heartbeatclassifier

April 27, 2021

[1]:
```
%%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

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

```
CPU times: user 1.16 s, sys: 302 ms, total: 1.46 s
Wall time: 1.59 s
```

[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")
            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 3 µs, sys: 0 ns, total: 3 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","extrahls"]

# 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 14min 53s, sys: 17.7 s, total: 15min 11s
Wall time: 2min 18s
```

[4]:
```
%%time

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

```
CPU times: user 1.12 ms, sys: 66 µs, total: 1.18 ms
Wall time: 160 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 99.4 ms, sys: 5.61 ms, total: 105 ms
Wall time: 13.2 ms
```

[5]:

	zero	centroid	rolloff	chromagram
count	539.000000	539.000000	539.000000	539.000000
mean	4286.894249	618.561566	1208.803925	0.661149
std	9063.343336	870.365388	1504.116326	0.081917
min	161.000000	101.834424	74.468994	0.115923
25%	960.500000	267.172097	546.951963	0.640450

```
50%     1558.000000   329.344657   681.509809    0.680350
75%     2647.500000   430.553676   874.944848    0.707019
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 301 ms, sys: 17.4 ms, total: 319 ms
Wall time: 40.9 ms
```

[6]:

	Freq0	Freq1	Freq2	Freq3	Freq4
count	539.000000	539.000000	539.000000	539.000000	539.000000
mean	-406.045462	169.288606	53.323498	-1.084115	1.276139
std	96.656671	50.163977	27.165184	23.925762	13.106193
min	-1081.043335	-29.527250	-72.262596	-53.103825	-28.883732
25%	-446.447266	154.142403	51.089611	-17.432729	-5.743252
50%	-403.137756	178.680283	62.443062	-3.918440	-0.049698
75%	-363.788162	200.125778	68.689850	9.829993	5.678255
max	130.121475	271.676331	91.316147	62.930393	48.075516

	Freq5	Freq6	Freq7	Freq8	Freq9	Freq10
count	539.000000	539.000000	539.000000	539.000000	539.000000	539.000000
mean	26.889087	19.883785	2.657310	-3.351093	10.569057	12.805894
std	9.859723	12.877723	9.368896	8.476874	6.422815	10.446832
min	-31.063078	-44.440163	-43.664692	-49.969437	-38.816525	-31.041985
25%	22.367726	18.751729	-1.932964	-7.997710	8.170370	12.157995
50%	27.606680	23.784496	2.561381	-3.031707	11.370013	16.101429
75%	32.710878	27.464014	7.885830	0.961425	13.977825	18.829214
max	50.836891	48.271702	38.122517	20.969564	24.214865	27.890099

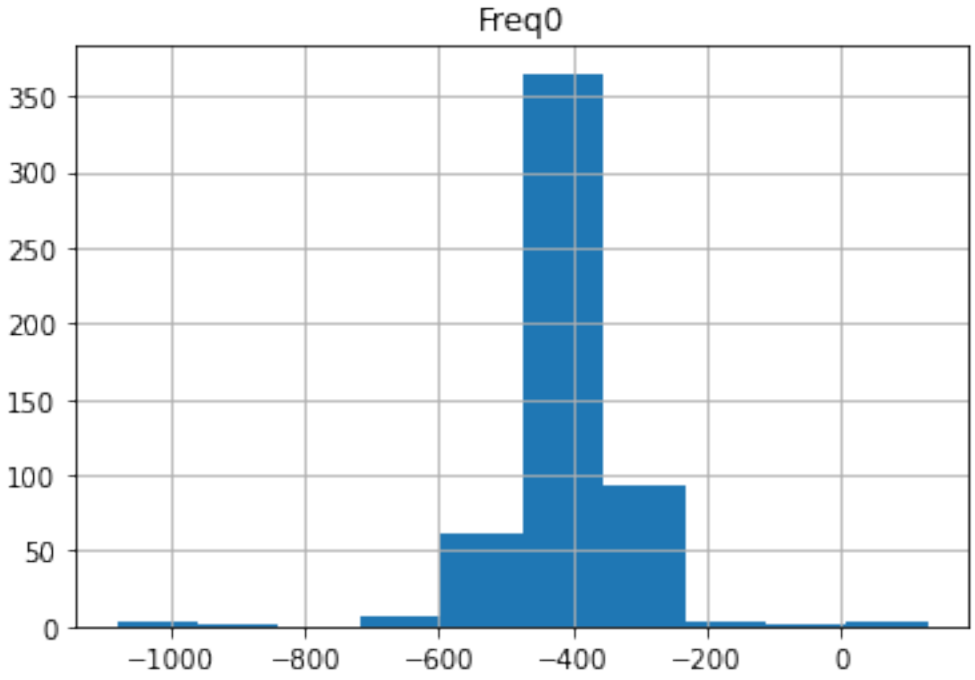
	Freq11	Freq12	Freq13	Freq14	Freq15	Freq16
count	539.000000	539.000000	539.000000	539.000000	539.000000	539.000000
mean	4.211871	-5.028657	0.621873	5.684094	4.151072	-2.303274
std	4.832663	4.642851	3.490314	6.504519	3.803879	4.338677
min	-35.024479	-22.014156	-18.243839	-20.437279	-14.023951	-13.795611
25%	2.099072	-7.785314	-1.340909	4.659462	2.821086	-4.629939
50%	5.065814	-5.178867	0.421793	7.575893	5.009160	-2.207715
75%	7.062870	-2.826142	1.951452	9.452503	6.367694	-0.179014
max	23.331343	23.732828	29.896132	43.768089	27.439344	47.039963

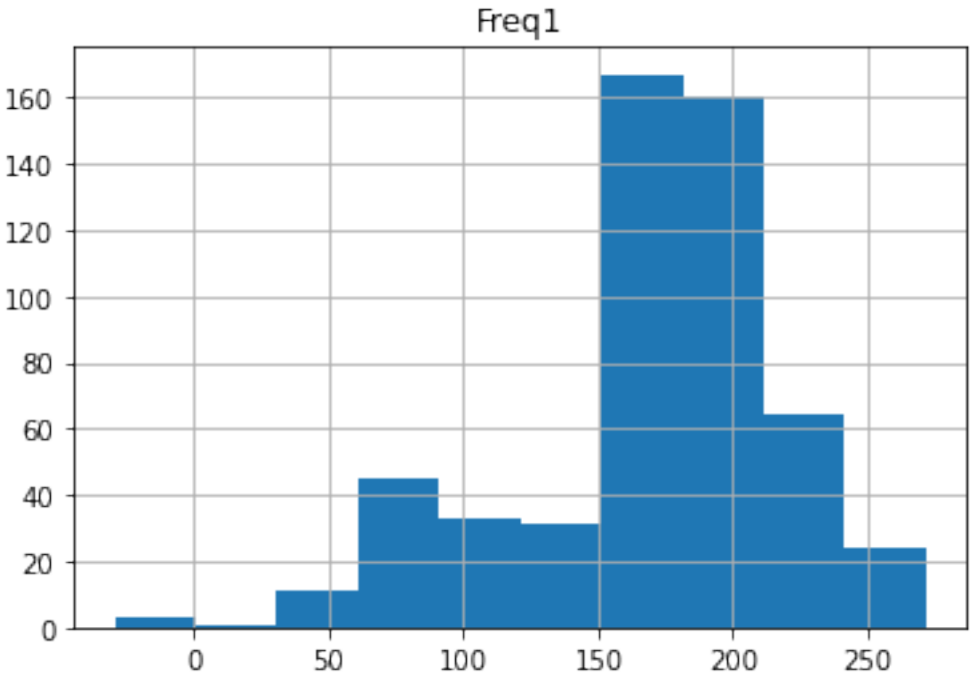
	Freq17	Freq18	Freq19
count	539.000000	539.000000	539.000000
mean	-0.733562	3.428893	4.031937
std	3.955479	4.882095	3.620167

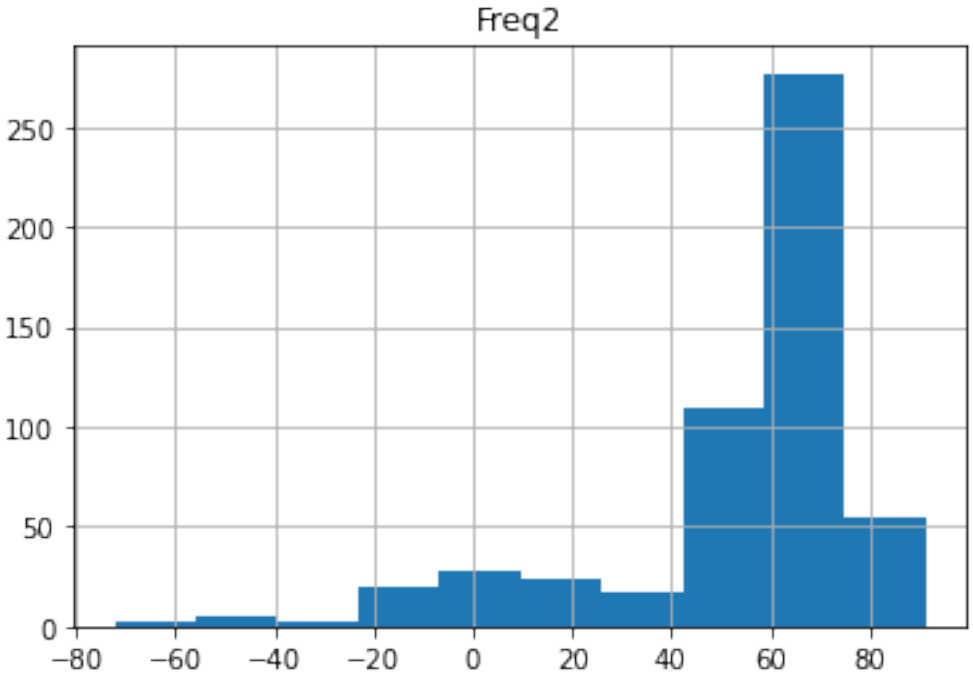
```
min    -25.276119  -16.287870  -11.521476
25%     -2.253933    2.464606    2.944626
50%     -0.998493    4.589147    4.891876
75%      0.251062    5.895007    6.143464
max     50.584553   39.139015   32.866734
```

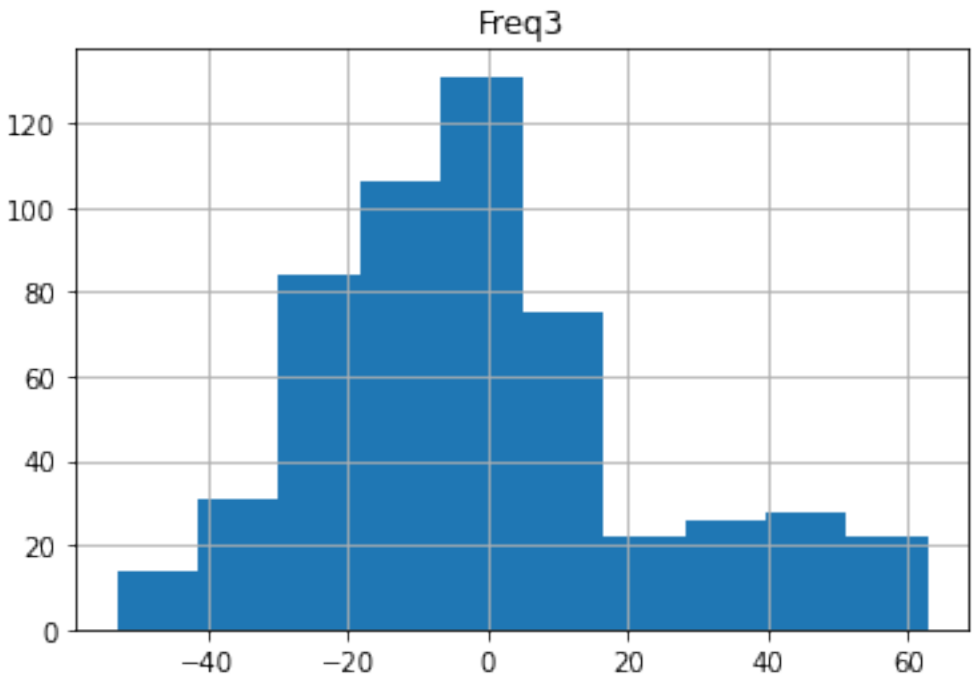
[7]:
```
%%time

