | | |---- feature_13 > -1.43  
| | | | | |---- class: 1.0  
| |---- feature_22 > -0.49  
| | |---- feature_1 <= -0.46  
| | | |---- class: 1.0  
| | | |---- feature_1 > -0.46  
| | | | |---- feature_47 <= 0.38  
| | | | | |---- feature_10 <= -0.36  
| | | | | | |---- class: 0.0  
| | | | | |---- feature_10 > -0.36  
| | | | | | |---- feature_24 <= -0.61  
| | | | | | |---- feature_3 <= -0.09  
| | | | | | |---- class: 1.0  
| | | | | | |---- feature_3 > -0.09  
| | | | | | |---- class: 0.0  
| | | | | |---- feature_24 > -0.61  
| | | | | | |---- class: 1.0  
| | | | |---- feature_47 > 0.38  
| | | | | |---- class: 1.0  
|---- feature_6 > 0.07  
| |---- feature_9 <= -0.64  
| | |---- feature_36 <= 0.26  
| | | |---- class: 0.0  
| | | |---- feature_36 > 0.26  
| | | |---- class: 1.0  
| |---- feature_9 > -0.64  
| | |---- feature_26 <= 3.94  
| | | |---- feature_14 <= -4.18  
| | | | |---- class: 0.0  
| | | | |---- feature_14 > -4.18  
| | | | | |---- feature_30 <= 1.05  
| | | | | | |---- class: 1.0  
| | | | | |---- feature_30 > 1.05  
| | | | | | |---- feature_13 <= -0.97  
| | | | | | |---- class: 1.0  
| | | | | |---- feature_13 > -0.97  
| | | | | | |---- class: 0.0  
| | | |---- feature_26 > 3.94  
| | | |---- class: 0.0  
  
|---- feature_38 <= 0.25  
| |---- feature_3 <= -0.62  
| | |---- feature_25 <= -0.63  
| | | |---- class: 1.0  
| | | |---- feature_25 > -0.63  
| | | | |---- feature_33 <= -0.36  
| | | | | |---- feature_34 <= -0.30  
| | | | | | |---- class: 0.0  
| | | | | |---- feature_34 > -0.30  
| | | | | | |---- class: 1.0  
| | | |---- feature_33 > -0.36  
| | | |---- feature_31 <= 1.17
```

```

|--- feature_18 <= 0.47
|--- feature_33 <= 1.02
|--- feature_32 <= 1.28
|--- class: 0.0
|--- feature_32 > 1.28
|--- feature_2 <= -0.66
|--- class: 1.0
|--- feature_2 > -0.66
|--- class: 0.0
|--- feature_33 > 1.02
|--- class: 1.0
|--- feature_18 > 0.47
|--- feature_23 <= -0.25
|--- class: 0.0
|--- feature_23 > -0.25
|--- class: 1.0
|--- feature_31 > 1.17
|--- class: 1.0
|--- feature_3 > -0.62
|--- feature_21 <= -0.49
|--- feature_26 <= 1.72
|--- feature_27 <= -0.38
|--- feature_6 <= 0.56
|--- class: 0.0
|--- feature_6 > 0.56
|--- class: 1.0
|--- feature_27 > -0.38
|--- feature_37 <= 0.57
|--- feature_19 <= -1.71
|--- feature_28 <= -1.01
|--- class: 0.0
|--- feature_28 > -1.01
|--- class: 1.0
|--- feature_19 > -1.71
|--- feature_5 <= -1.20
|--- feature_18 <= -1.08
|--- class: 1.0
|--- feature_18 > -1.08
|--- class: 0.0
|--- feature_5 > -1.20
|--- feature_22 <= -0.49
|--- class: 0.0
|--- feature_22 > -0.49
|--- feature_48 <= 0.08
|--- feature_8 <= -1.18
|--- truncated branch of depth 2
|--- feature_8 > -1.18
|--- truncated branch of depth 4
|--- feature_48 > 0.08
|--- class: 0.0
|--- feature_37 > 0.57
|--- feature_49 <= -0.29
|--- class: 0.0
|--- feature_49 > -0.29
|--- class: 1.0
|--- feature_26 > 1.72
|--- class: 0.0
|--- feature_21 > -0.49
|--- feature_6 <= -1.32
|--- feature_4 <= -0.57
|--- class: 1.0
|--- feature_4 > -0.57
|--- class: 0.0
|--- feature_6 > -1.32
|--- feature_8 <= -0.94
|--- feature_11 <= -0.61
|--- feature_38 <= -0.42
|--- class: 0.0
|--- feature_38 > -0.42
|--- class: 1.0
|--- feature_11 > -0.61
|--- feature_40 <= -0.27
|--- class: 1.0
|--- feature_40 > -0.27
|--- class: 0.0
|--- feature_8 > -0.94
|--- feature_18 <= -0.75
|--- feature_27 <= -0.34
|--- feature_11 <= 1.06
|--- class: 0.0
|--- feature_11 > 1.06
|--- class: 1.0
|--- feature_27 > -0.34
|--- class: 1.0
|--- feature_18 > -0.75
|--- feature_16 <= -2.19

```

