heartbeatclassifier

April 28, 2021

[37]:

```
%%time

# import libraries used in this project

import os
import fnmatch

import numpy as np
import pandas as pd
import librosa
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.preprocessing import OneHotEncoder
from sklearn.preprocessing import LabelEncoder

# configure matplot to not warn on large data set
plt.rcParams.update({'figure.max_open_warning': 0})
%matplotlib inline
```

```
CPU times: user 530 µs, sys: 1 µs, total: 531 µs
Wall time: 535 µs
```

[2]:

```
%%time

#
# method to get zero_crossing, sepctral_centroid, spectral_rolloff, and␣
↪chroma_stft features from .wav files
#
def getDataFrame(inputFolders,dataFrameColumns,heartbeatclassifier):
    inputList=[]
    counter=0
    for inputFolder in inputFolders:
        for soundType in heartbeatclassifier:
            filesOfCategory=fnmatch.filter(os.listdir("./data/"+inputFolder+"/
↪"),soundType+"*.wav")

            if soundType == "extrastole":
                moreFiles=fnmatch.filter(os.listdir("./data/"+inputFolder+"/
↪"),"extrahls*.wav")
                filesOfCategory = filesOfCategory + moreFiles


            for file in filesOfCategory:
                x,sr=librosa.load("./data/"+inputFolder+"/
↪"+file,duration=5,res_type='kaiser_fast')
                inputList.append([np.mean(x) for x in librosa.feature.
↪mfcc(x,sr=sr)])
                inputList[counter].append(sum(librosa.zero_crossings(x)))
                inputList[counter].append(np.mean(librosa.feature.
↪spectral_centroid(x)))
                inputList[counter].append(np.mean(librosa.feature.
↪spectral_rolloff(x,sr=sr)))
                inputList[counter].append(np.mean(librosa.feature.
↪chroma_stft(x,sr=sr)))
                inputList[counter].append(soundType)
                counter+=1
    return pd.DataFrame(inputList,columns=dataFrameColumns)
```

```
CPU times: user 2 µs, sys: 0 ns, total: 2 µs
Wall time: 4.05 µs
```

[3]:

```
%%time

# music_folders=["set_a"]
music_folders=["set_a","set_b"]

# label frequency and librosa feature column headers
inputColums1=["Freq"+str(i) for i in range(20)]
inputColums2=["zero","centroid","rolloff","chromagram","outputbeatclassifier"]
inputColums1.extend(inputColums2)

# label output classifiers
outputClassifier=["normal","artifact","murmur","extrastole"]

# process data
dataframe=getDataFrame(music_folders,inputColums1,outputClassifier)

# save data frame to csv
dataframe.to_csv(r'music_dataframe.csv', index = False)
```

```
/Users/vijit/opt/anaconda3/lib/python3.8/site-
packages/librosa/core/pitch.py:153: UserWarning: Trying to estimate tuning from
empty frequency set.
  warnings.warn("Trying to estimate tuning from empty frequency set.")
```

```
CPU times: user 16min 43s, sys: 15.4 s, total: 16min 59s
Wall time: 2min 33s
```

[4]:

```
%%time

# print data frame
dataframe.head()
```

```
CPU times: user 1.04 ms, sys: 29 µs, total: 1.06 ms
Wall time: 134 µs
```

[4]:

```
        Freq0       Freq1      Freq2      Freq3      Freq4      Freq5  \
0 -489.621796   70.239189  61.142830  48.898048  36.555328  26.469486
1 -406.428528  153.238861  -1.369525  16.263828  10.937109  16.939487
2 -511.582214   82.091522   6.478385  35.782322   4.926917  23.501289
3 -514.132935   78.292191  65.463066  49.305317  34.505836  23.954039
4 -371.671722  155.286530  35.827465  19.501045  37.935871  34.704395

       Freq6      Freq7      Freq8      Freq9  …    Freq15    Freq16  \
0  19.623278  15.663741  13.472218  11.869776  …  2.056817  2.049077
1   4.494656   6.633343   6.228123   3.696192  … -2.767086 -3.141026
2   2.172138  16.772097  -0.364136  12.615508  …  4.534374 -2.864163
3  18.073490  15.343872  13.722631  11.918728  …  1.235011  1.578198
4  17.897236   9.181622  10.555705  10.437612  … -3.627311 -3.266012

     Freq17    Freq18    Freq19   zero     centroid      rolloff  chromagram  \
0  2.306891  2.535395  2.566249    605   157.260560   208.852132    0.743970
1 -3.952870 -3.527147 -4.081270   7624  1046.537575  1888.940430    0.663114
2  2.395745 -2.710135  1.320220  22103  2243.817234  4613.987223    0.754454
3  2.168477  2.570371  2.564390    660   167.595804   213.587443    0.703607
4  0.071095  0.160198 -1.439477   1834   513.218302   749.435967    0.634785

  outputbeatclassifier
0               normal
1               normal
2               normal
3               normal
4               normal

[5 rows x 25 columns]
```

[5]:

```
%%time

# statistically describe librosa features
columnsToDescribe=["zero","centroid","rolloff","chromagram"]
dataframe[columnsToDescribe].describe()
```

```
CPU times: user 92.7 ms, sys: 4.07 ms, total: 96.8 ms
```

```
Wall time: 12 ms
```

[5]:

```
                zero     centroid      rolloff  chromagram
count     585.000000   585.000000   585.000000  585.000000
mean     4062.259829   593.459736  1163.797054    0.663512
std      8735.425918   840.006987  1452.608685    0.079439
min       161.000000   101.834424    74.468994    0.115923
25%       958.000000   266.161344   543.713379    0.643089
50%      1529.000000   323.542573   676.552012    0.681797
75%      2502.000000   415.151187   860.391899    0.707757
max     75315.000000  6769.973347  8923.169963    0.806292
```

[6]:

```
%%time

# statistically describe frequencies
freqColums=["Freq"+str(i) for i in range(20)]
dataframe[freqColums].describe()
```

```
CPU times: user 279 ms, sys: 5.65 ms, total: 284 ms
Wall time: 35.5 ms
```

[6]:

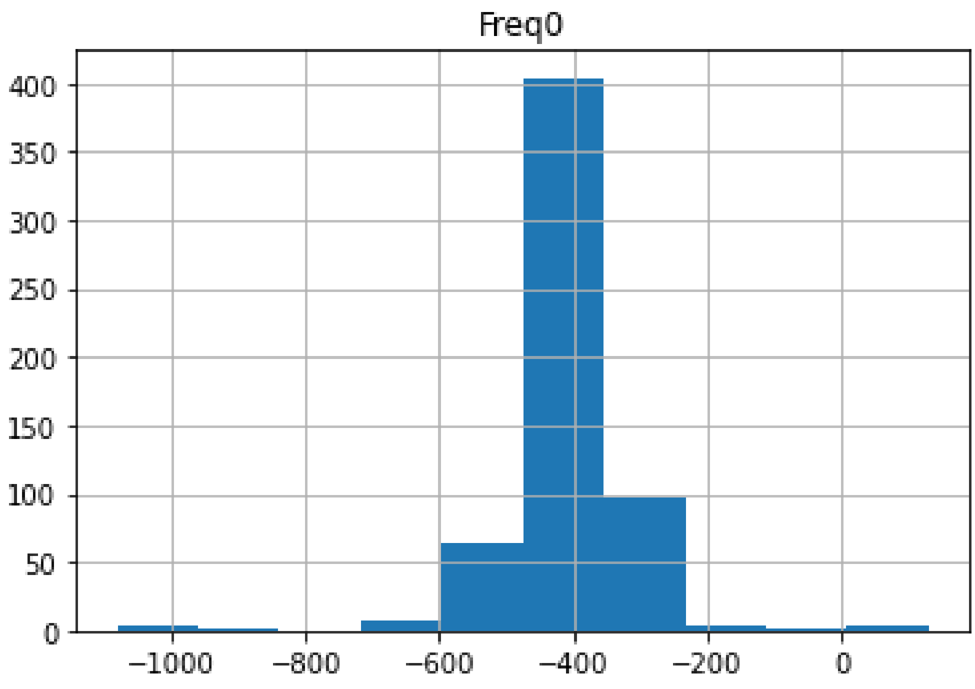
```
             Freq0       Freq1       Freq2       Freq3       Freq4  \
count   585.000000  585.000000  585.000000  585.000000  585.000000
mean   -405.757946  170.079428   54.052007   -1.498439    1.345889
std      93.353767   48.520015   26.297832   23.266973   12.645158
min   -1081.043335  -29.527250  -72.262596  -53.103825  -28.883732
25%    -443.315155  155.420853   52.296009  -17.343857   -5.253887
50%    -403.216949  177.656403   62.453419   -4.244802    0.300408
75%    -365.044312  199.055923   68.766457    8.346755    5.557584
max     130.121475  271.676331   91.316147   62.930393   48.075516

            Freq5       Freq6       Freq7       Freq8       Freq9      Freq10  \
count  585.000000  585.000000  585.000000  585.000000  585.000000  585.000000
mean    27.155482   20.358246    2.652989   -3.246019   10.722109   13.194057
std      9.634136   12.516750    9.144572    8.266007    6.241936   10.146853
min    -31.063078  -44.440163  -43.664692  -49.969437  -38.816525  -31.041985
25%     22.754147   19.233067   -1.925813   -7.692395    8.333854   12.741400
50%     27.771646   23.946444    2.696302   -2.829227   11.513292   16.187937
75%     33.162655   27.599564    7.811433    1.094737   14.004535   18.846331
max     50.836891   48.271702   38.122517   20.969564   24.214865   27.890099

           Freq11      Freq12      Freq13      Freq14      Freq15      Freq16  \
count  585.000000  585.000000  585.000000  585.000000  585.000000  585.000000
mean     4.294947   -5.005561    0.597928    5.872527    4.242858   -2.246271
std      4.716163    4.521289    3.401845    6.309628    3.699300    4.221884
min    -35.024479  -22.014156  -18.243839  -20.437279  -14.023951  -13.795611
25%      2.292238   -7.601873   -1.298143    5.311940    2.965489   -4.529719
50%      5.078257   -5.150558    0.380347    7.603932    5.057027   -2.086371
```