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

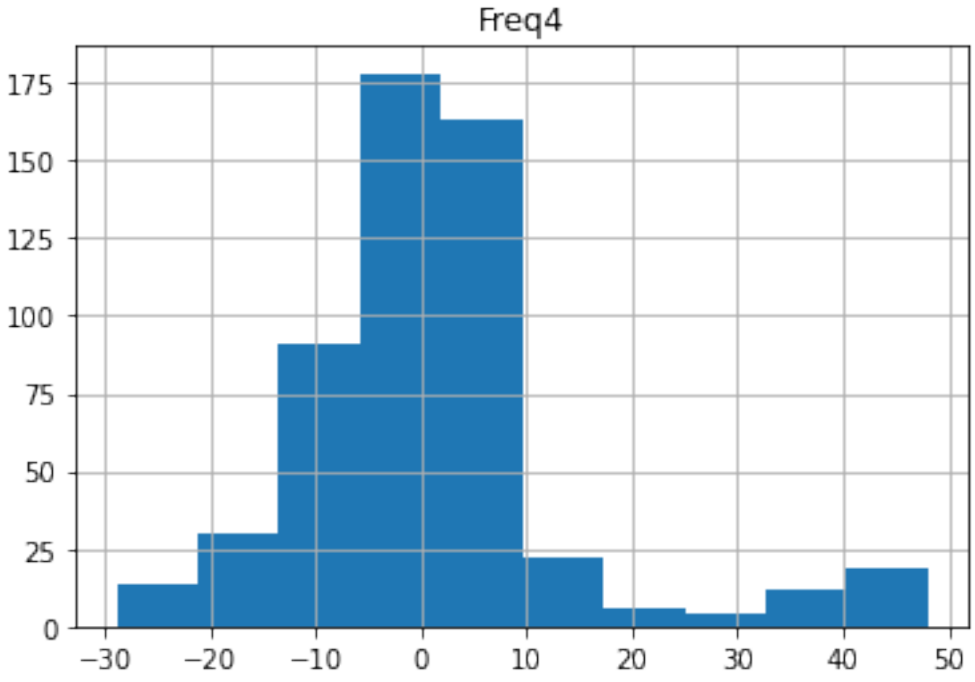
```
CPU times: user 811 ms, sys: 19.8 ms, total: 831 ms
Wall time: 616 ms
```