```
| | | | | | | | |---- feature_38 <= -0.35
| | | | | | | | |---- class: 0.0
| | | | | | | | |---- feature_38 > -0.35
| | | | | | | | |---- class: 1.0
| | | | | | | | |---- feature_16 > -2.19
| | | | | | | | |---- class: 1.0
|---- feature_38 > 0.25
| |---- feature_21 <= -0.31
| | |---- feature_11 <= 0.64
| | | |---- feature_9 <= -1.53
| | | | |---- feature_19 <= 0.82
| | | | |---- class: 1.0
| | | | |---- feature_19 > 0.82
| | | | |---- class: 0.0
| | | | |---- feature_9 > -1.53
| | | | |---- feature_30 <= 1.46
| | | | |---- feature_32 <= -0.60
| | | | |---- class: 1.0
| | | | |---- feature_32 > -0.60
| | | | |---- feature_29 <= 1.04
| | | | |---- feature_38 <= 0.41
| | | | |---- class: 0.0
| | | | |---- feature_38 > 0.41
| | | | |---- class: 1.0
| | | | |---- feature_29 > 1.04
| | | | |---- feature_8 <= -1.56
| | | | |---- class: 1.0
| | | | |---- feature_8 > -1.56
| | | | |---- feature_9 <= -1.13
| | | | |---- feature_23 <= 0.74
| | | | |---- class: 0.0
| | | | |---- feature_23 > 0.74
| | | | |---- feature_11 <= -0.92
| | | | |---- class: 0.0
| | | | |---- feature_11 > -0.92
| | | | |---- class: 1.0
| | | | |---- feature_9 > -1.13
| | | | |---- class: 0.0
| | | | |---- feature_30 > 1.46
| | | | |---- class: 1.0
| | | |---- feature_11 > 0.64
| | | |---- feature_42 <= 1.79
| | | |---- class: 1.0
| | | |---- feature_42 > 1.79
| | | |---- class: 0.0
| |---- feature_21 > -0.31
| | |---- feature_48 <= 0.04
| | |---- class: 1.0
| | |---- feature_48 > 0.04
| | | |---- feature_32 <= 0.81
| | | |---- class: 1.0
| | | |---- feature_32 > 0.81
| | | |---- class: 0.0
```

<Figure size 1080x720 with 0 Axes>

In [154]:

```
clf.score(X_train,y_train)
```

Out[154]:

0.9966887417218543

In [155]:

```
clf.score(X_test,y_test)
```

Out[155]:

0.8552631578947368

In [156]:

```
y_clfPred = clf.predict(X_test)
```

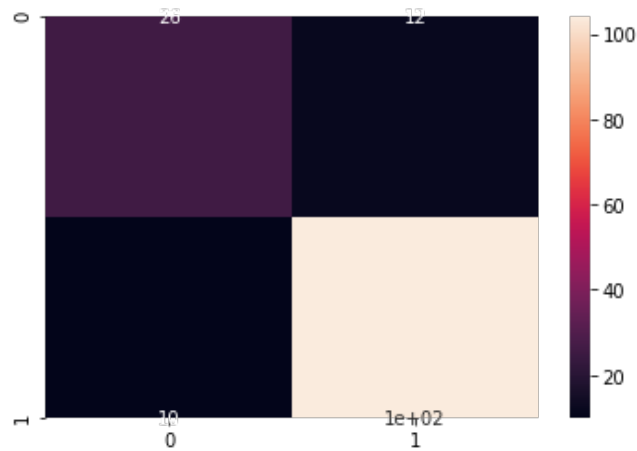
In [157]:

```
from sklearn.metrics import classification_report,confusion_matrix,accuracy_score
cm = confusion_matrix(y_test,y_clfPred)
print(cm)
sns.heatmap(cm, annot=True)
print('\n')
print(classification_report(y_test,y_clfPred))
print('Accuracy: ' +str(accuracy_score(y_test,y_rbfPred)))
```