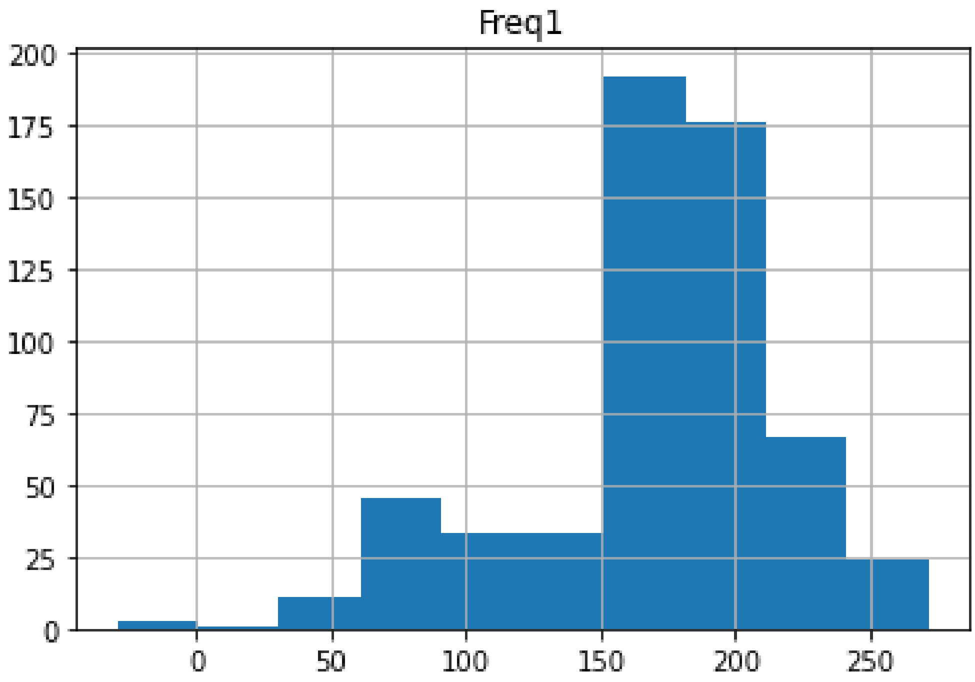
```
75%      7.108112   -2.797366    1.936331    9.408846    6.316283   -0.114404
max     23.331343   23.732828   29.896132   43.768089   27.439344   47.039963

           Freq17      Freq18      Freq19
count  585.000000  585.000000  585.000000
mean    -0.726721    3.581544    4.159655
std      3.813255    4.734485    3.515664
min    -25.276119  -16.287870  -11.521476
25%     -2.209787    2.712182    3.098541
50%     -0.976935    4.631459    5.032918
75%      0.263281    5.920696    6.155967
max     50.584553   39.139015   32.866734
```

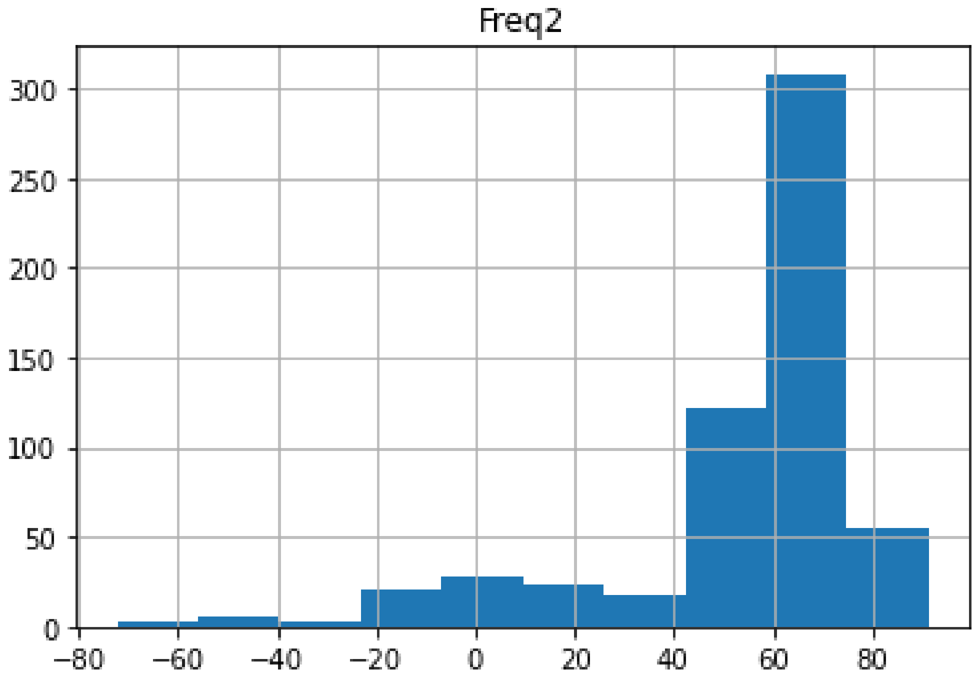
[7]:

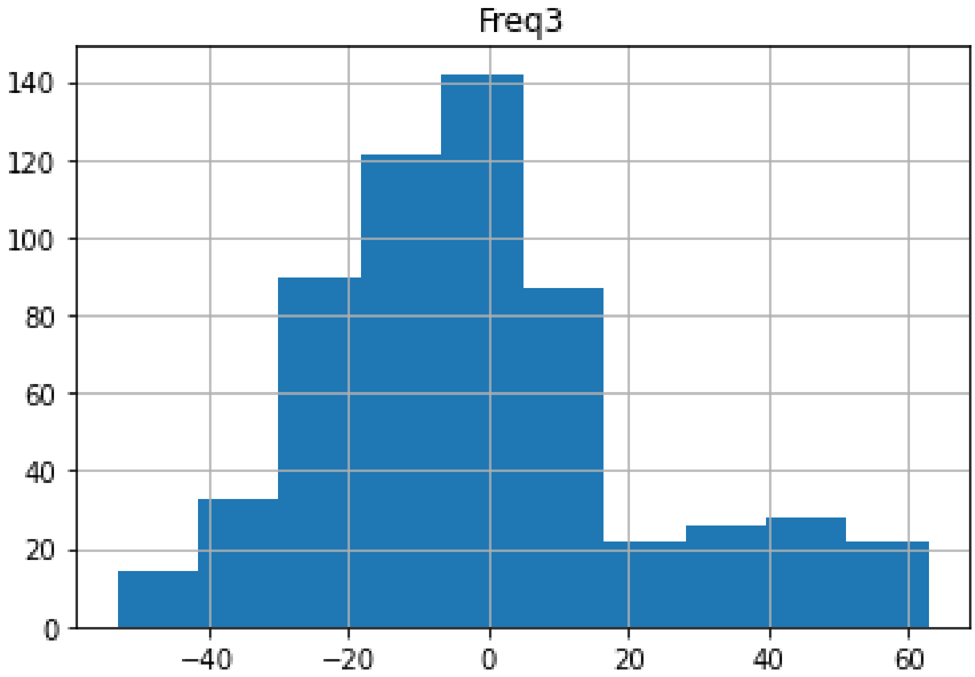
```
%%time

# graph data frame
columnsToRemove=["filename","outputbeatclassifier"]
for col in dataframe.columns:
    if(col not in columnsToRemove):
        dataframe.hist(column=col)
```