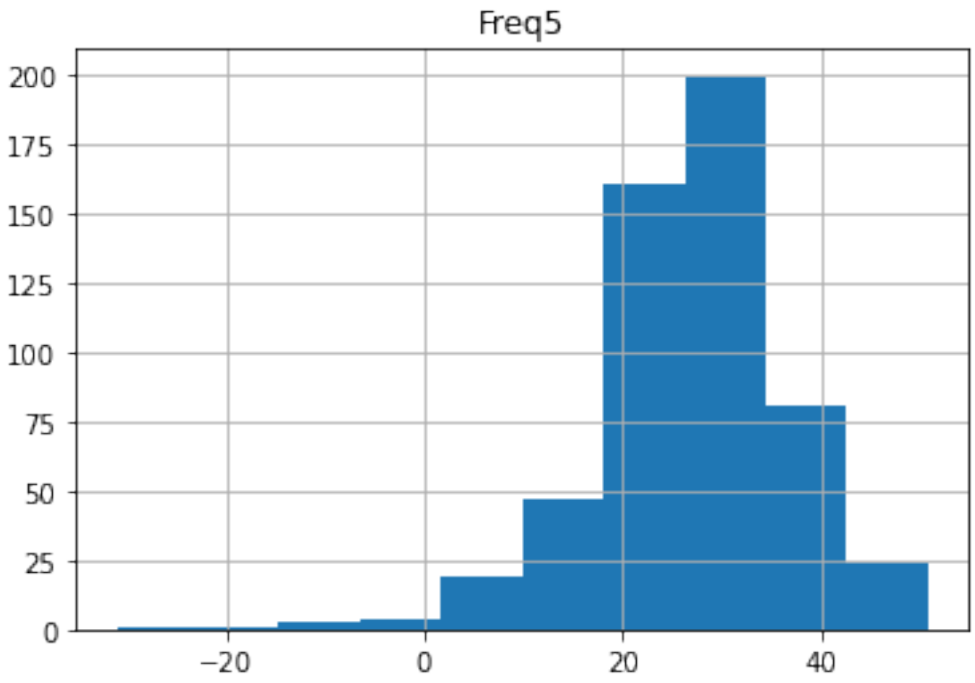


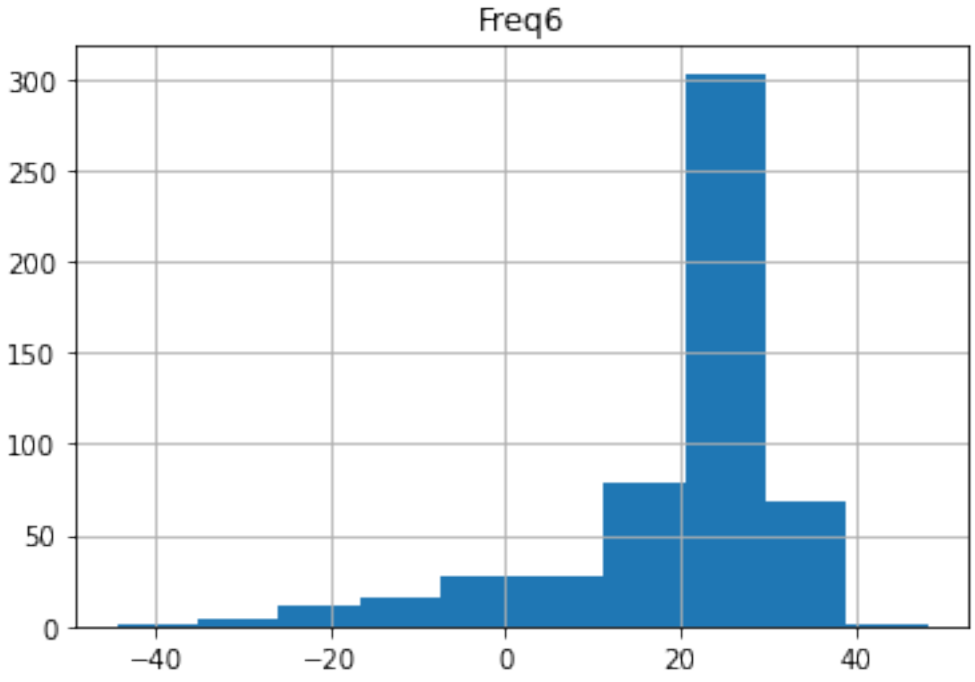

Freq1
160
140
120
100
80
60
40
20
0
0
50
100
150
200
250

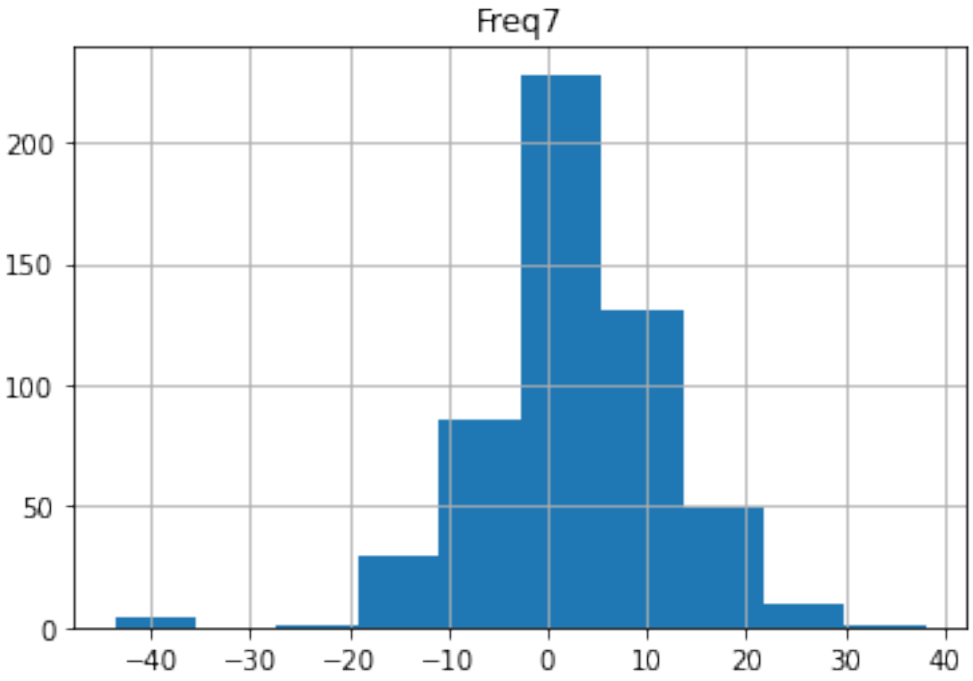

Freq2
250
200
150
100
50
0
−80
−60
−40
−20
0
20
40
60
80


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


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


Freq5
200
175
150
125
100
75
50
25
0
−20
0
20
40


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