```
[ [ 26 12]
[ 10 104]]
```

	precision	recall	f1-score	support
0	0.72	0.68	0.70	38
1	0.90	0.91	0.90	114
accuracy			0.86	152
macro avg	0.81	0.80	0.80	152
weighted avg	0.85	0.86	0.85	152

Accuracy: 0.875



## Extra Tree Classifier - Ensemble Technique [Bagging ]

In [24]:

```
X = parkinsons_data[col]
y = parkinsons_data['class']

#Feature Scaling
from sklearn.preprocessing import StandardScaler
sc = StandardScaler()
x = sc.fit_transform(X)

from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)

from sklearn import tree
from sklearn.ensemble import ExtraTreesClassifier

etc = ExtraTreesClassifier(n_estimators=100,random_state=0)
etc.fit(X_train,y_train)
```

Out[24]:

```
ExtraTreesClassifier(bootstrap=False, class_weight=None, criterion='gini',
                    max_depth=None, max_features='auto', max_leaf_nodes=None,
                    min_impurity_decrease=0.0, min_impurity_split=None,
                    min_samples_leaf=1, min_samples_split=2,
                    min_weight_fraction_leaf=0.0, n_estimators=100,
                    n_jobs=None, oob_score=False, random_state=0, verbose=0,
                    warm_start=False)
```

In [25]:

```
from sklearn.model_selection import cross_val_score

cv_scores = cross_val_score(etc,X_train,y_train,cv=10)
print("Cross Validation Average Score : " , cv_scores.mean())
```

Cross Validation Average Score : 0.8808196721311475

In [26]:

```
y_etcPred = etc.predict(X_test)
```

In [27]:

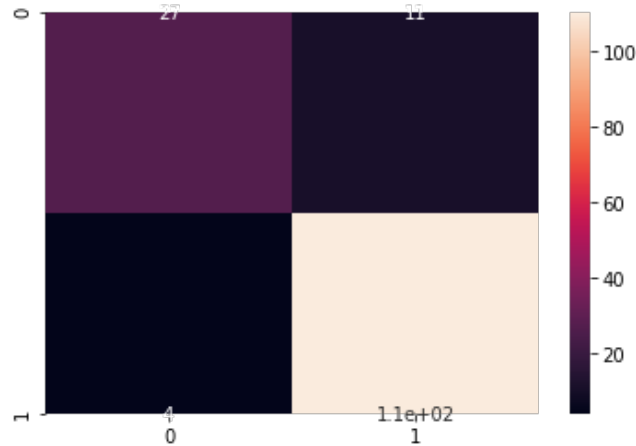
```
from sklearn.metrics import classification_report,confusion_matrix
cm = confusion_matrix(y_test,y_etcPred)
print(cm)
sns.heatmap(cm, annot=True)
print('\n')
print(classification_report(y_test,y_etcPred))
print('Accuracy: ' +str(accuracy_score(y_test,y_etcPred)))
```



```
[[ 27  11]
 [  4 110]]
```

	precision	recall	f1-score	support
0	0.87	0.71	0.78	38
1	0.91	0.96	0.94	114
accuracy			0.90	152
macro avg	0.89	0.84	0.86	152
weighted avg	0.90	0.90	0.90	152

Accuracy: 0.9013157894736842



## ROC & AUC Curve as Best Accuracy is given by this Extra Tree Classifier

In [40]:

```
mythreshold=0.88 #Random Threshold
from sklearn.metrics import confusion_matrix

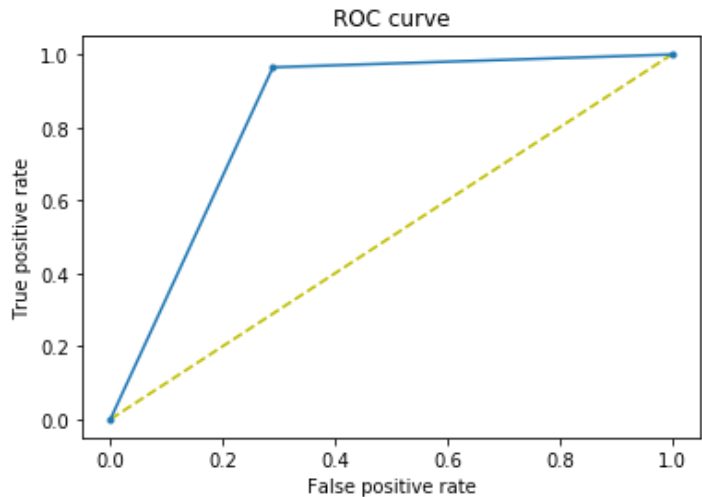
y_pred = (etc.predict(X_test)>= mythreshold).astype(int)
cm=confusion_matrix(y_test, y_pred)
print(cm)
```