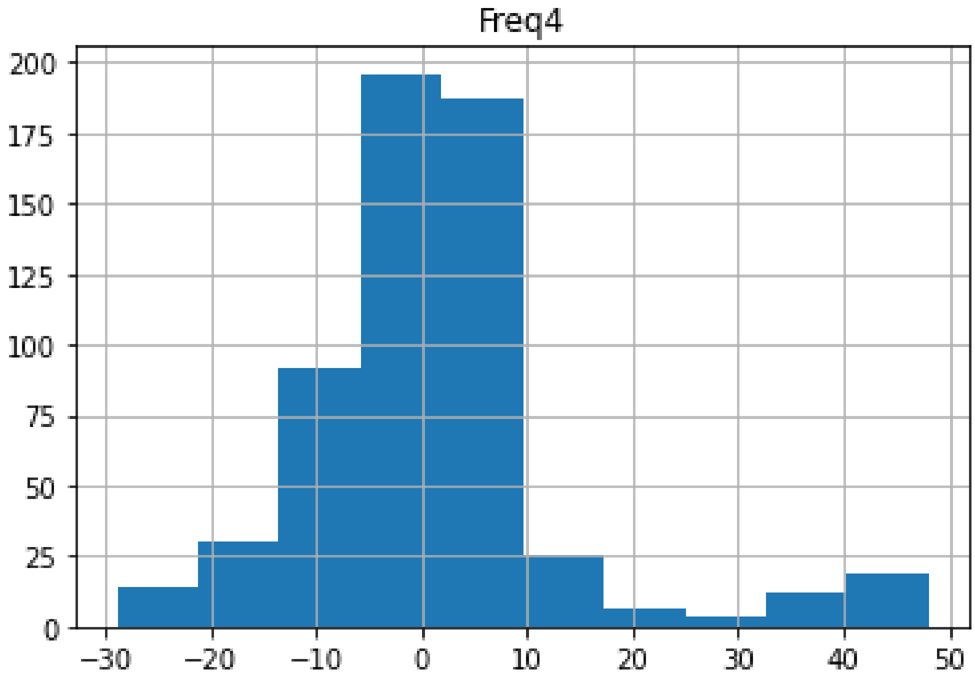
```
CPU times: user 995 ms, sys: 11.7 ms, total: 1.01 s
Wall time: 594 ms
```