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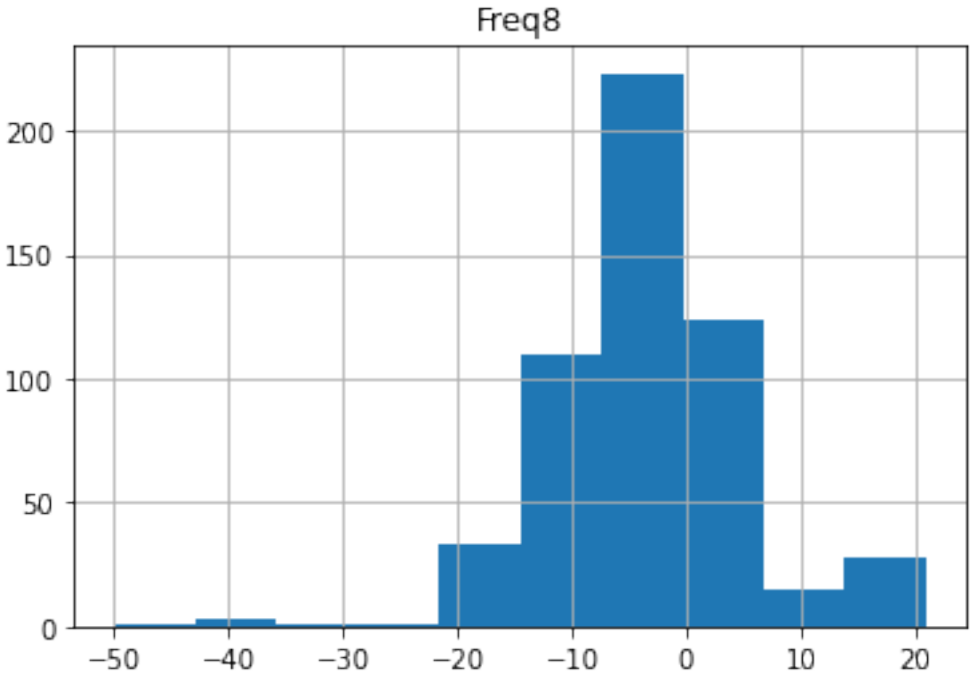
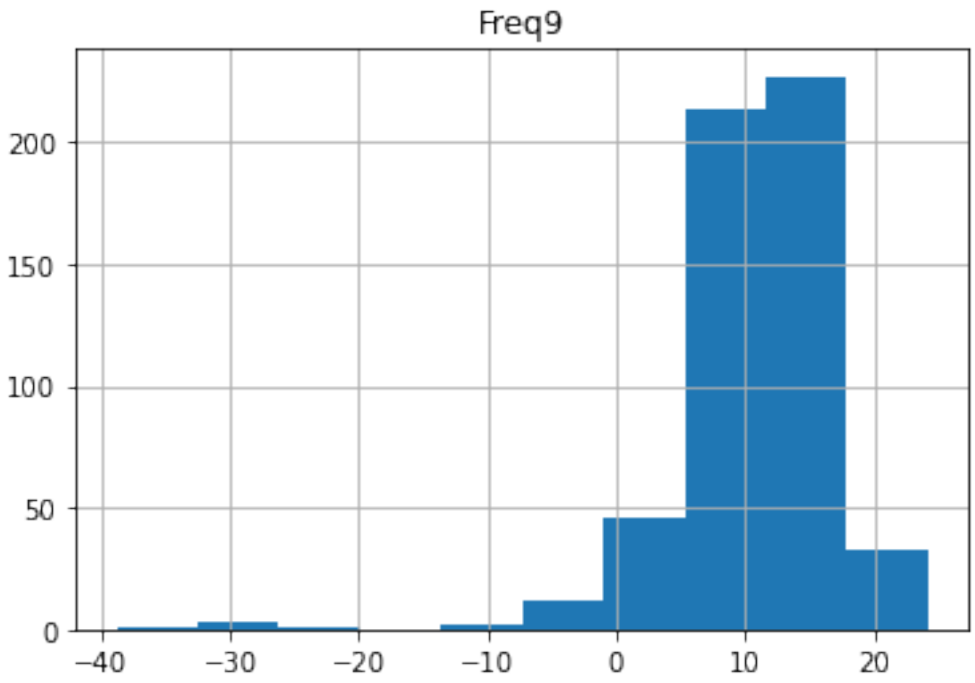
30
40


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


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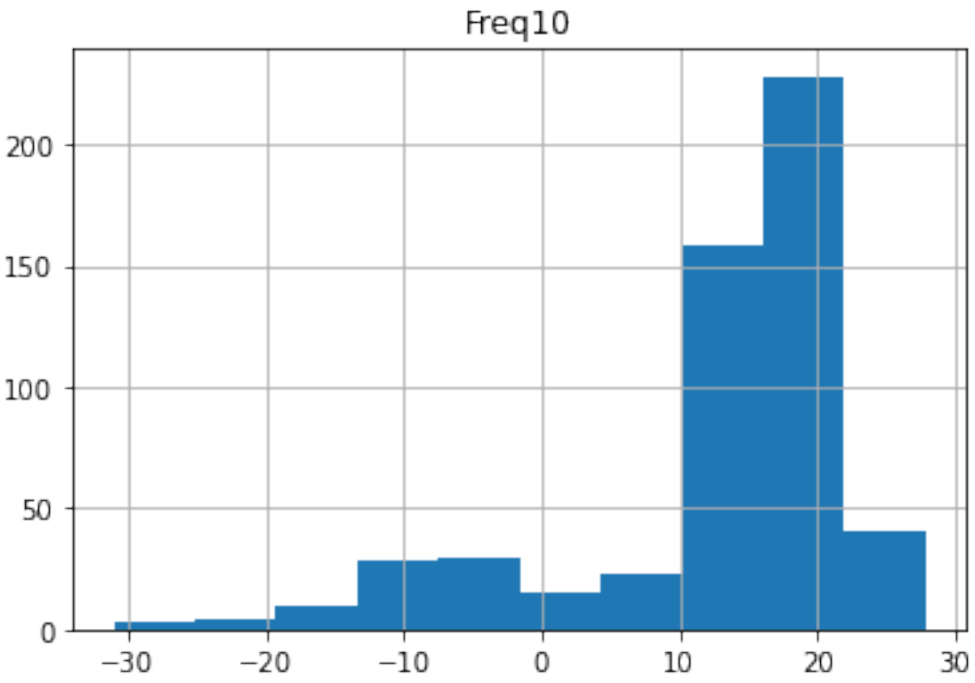
−40
−30
−20
−10
0
10
20


Freq10
200
150
100
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−30
−20
−10
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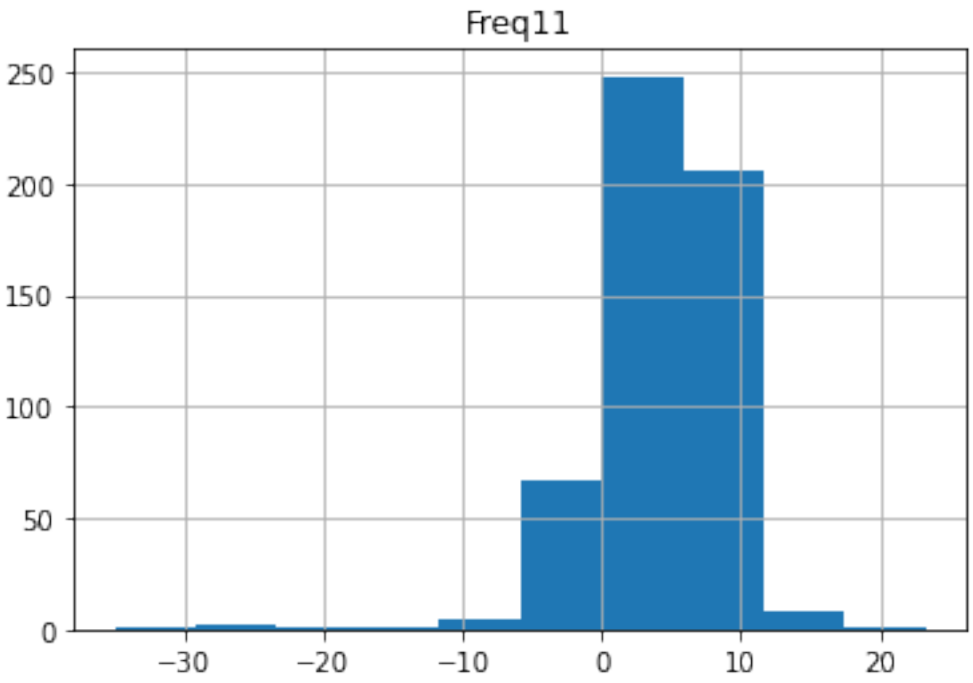
30