```
[[ 27  11]
 [  4 110]]
```

In [41]:

```
#ROC
from sklearn.metrics import roc_curve
y_preds = etc.predict(X_test).ravel()

fpr, tpr, thresholds = roc_curve(y_test, y_preds)
plt.figure(1)
plt.plot([0, 1], [0, 1], 'y--')
plt.plot(fpr, tpr, marker='.')
plt.xlabel('False positive rate')
plt.ylabel('True positive rate')
plt.title('ROC curve')
plt.show()
```



In [42]:

```
import pandas as pd
i = np.arange(len(tpr))
roc = pd.DataFrame({'tf' : pd.Series(tpr-(1-fpr), index=i), 'thresholds' : pd.Series(thresh
olds, index=i)})
```

```
ideal_roc_thresh = roc.iloc[(roc.tf-0).abs().argsort()[:1]] #Locate the point where the value is close to 0
print("Ideal threshold is: ", ideal_roc_thresh['thresholds'])
```

Ideal threshold is: 1 1  
Name: thresholds, dtype: int64

In [43]:

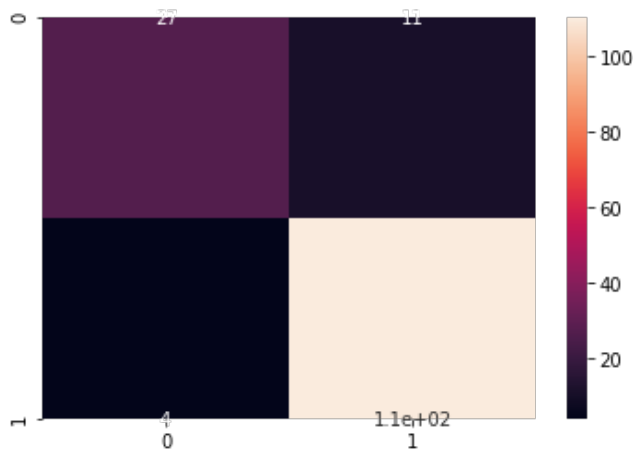
```
mythreshold=1 # Ideal thresholds
from sklearn.metrics import confusion_matrix

y_pred = (etc.predict(X_test)>= mythreshold).astype(int)
cm=confusion_matrix(y_test, y_pred)
print(cm)
sns.heatmap(cm, annot=True)
```

[[ 27 11]
 [ 4 110]]

Out[43]:

<matplotlib.axes.\_subplots.AxesSubplot at 0x1b5a173e748>



In [44]:

```
from sklearn.metrics import auc
auc_value = auc(fpr, tpr)
print("Area under curve, AUC = ", auc_value)
```

Area under curve, AUC = 0.8377192982456141

**There is 83% Chance that model can distinguish between True Positive & True Negative**

## AdaBoost Algorithm - Boosting Technique

In [164]:

```
X = parkinsons_data[col]
y = parkinsons_data['class']

# Feature Scaling
# from sklearn.preprocessing import StandardScaler
# sc = StandardScaler()
# x = sc.fit_transform(X)

from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)

from sklearn import tree
from sklearn.ensemble import AdaBoostClassifier

ac = AdaBoostClassifier(n_estimators=100, learning_rate=1, random_state=42)
ac.fit(X_train, y_train)
```

Out[164]:

AdaBoostClassifier(algorithm='SAMME.R', base\_estimator=None, learning\_rate=1, n\_estimators=100, random\_state=42)

In [165]:

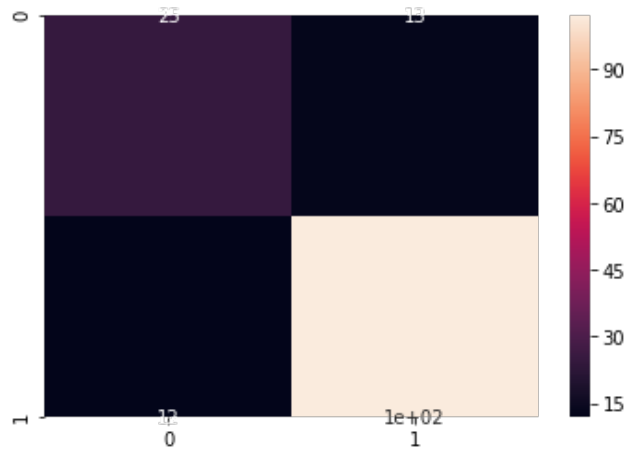
```
from sklearn.metrics import classification_report, confusion_matrix, accuracy_score
y_acPred = ac.predict(X_test)
cm = confusion_matrix(y_test, y_acPred)
print(cm)
sns.heatmap(cm, annot=True)
print('\n')
```