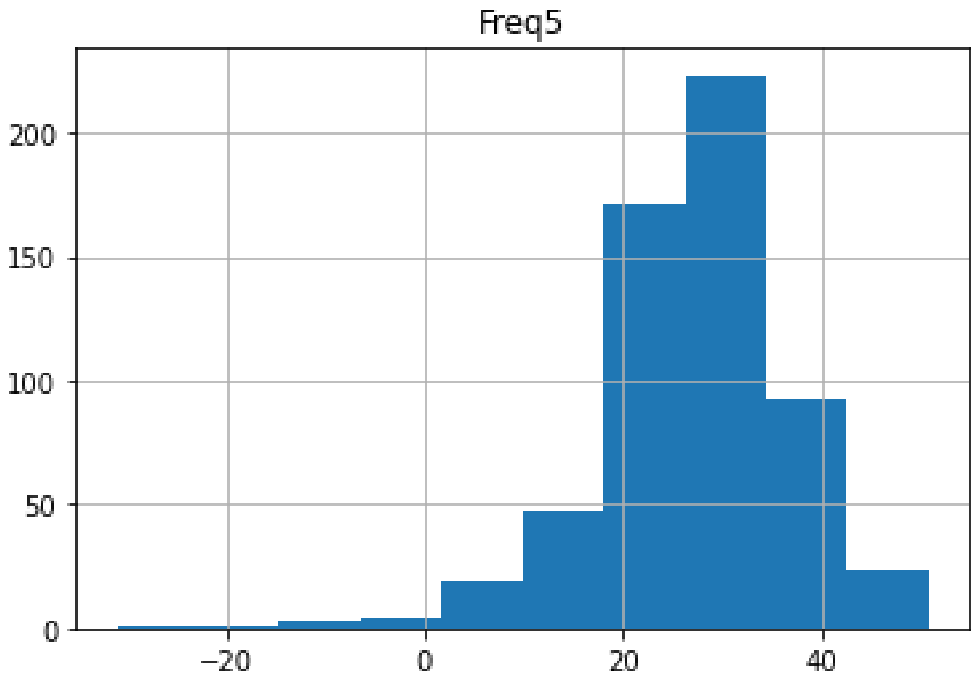


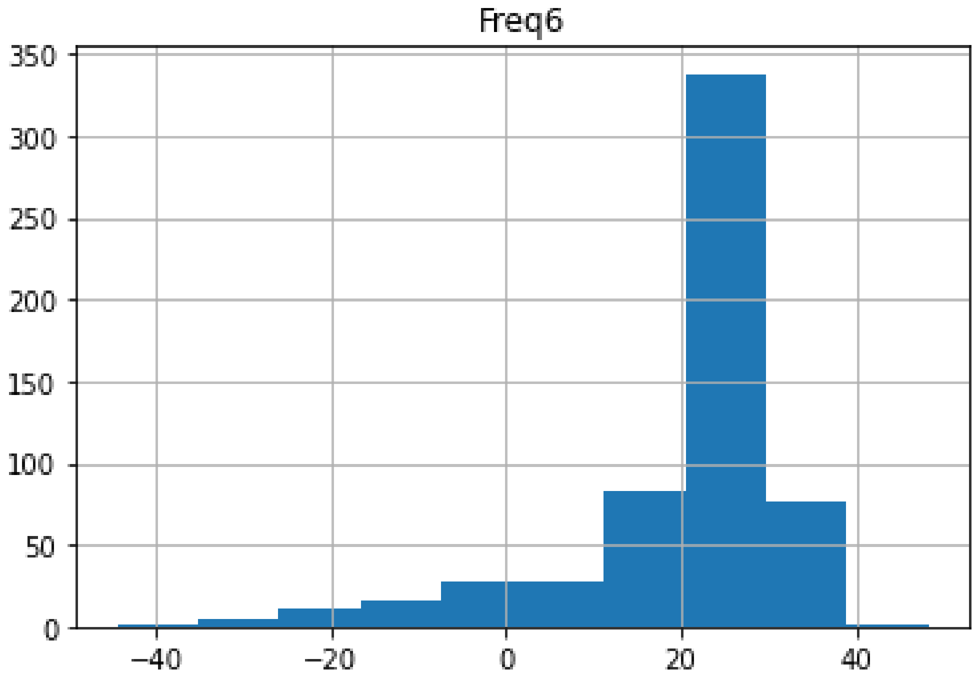

Freq1
200
175
150
125
100
75
50
25
0
0
50
100
150
200
250

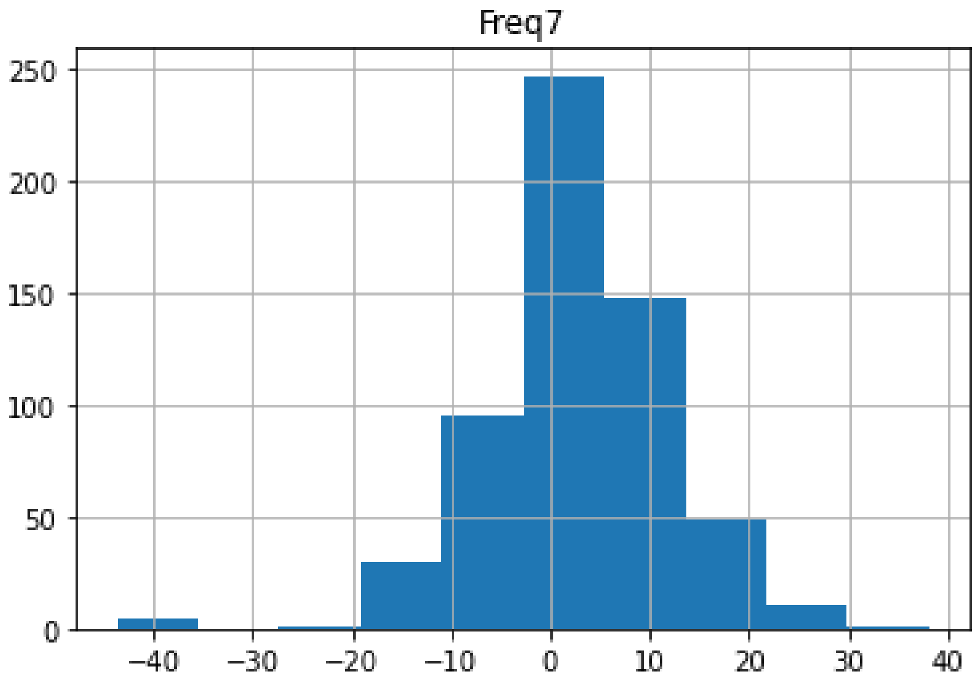

Freq2
300
250
200
150
100
50
0
−80
−60
−40
−20
0
20
40
60
80

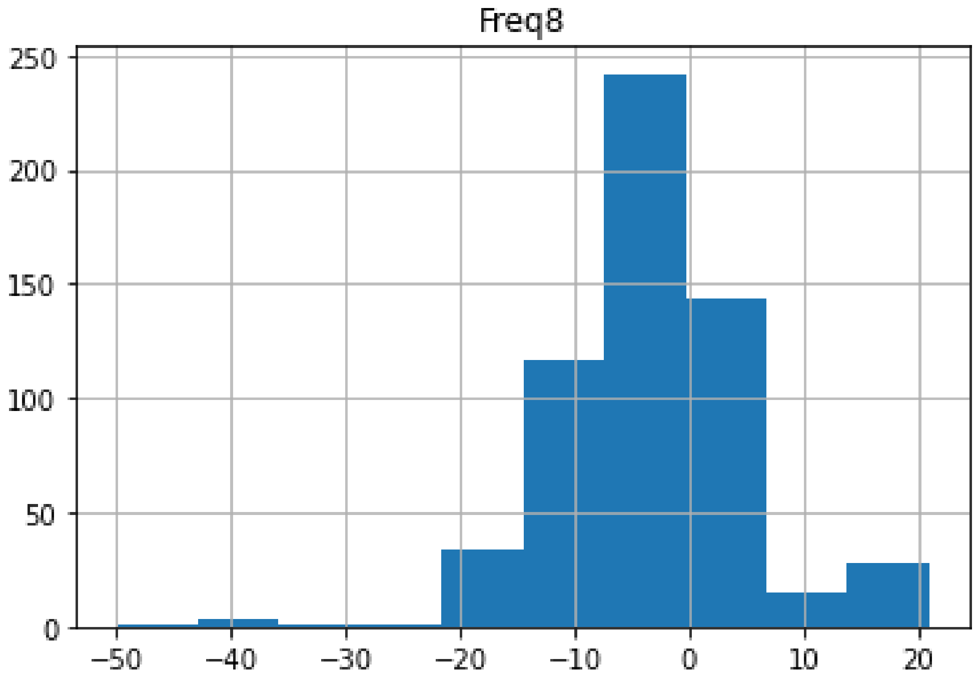

Freq3
140
120
100
80
60
40
20
0
−40
−20
0
20
40
60

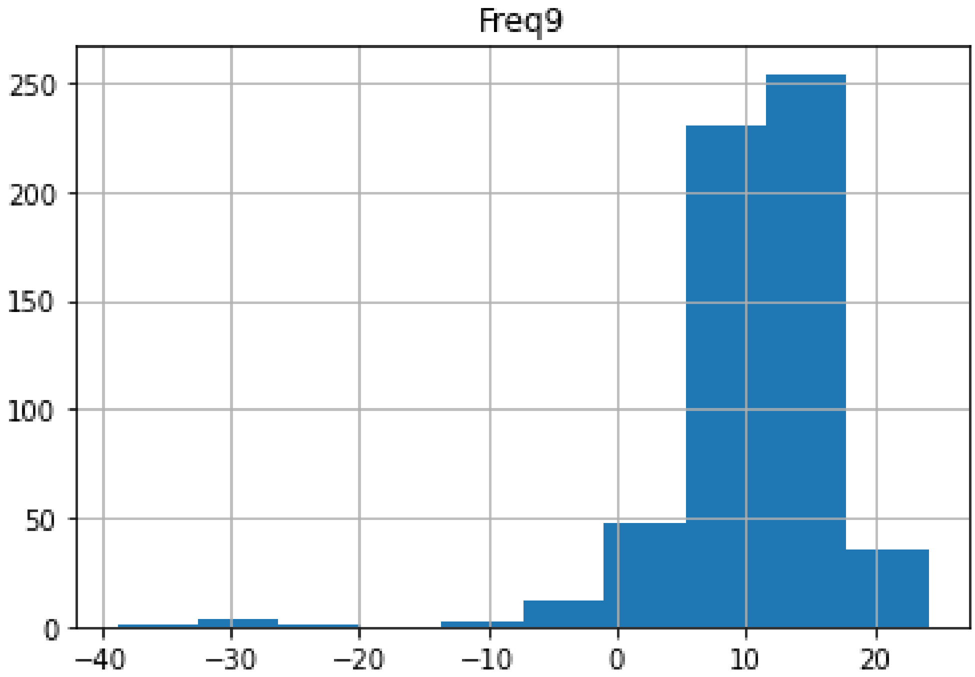

Freq4
200
175
150
125
100
75
50
25
0
−30
−20
−10
0
10
20
30
40
50

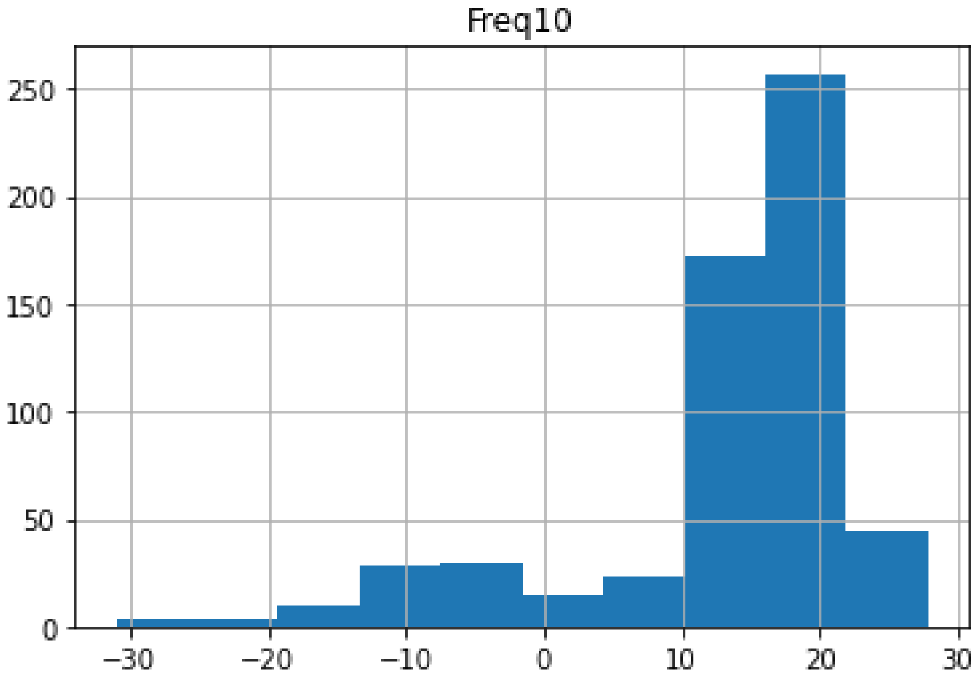

Freq5
0
50
100
150
200
−20
0
20
40

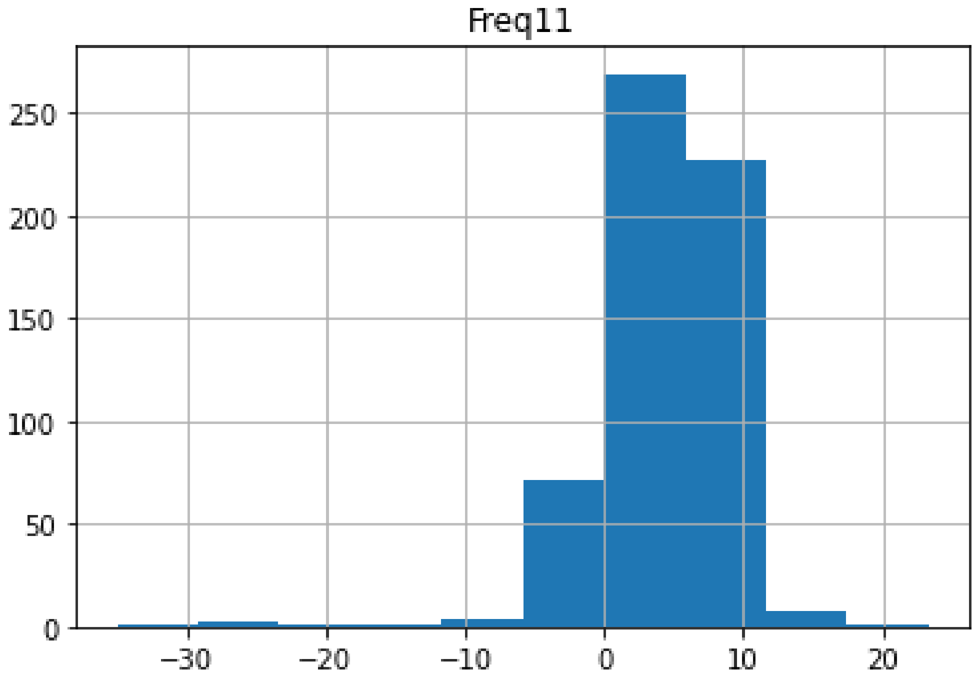

Freq6
0
50
100
150
200
250
300
350
−40
−20
0
20
40

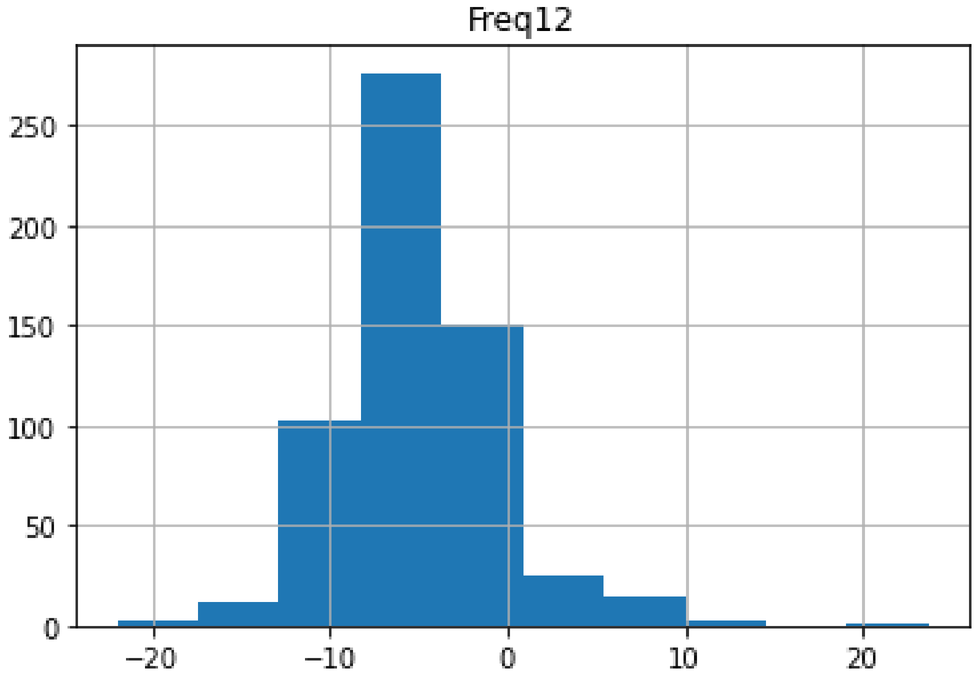

Freq7
250
200
150
100
50
0
−40
−30