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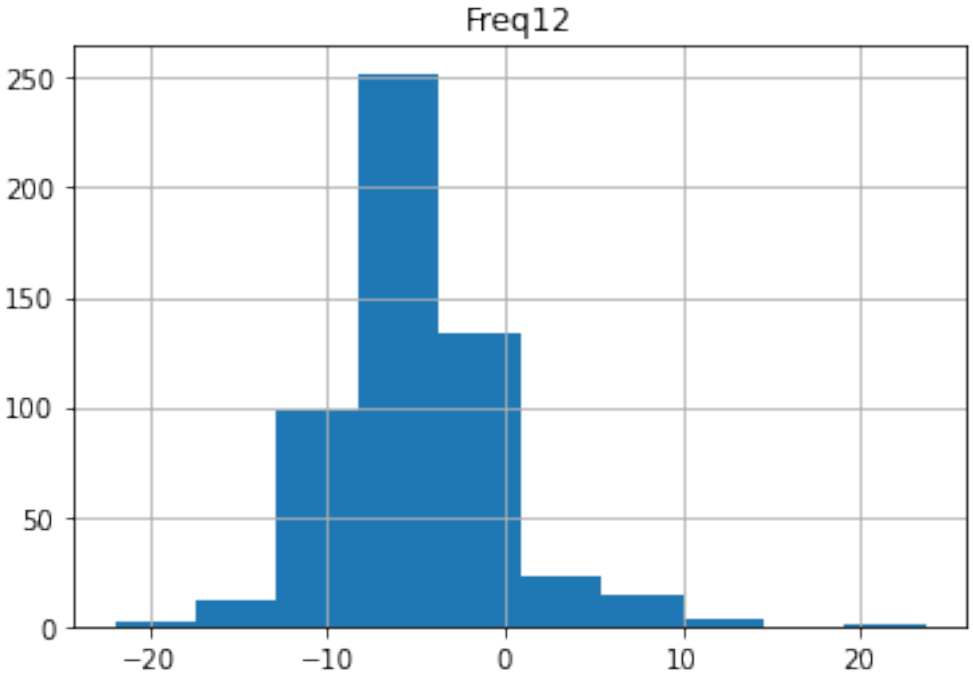
0
−30
−20
−10
0
10
20


Freq12
250
200
150
100
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0
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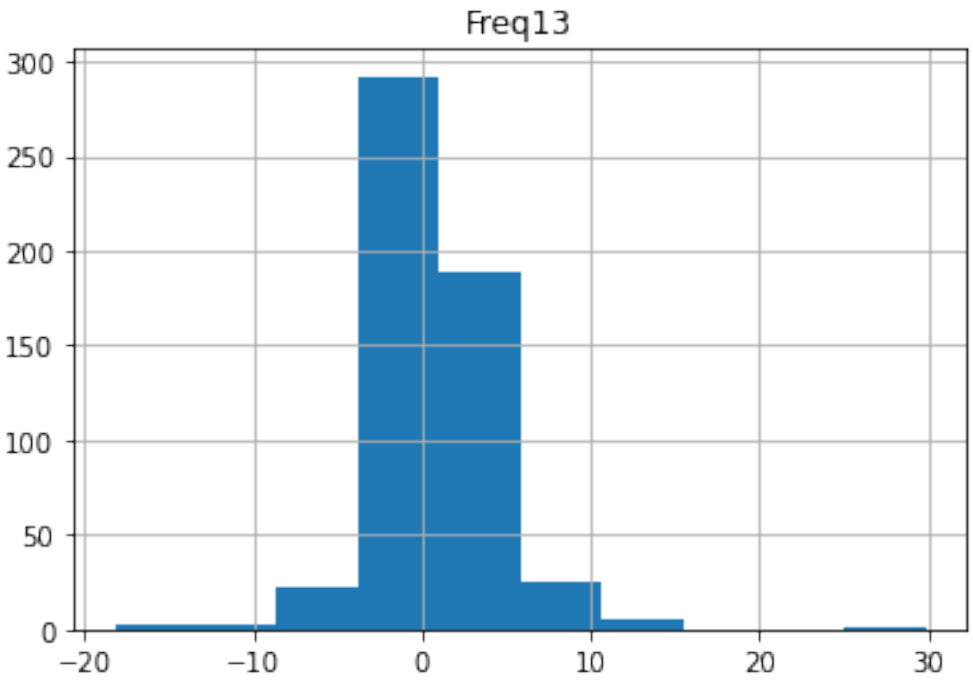
20


Freq13
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250
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150
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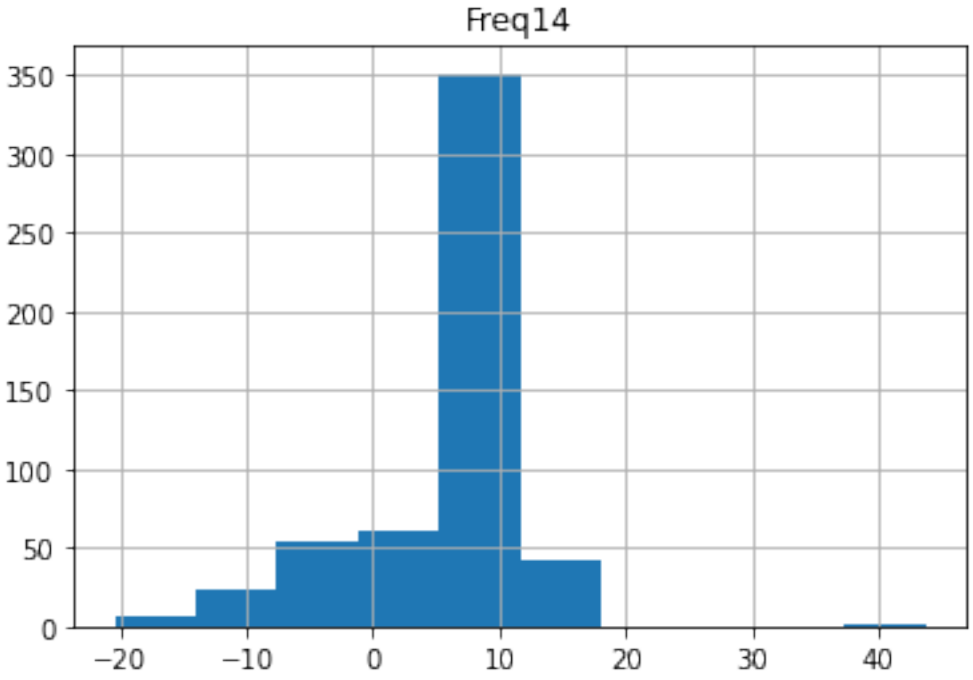
50
0
−20
−10
0
10
20
30


Freq14
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250
200
150
100
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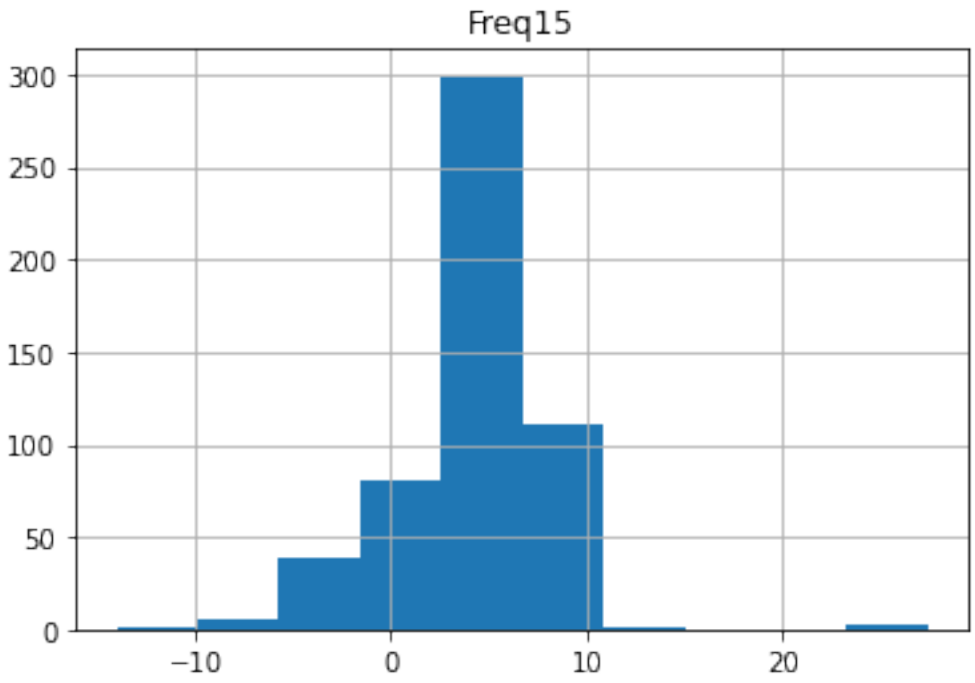
−20
−10
0
10
20
30
40


Freq15
300
250
200
150
100
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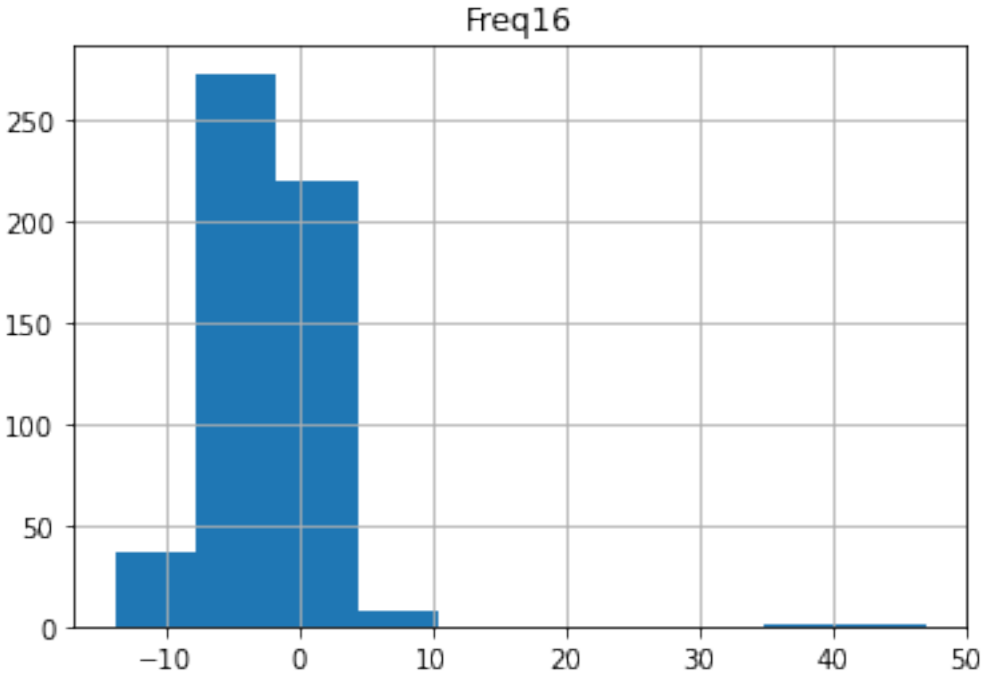
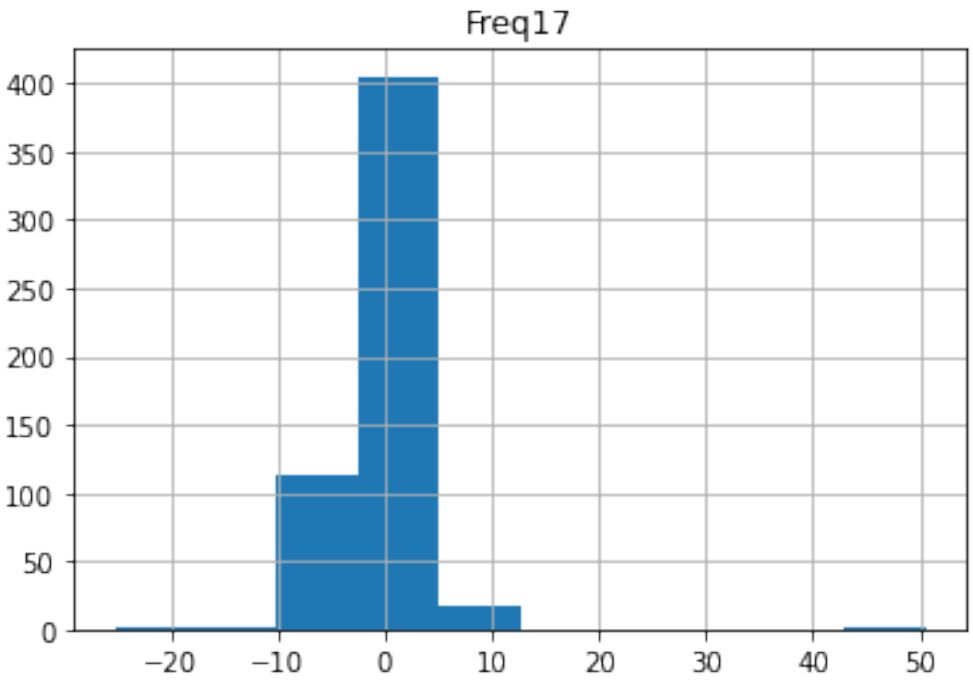
−10
0
10
20


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


Freq17
400
350
300
250
200
150
100
50
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−20
−10
0
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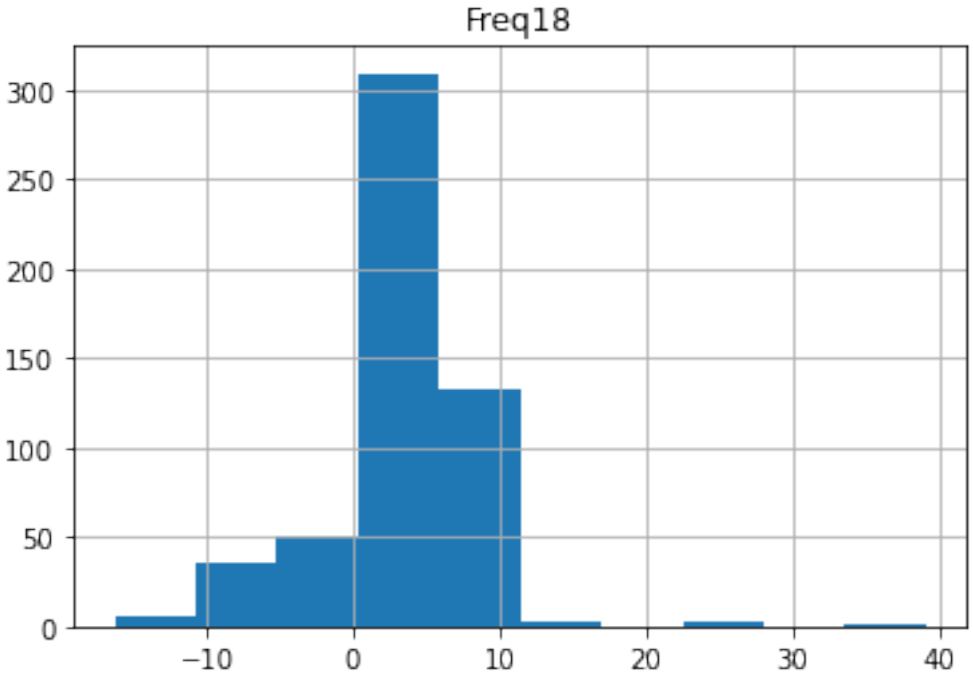
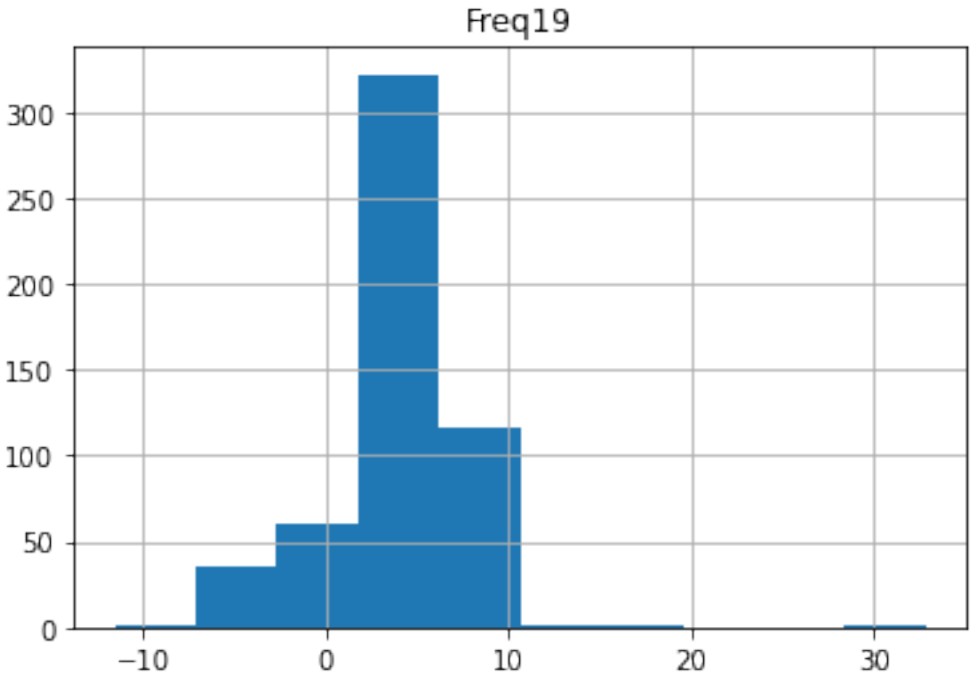
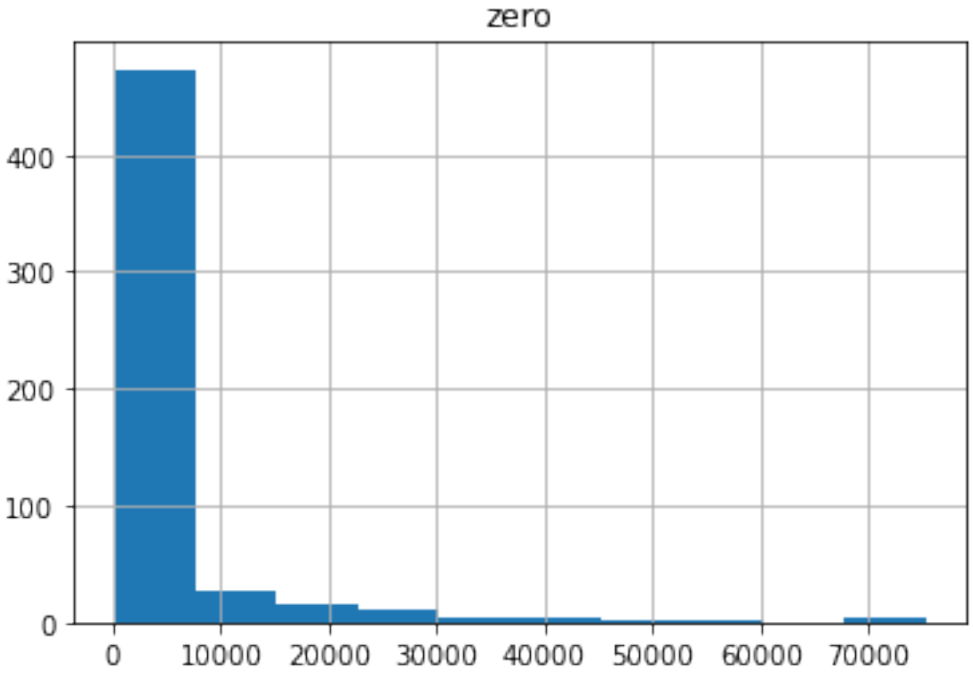
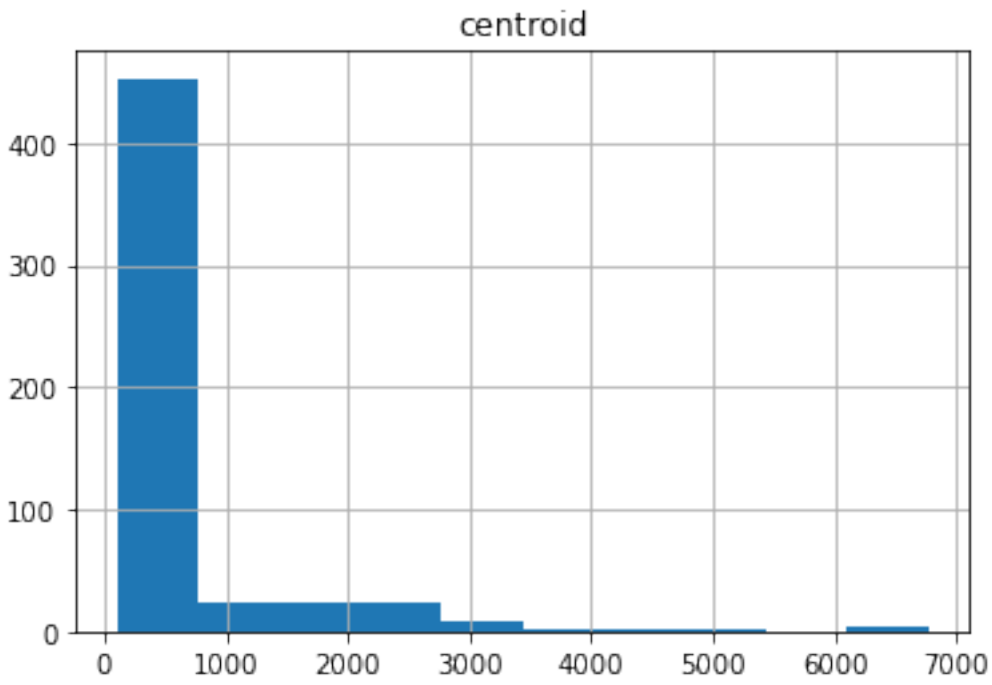
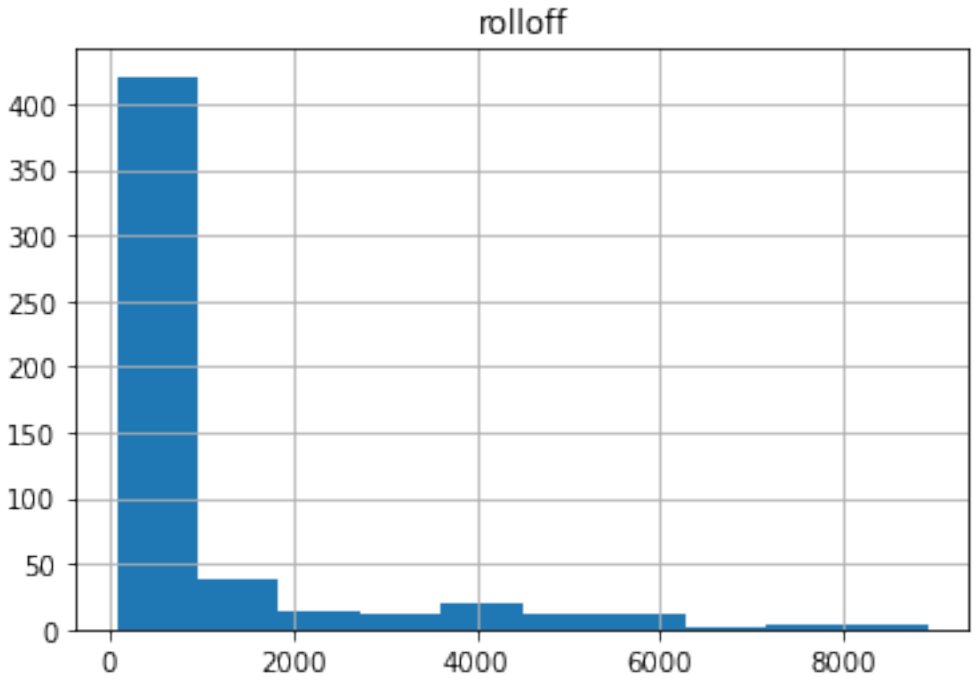
20
30
40
50

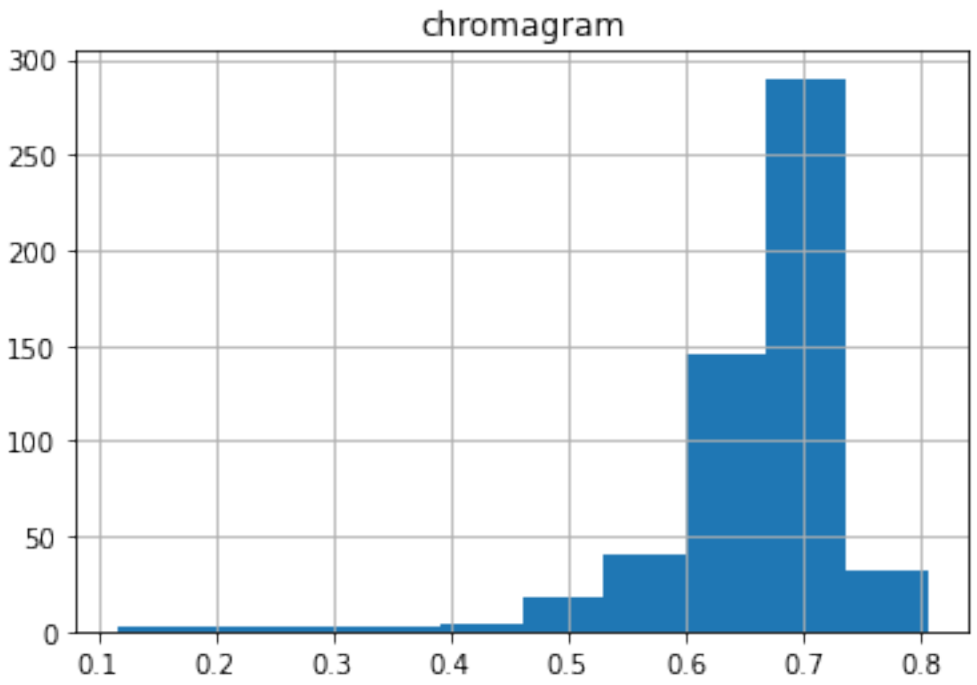

Freq18
300
250
200
150
100
50
0
−10
0
10
20
30
40


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


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


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


rolloff
400
350
300
250
200
150
100
50
0
0
2000
4000
6000
8000

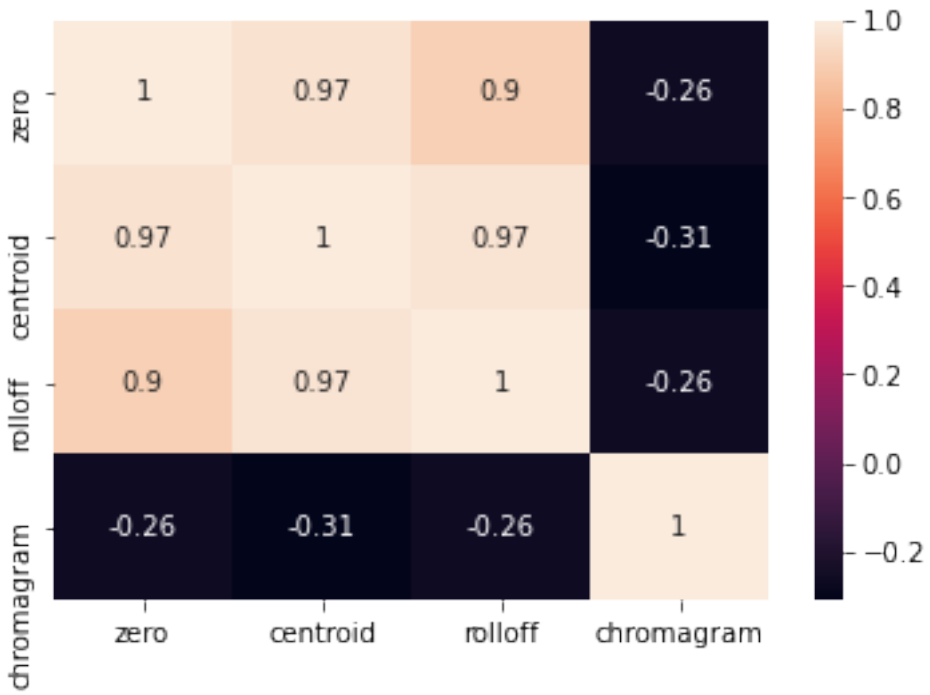


[8]:
```
%%time

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

```
CPU times: user 82.3 ms, sys: 8.84 ms, total: 91.1 ms
Wall time: 89.5 ms
```

[8]: <AxesSubplot:>



[9]:
```
%%time

# classification of each file in dataframe
x=dataframe.iloc[:, 0]
y=dataframe.iloc[:,-1]
y
# correlation= np.corrcoef(x,y)
# print(correlation)
```

```
CPU times: user 221 µs, sys: 1 µs, total: 222 µs
Wall time: 226 µs
```

[9]:
```
0       normal
1       normal
2       normal
3       normal
4       normal
        ...
534     murmur
535     murmur
536     murmur
537     murmur
538     murmur
Name: outputbeatclassifier, Length: 539, dtype: object
```