```
print(classification_report(y_test,y_acPred))
print('Accuracy: ' +str(accuracy_score(y_test,y_acPred)))
```

```
[[ 25  13]
 [ 12 102]]
```

	precision	recall	f1-score	support
0	0.68	0.66	0.67	38
1	0.89	0.89	0.89	114
accuracy			0.84	152
macro avg	0.78	0.78	0.78	152
weighted avg	0.83	0.84	0.83	152

Accuracy: 0.8355263157894737



SVM - RBF As Base Estimator

In [175]:

```
from sklearn.svm import SVC

sv = SVC(kernel="rbf", gamma='auto', C=2)
sv.fit(X_train,y_train)

ac_svModel = AdaBoostClassifier(base_estimator=sv,n_estimators=100,learning_rate=1,random_state=42,algorithm='SAMME')
ac_svModel.fit(X_train,y_train)

y_ac_svPred = ac_svModel.predict(X_test)
```

In [176]:

```
# SVM ~ Score -
score = ac.score(X_test,y_test)
print("Score  :", score)
```

Score : 0.8355263157894737

In [177]:

```
print('Accuracy SVM Model on AdaBoost: ' +str(accuracy_score(y_test, y_ac_svPred)))
```

Accuracy SVM Model on AdaBoost: 0.75

In [178]:

```
from sklearn.metrics import classification_report,confusion_matrix,accuracy_score
y_ac_svPred = ac_svModel.predict(X_test)
cm = confusion_matrix(y_test,y_ac_svPred)
print(cm)
sns.heatmap(cm, annot=True)
print('\n')
print(classification_report(y_test,y_ac_svPred))
print('Accuracy: ' +str(accuracy_score(y_test,y_ac_svPred)))
```

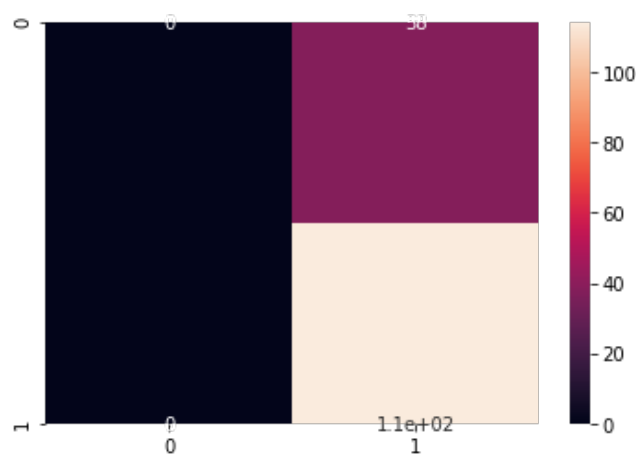
```
[[ 0  38]
 [ 0 114]]
```

	precision	recall	f1-score	support
0	0.00	0.00	0.00	38
1	0.75	1.00	0.86	114
accuracy			0.75	152
macro avg	0.38	0.50	0.43	152
weighted avg	0.56	0.85	0.64	152

weighted avg            0.56            0.75            0.64            152

Accuracy: 0.75

C:\Users\Lenovo\Anaconda3\lib\site-packages\sklearn\metrics\classification.py:1437: UndefinedMetricWarning: Precision and F-score are ill-defined and being set to 0.0 in labels with no predicted samples.  
'precision', 'predicted', average, warn\_for)



## Deep Learning Algorithm ~ Multi Layer Perceptron

In [22]:

```
#MLP classifier multilayer perceptron
X = parkinsons_data[col]
y = parkinsons_data['class']