−20
−10
0
10
20
30
40

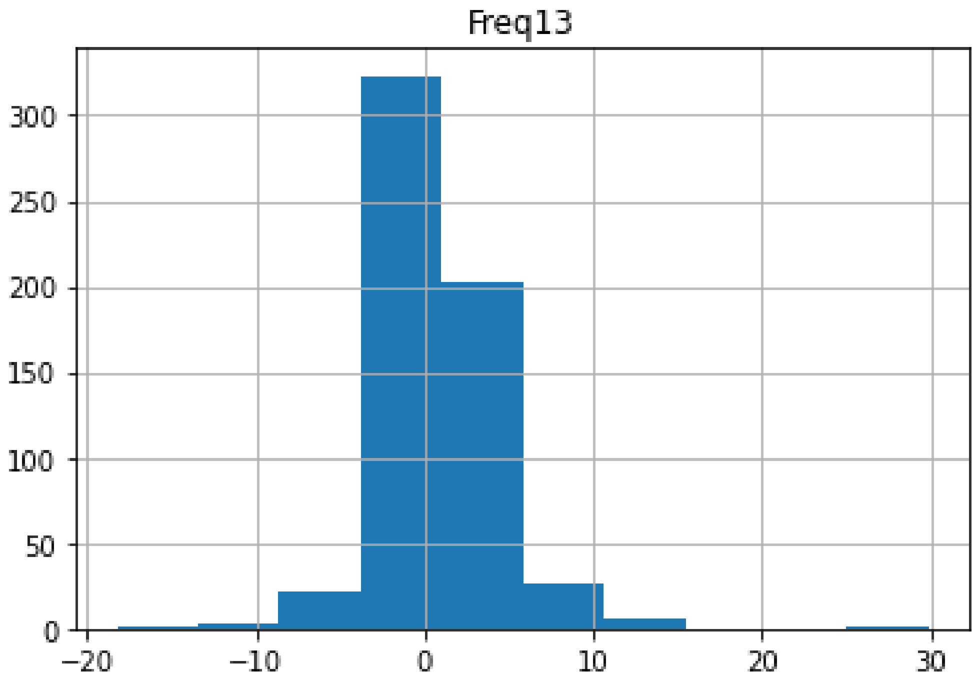

Freq8
250
200
150
100
50
0
−50
−40
−30
−20
−10
0
10
20

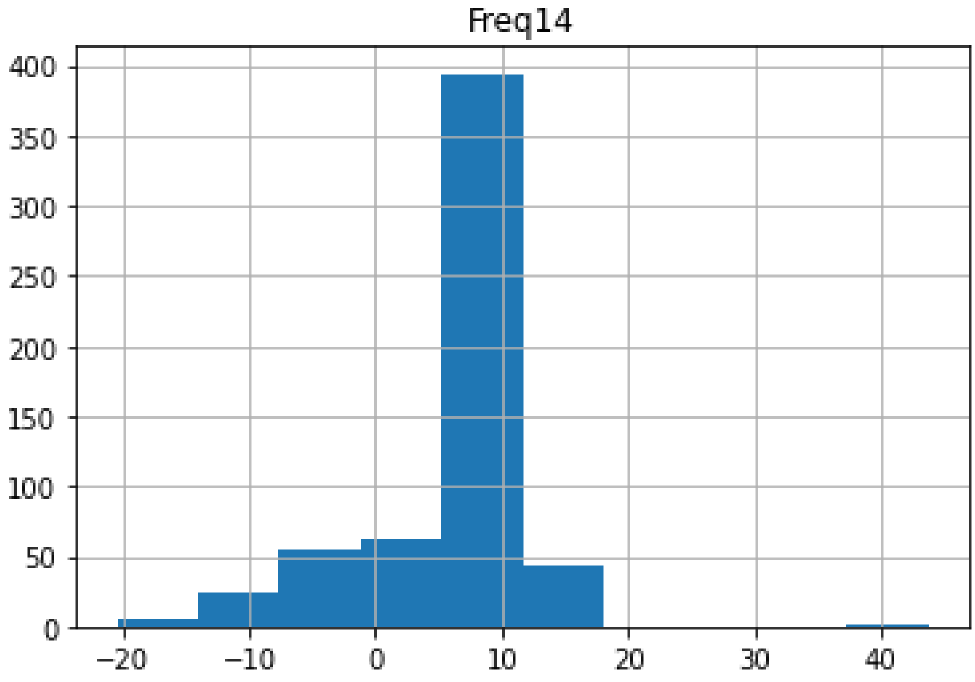

Freq9
0
50
100
150
200
250
−40
−30
−20
−10
0
10
20

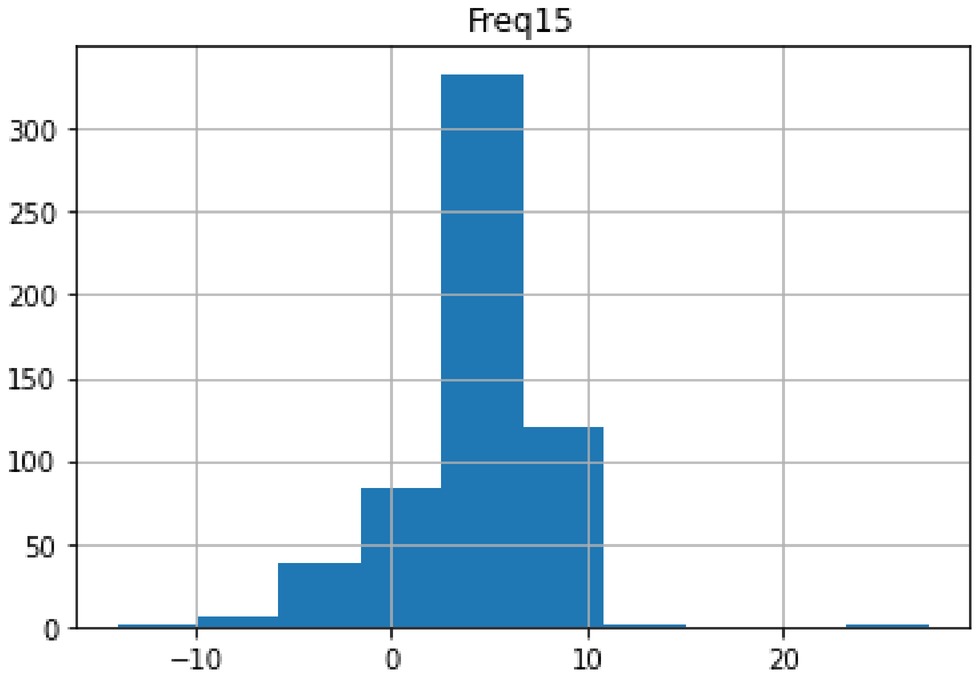

Freq10
0
50
100
150
200
250
−30
−20
−10
0
10
20
30

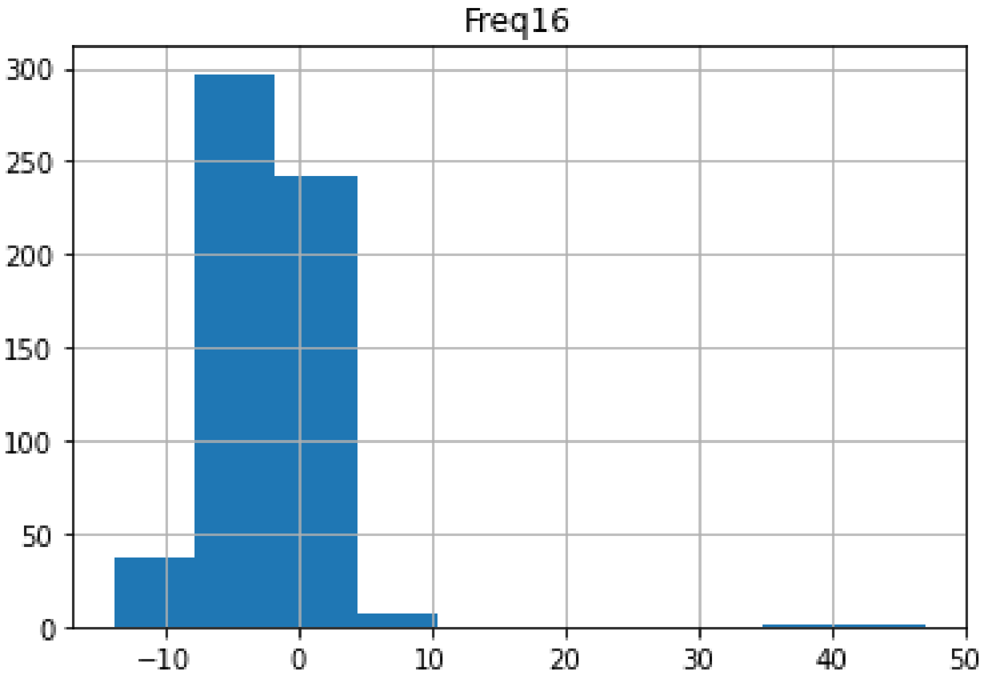

Freq11
250
200
150
100
50
0
−30
−20
−10
0
10
20

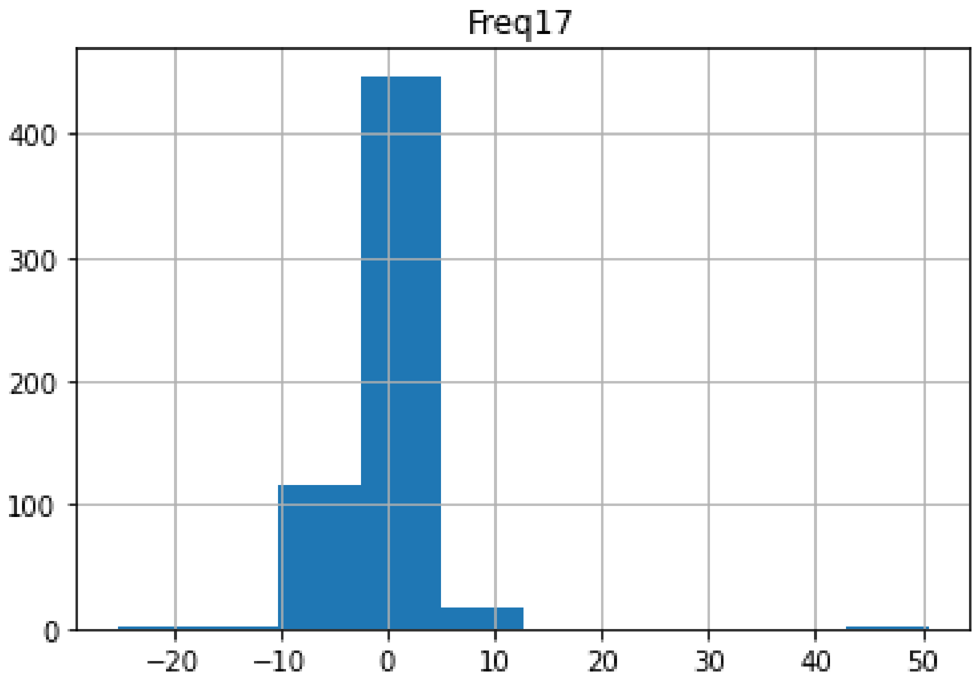

Freq12
250
200
150
100
50
0
−20
−10
0
10
20

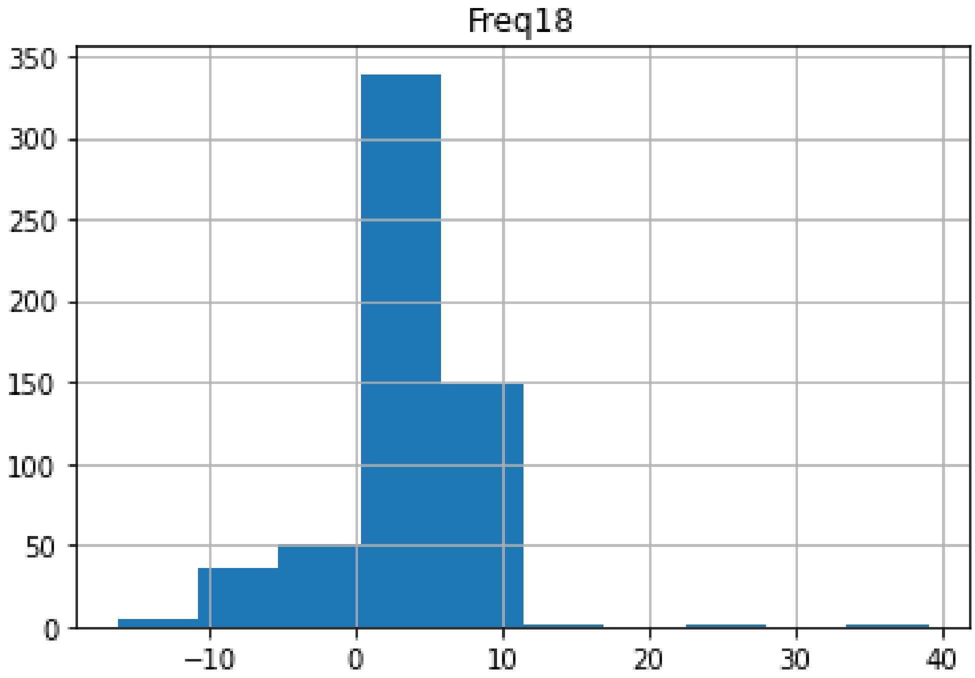

Freq13
300
250
200
150
100
50
0
−20
−10
0
10
20
30

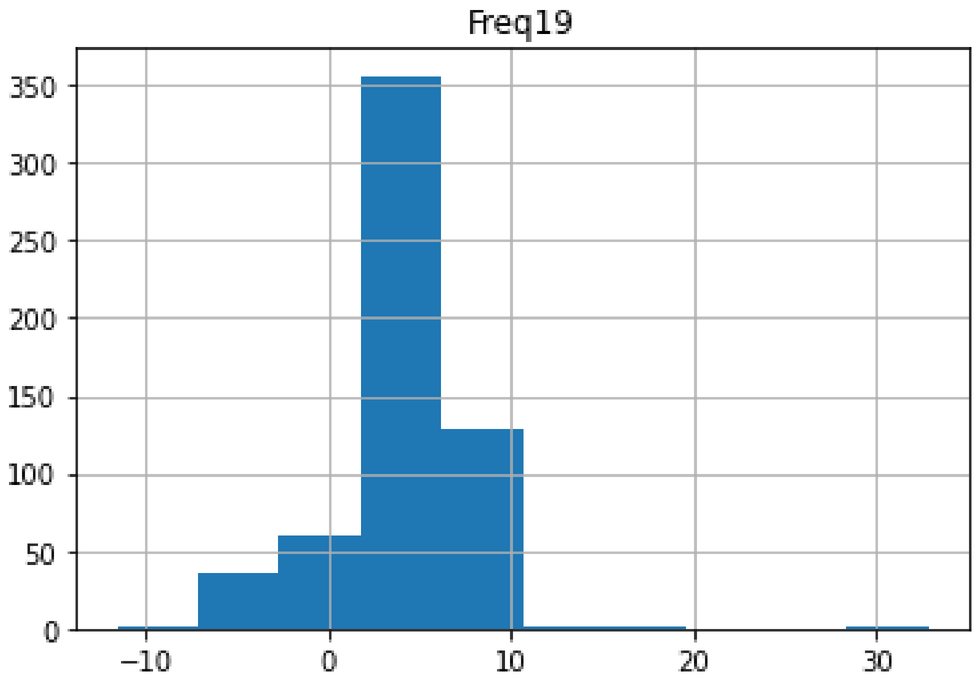

Freq14
400
350
300
250
200
150
100
50
0
−20
−10
0
10
20
30
40

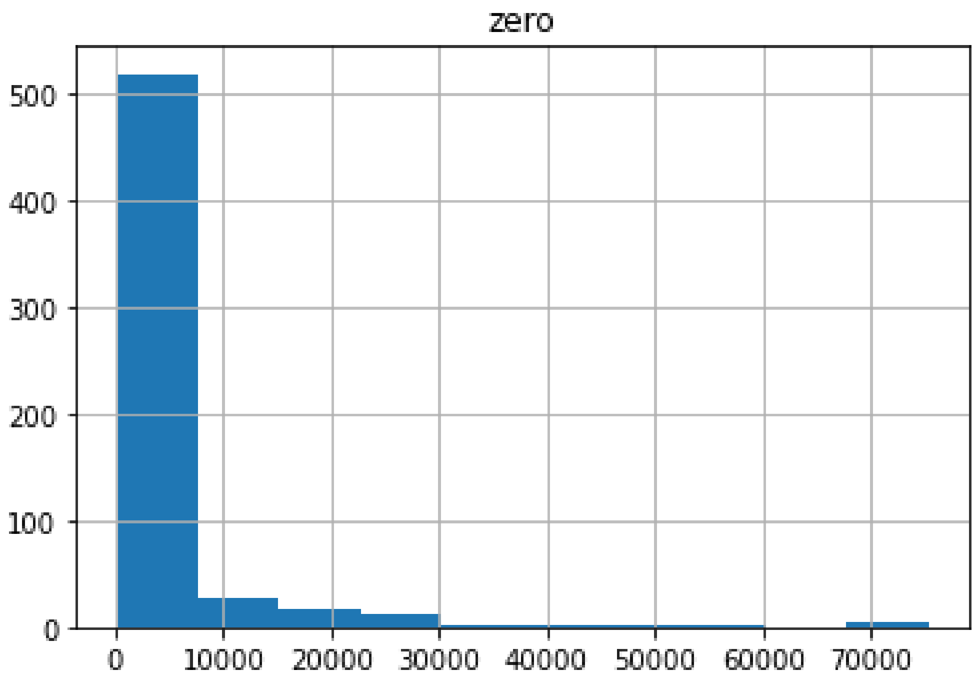

Freq15
300
250
200
150
100
50
0
−10
0
10
20

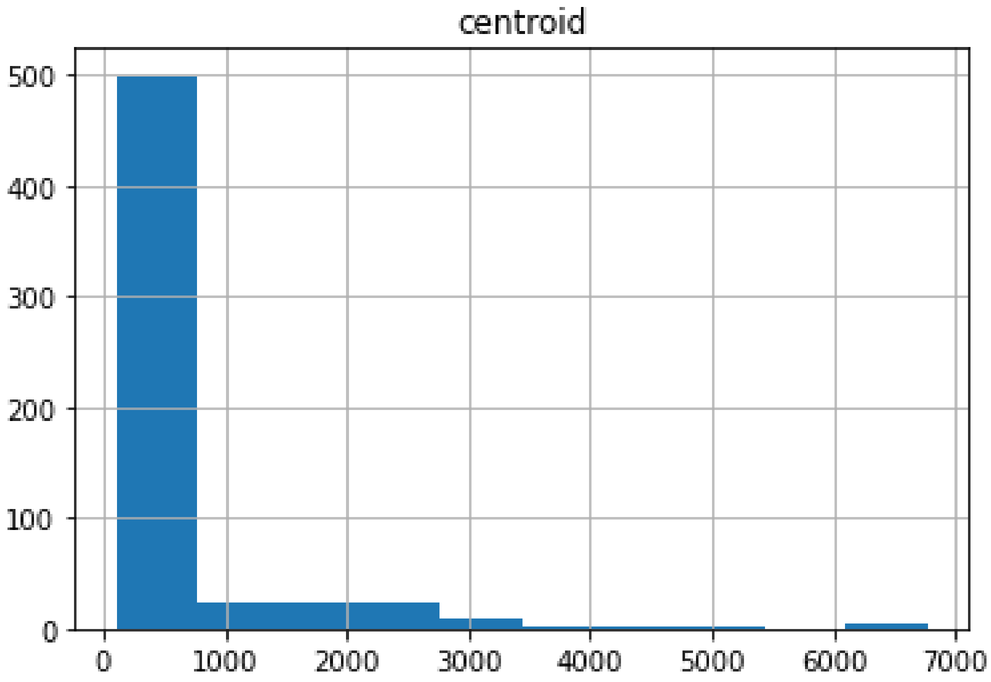

Freq16
300
250
200
150
100
50
0
−10
0
10
20
30
40
50

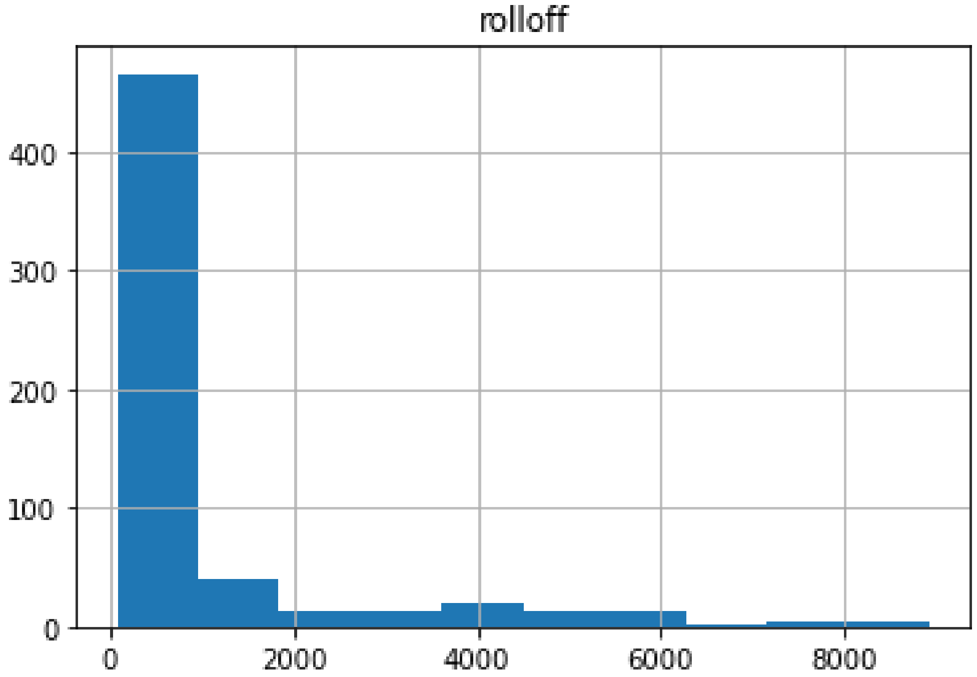

Freq17
0
100
200
300
400
−20
−10
0
10
20
30
40
50

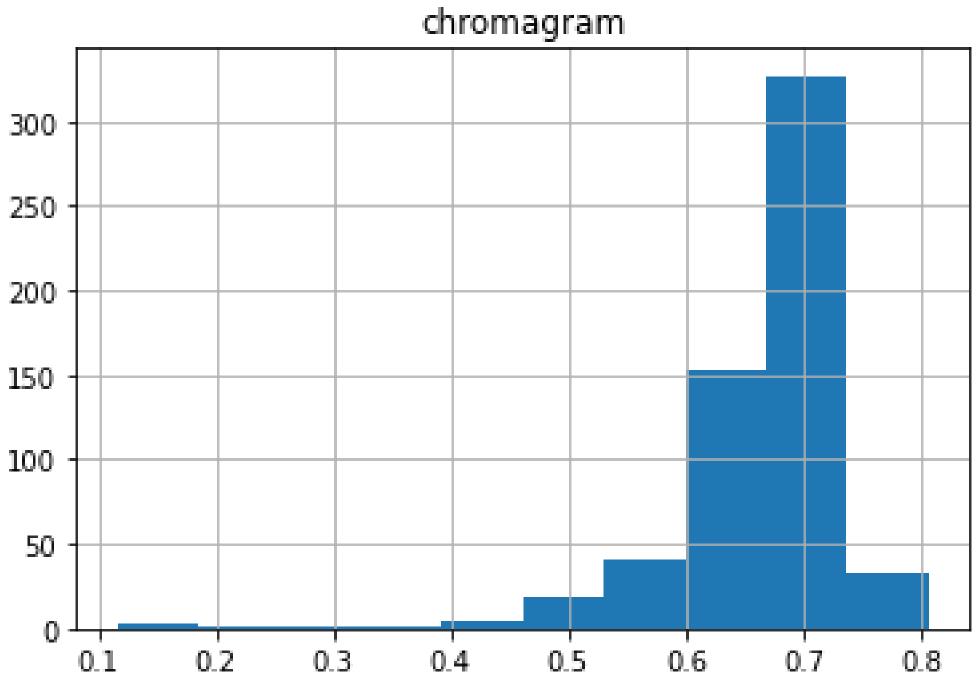

Freq18
0
50
100
150
200
250
300
350
−10
0
10
20
30
40


Freq19
350
300
250
200
150
100
50
0
−10
0
10
20
30


zero
500
400
300
200
100
0
0
10000
20000
30000
40000
50000
60000
70000


centroid
500
400
300
200
100
0
0
1000
2000
3000
4000
5000
6000
7000

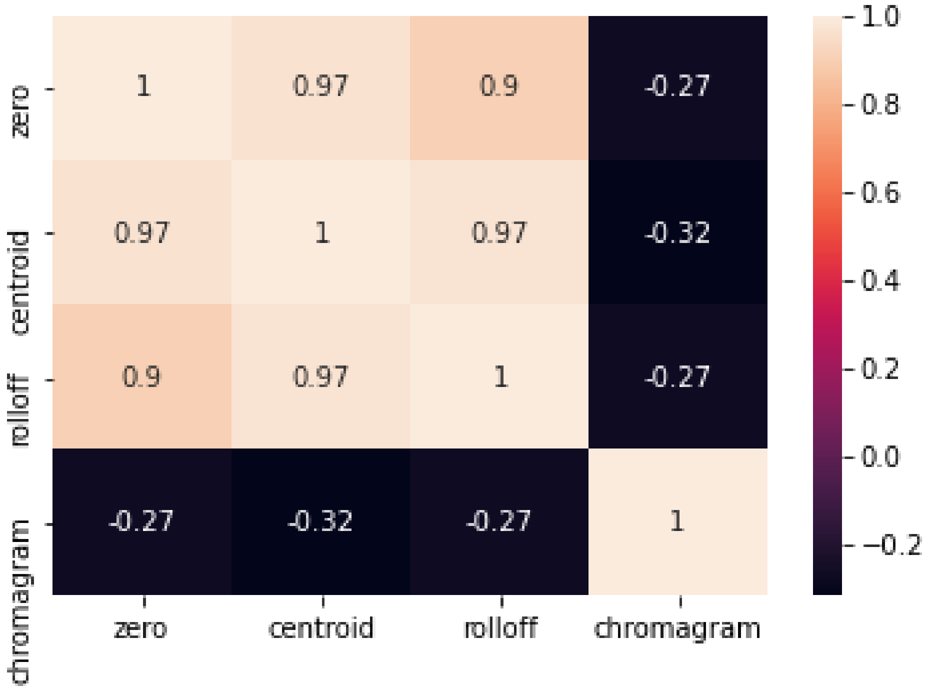

rolloff
400
300
200
100
0
0
2000
4000
6000
8000



```
[8]: %%time

     # graph heat map for dataframe
     inputColumns= dataframe.iloc[:,20:]
     correlation_mat = inputColumns.corr()
     sns.heatmap(correlation_mat, annot = True)
```

```
CPU times: user 77.2 ms, sys: 8.48 ms, total: 85.7 ms
Wall time: 83.9 ms
```

```
[8]: <AxesSubplot:>
```



[47]:

```
%%time

# classification of each file in dataframe
x=dataframe.iloc[:, 0]
y=dataframe.iloc[:,-1]

values = np.array(y)

enc = OneHotEncoder(handle_unknown='ignore')

# enc.fit(y)
# print(enc.transform(y))

# integer encode
label_encoder = LabelEncoder()
integer_encoded = label_encoder.fit_transform(values)
# print(integer_encoded)
# binary encode
onehot_encoder = OneHotEncoder(sparse=False)
integer_encoded = integer_encoded.reshape(len(integer_encoded), 1)
onehot_encoded = onehot_encoder.fit_transform(integer_encoded)
print(onehot_encoded)
```

```python
correlation= np.corrcoef(x,onehot_encoded, rowvar=False)
print(correlation)
```

```
[[0. 0. 0. 1.]
 [0. 0. 0. 1.]
 [0. 0. 0. 1.]
 …
 [0. 1. 0. 0.]
 [0. 1. 0. 0.]
 [0. 1. 0. 0.]]
[[ 1.          0.04853167 -0.08556399  0.04915338 -0.01171136]
 [ 0.04853167  1.         -0.09578263 -0.14409343 -0.33180076]
 [-0.08556399 -0.09578263  1.         -0.18804745 -0.4330127 ]
 [ 0.04915338 -0.14409343 -0.18804745  1.         -0.65141546]
 [-0.01171136 -0.33180076 -0.4330127  -0.65141546  1.        ]]
CPU times: user 9.73 ms, sys: 1.75 ms, total: 11.5 ms
Wall time: 3.56 ms
```