#Feature Scaling
from sklearn.preprocessing import StandardScaler
sc = StandardScaler()
x = sc.fit_transform(X)

from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)

from sklearn.neural_network import MLPClassifier

mlp = MLPClassifier(max_iter=500, activation='relu')
mlp.fit(X_train,y_train)
```

C:\Users\Lenovo\Anaconda3\lib\site-packages\sklearn\neural\_network\multilayer\_perceptron.py:566: ConvergenceWarning: Stochastic Optimizer: Maximum iterations (500) reached and the optimization hasn't converged yet.  
% self.max\_iter, ConvergenceWarning)

Out[22]:

MLPClassifier(activation='relu', alpha=0.0001, batch\_size='auto', beta\_1=0.9, beta\_2=0.999, early\_stopping=False, epsilon=1e-08, hidden\_layer\_sizes=(100,), learning\_rate='constant', learning\_rate\_init=0.001, max\_iter=500, momentum=0.9, n\_iter\_no\_change=10, nesterovs\_momentum=True, power\_t=0.5, random\_state=None, shuffle=True, solver='adam', tol=0.0001, validation\_fraction=0.1, verbose=False, warm\_start=False)

In [23]:

```
from sklearn.metrics import classification_report,confusion_matrix,accuracy_score
MLP_Pred = mlp.predict(X_test)
cm = confusion_matrix(y_test,MLP_Pred)
print(cm)
sns.heatmap(cm, annot=True)
print('\n')
print(classification_report(y_test,MLP_Pred))
print('Accuracy: ' +str(accuracy_score(y_test,MLP_Pred)))
```

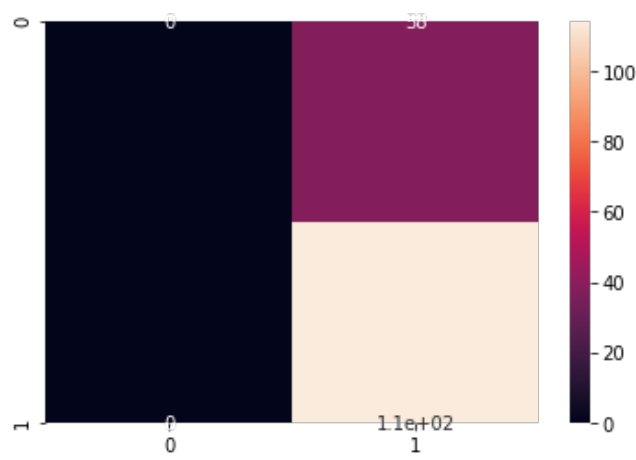
[[ 0 38]
 [ 0 114]]

	precision	recall	f1-score	support
0	0.00	0.00	0.00	38
1	0.75	1.00	0.86	114
accuracy			0.75	152
macro avg	0.38	0.50	0.43	152
weighted avg	0.56	0.75	0.64	152

Accuracy: 0.75

C:\Users\Lenovo\Anaconda3\lib\site-packages\sklearn\metrics\classification.py:1437: UndefinedMetricWarning: Precision and F-score are ill-defined and being set to 0.0 in labels with no predicted samples.

```
'precision', 'predicted', average, warn_for)
```



## Test Model

In [186]:

```
X = parkinsons_data[col]
y = parkinsons_data['class']
```

In [189]:

```
# X.to_csv('pd_top_50.csv')
```

In [200]:

```
input_data = (69.9974958,2.4874,0.34158,0.049933,0.040231,0.02883,0.028115,0.04718,0.016392
,0.014642,0.019681,0.012829,0.021703,-79779216.69,-129684181.7,-459058057.8,262.2272,-184901
.7535,-381059.351,124.1971,2091.946,0.057575,0.10807,4.884,89.7525,189.5,0.015562,-229943.29
67,-201985.0408,-52209.7866,-34671.0477,-3190.1752,5.03E-05,2.33E-05,0.00012787,0.008643,7.
36E-05,5.90E-05,0.00018979,-1.41E-18,-9.93E-19,0.0043241,0.063087,-0.02416,-0.026321,0.0227
96,0.024286,0.46639,-2.7303,1.6058
)

# changing input data to a numpy array
input_data_as_numpy_array = np.asarray(input_data)

# reshape the numpy array
input_data_resaped = input_data_as_numpy_array.reshape(1,-1)

# standardize the data
# std_data = scaler.transform(input_data_resaped)

prediction = etc.predict(input_data_resaped)
print("Acutal Output:      ",y[1])
print("Predicted Output:   ",prediction)

if (prediction[0] == 0):
    print("The Person does not have Parkinsons Disease")

else:
    print("The Person has Parkinson's Disease")
```

Acutal Output: 1  
Predicted Output: [1]  
The Person has Parkinson's Disease

In [ ]: